

UBC Botanical Garden: Redevelopment Proposal Plan

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CIVL 445
UBC Botanical Garden
Redevelopment Proposal Plan

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EXECUTIVE SUMMARY

This document presents the CIVL 445 Group 21 proposal for the UBC Botanical Garden (UBCBG) Redevelopment Plan.

Currently, the garden is suffering from both a lack of visitors and funding. Our concept solution attempts to outline innovative methods to provide food choices, enhance the Greenheart Canopy Walkway experience, provide learning and rehabilitation in key locations throughout the park, and provide a nursery and laboratory area for research. Smaller infrastructure ideas are included in the Master Plan to boost the visitor experience such as to decorate the entrance tunnel as well as increase the number of signs around the gardens. Our main concepts from the Master Plan are outlined below.

Sky Café

The proposed Sky Café will allow patrons to experience fine dining while enjoying the natural, serene beauty of the Asian Gardens from a vantage point high above the ground. The Sky Café will feature a glass floor and will wrap around one of the large trees in the Asian Gardens and will be suspended 30m in the air.

Multi-purpose Dome

The proposed multi-purpose building in the UBCBG will provide a necessary indoor space that can be used by visitors and employees year round. A nursery will be constructed as one-half of the dome and an indoor space for banquets, seminars, educational classes and food preparation will be constructed on the other half.

Stormwater Collection System

The UBCBG currently uses 100% of potable water to meet its water demands for irrigation of the gardens and refilling ponds. In order to minimize this large-volume waste of clean, potable water, a system of permeable walkways, permeable Great Lawn, and a detention tank under the parkade all serve to collect rainwater and stormwater and allow for its reuse in the garden.

Each of these items above have relevant costing and timing details listed in the proceeding sections of the report. Below is a final cost summary of options presented in the Master Plan.

Project Option	Estimated Cost
Sky Café	\$465,000
Multi-purpose Dome	\$1,200,000 - \$3,400,000
Stormwater Management (Permeable Pathways)	\$72,000/1000m ²
Multi-level Parkade	\$14,908,800
Moon Tunnel Renovations	\$50,000

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1 INTRODUCTION

1.1 BACKGROUND

The UBC Botanical Garden (UBCBG) Redevelopment Plan is the main deliverable for CIVL 445 – a fourth-year capstone project at the University of British Columbia (UBC). Over the course of the semester, many guest lecturers, UBCBG staff, and employees of UBC briefed our project groups on the past, current, and future state of the garden. The course’s “Connect” website also provided numerous resources and our own independent research was conducted to develop conceptual designs.

The UBCBG is located on the south-west corner of the UBC campus adjacent to SW Marine Drive. The site geography poses numerous challenges; with the majority of the garden to the west of SW Marine Drive.

The Directors of the UBCBG outlined the rich history of the institution. First and foremost, it is a collections-based garden and nothing should be done to compromise this. They outlined problems in sustainability, integration of facilities, and attraction of visitors as key concerns to both the experience and fiscal state of the garden. Currently, the garden has a very one-dimensional demographic of older, affluent Caucasian visitors and is in a financial deficit with inadequate funding to meet operational requirements. Our project will attempt to address these main challenges faced by the UBCBG, amongst other priorities outlined throughout the course.

The following sections of this document serve to outline our firm’s plan for updating and improving the UBCBG.

1.2 MISSION AND SCOPE

1.2.1 Mission

The UBCBG’s mission statement is “to assemble, curate and maintain a documented collection of temperate plants for the purposes of research, conservation, education, community outreach and public display”.

Our mission as a consulting company on this project is to aid the UBCBG by promoting the attraction of visitors, community outreach and funding while being responsible and cognizant of the collections and their intrinsic value. These were all identified as key issues by the UBCBG Directors.

1.2.2 Scope

The scope of our work on the UBCBG redevelopment is to develop creative, feasible solutions within the bounds of reality for the staff. Given that financial issues are a key concern for management, we have proposed numerous ways to fund these projects and phase them accordingly to minimize the fiscal burden. The only constraints to our planning were the economic viability of our options and the retention of the original footprint of the UBCBG (as defined by the Directors and course advisors).

1.3 SITE LOCATION, PLANNING CONTEXT

The UBC Botanical Garden is located on the UBC Vancouver campus at the western tip of the Point Grey Peninsula. The existing main garden covers an area of approximately 440,000 square metres. The entrance to the UBCBG is located on the west side of SW Marine Drive, near the intersection of SW Marine Drive and Stadium Road. The North Gardens and the Asian Garden are linked by an underpass crossing SW Marine Drive.

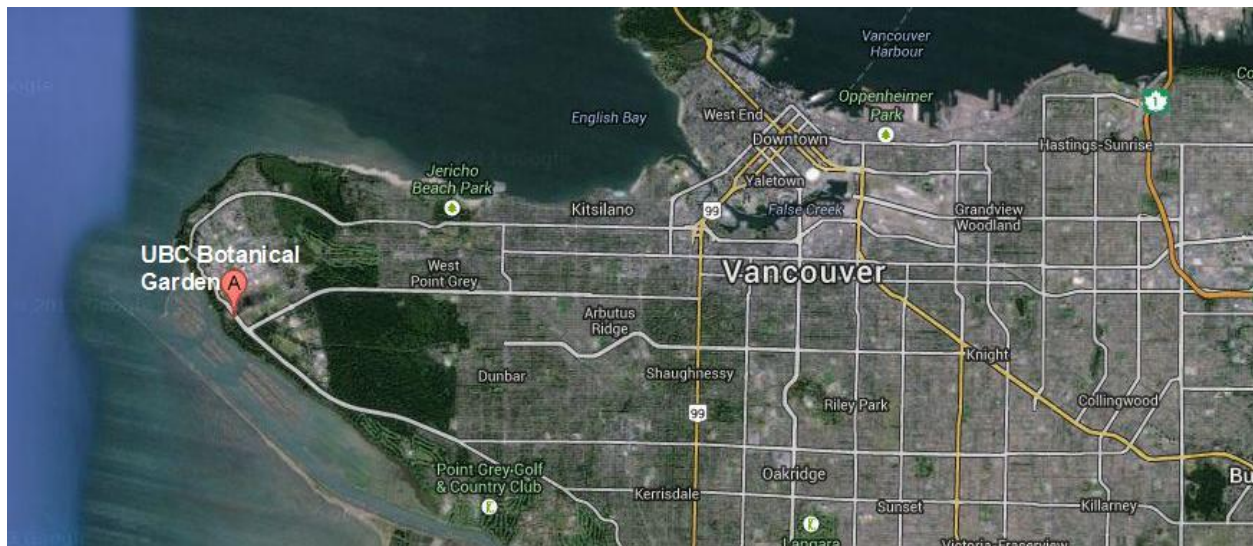


Figure 1. Map of metro Vancouver showing the location of UBCBG

(Google Maps, 2013)

The planning context of the UBCBG is set by a number of regulatory documents guiding the development of the UBC campus. Redevelopment plans of the UBCBG need to follow the guidelines stated in the Main Campus Plan (MCP) and the Official Community Plan (OCP). Other adjacent areas under the jurisdiction of the Ministry of Transportation and Infrastructure and environmental agencies such as the provincial Ministry of Water, Land and Air Protection and

the federal Department of Fisheries and Oceans also need to be considered in any proposed redevelopment plans for the UBCBG. Any changes made along SW Marine Drive should comply with road safety and not disrupt fish and wildlife habitat. Two land areas within the UBCBG are not part of the scope of work on this project. One of which is an area in the Native Garden that is designated for tree preservation as a Greenway at the northwest corner of East Mall and 16th Avenue. The second area is located on the west of SW Marine Drive and east of Old Marine Drive, south of 16th Avenue. Currently, some plants and trails of the UBCBG extend to this area and this area is designated by the OCP to remain as a park area (Durante Kreuk Ltd, 2001).

Some other constraints also need to be accounted for in the final decisions of the UBCBG redevelopment plan, of which the largest was funding and project budgets. A phasing procedure was established to prioritize potential projects according to available funding. The most expensive items may be difficult to implement based on this constraint and a detailed financial plan from the management team of the UBCBG will help prioritize proposed projects.

Another constraint for the proposed redevelopment plan is the space available for projects. This is the limited areas and space available for new structures or administration of projects such as the stormwater management system. For instance, the plan area of the parking lot should not be exceeded and instead the proposed parking redevelopment should be designed as a multi-level parkade. Some areas of the UBCBG were not available for development projects, such as the lawn near the existing parking lot, as future plans have already been made for this space. Given the available space constraints, the dimensional area of structures also needs to fit in existing areas. For example, the dimensions of the multi-purpose space is limited to 35 metres in diameter due to the available buildable area near the marsh and Great Lawn. As previously stated, the integrity and mission of the UBCBG must be adhered to and disturbance of plants in the garden should be avoided or minimized. UBCBG's mission is to promote research and education of plants, thus this should be reinforced throughout all of our designs.

2 ANALYSIS

2.1 ACCESS

Visitors can access the UBCBG by foot, bicycle, bus, or vehicle. The garden is conveniently located within walking distance of the university residences and facilities, making it easy for students to visit. Biking along SW Marine Drive provides a fast, efficient mode of transportation to access the UBCBG with bike racks at the entrance to support this form of commuting.

The C20 bus traverses a loop around campus, which includes a stop nearby at SW Marine Drive and Stadium Road. Most campus amenities and residences are far from the UBCBG itself so this bus route provides a crucial link to bring visitors within walking distance. Visitors to the UBC campus can go to the main bus loop and transfer to the C20 for access to the garden; however, this bus only comes approximately every half hour. Alternative routes include the following:

- If arriving to campus via the 25, 33, or 41 buses, visitors can get off at Hampton Place and walk for about 10 minutes to arrive at the UBCBG.
- The 480, 43, and 49 buses stop fairly close to the garden, at the intersection of 16th and SW Marine Drive. From here, visitors can walk 5 minutes to arrive at the UBCBG.

Improved bus service with stops closer to the UBCBG (or identifying its location at existing stops) would improve access; however, we deemed dealing with TransLink outside of our scope of work on this project and did not include such a plan in our final conceptual design.

The garden currently has a free parking lot for visitors and typically has a lot of empty stalls. However, sometimes the parking lot is used as a space for big events such as the Apple Festival, forcing guests to use parkades located further away on campus. Developing initiatives to best utilize this space when there is low traffic volumes, yet supply parking during large volume events is a key concern (UBC Botanical Garden, n.d.).

2.2 EXISTING CONDITIONS & AREA

2.2.1 Primary Functions of the Botanical Garden

The following is a brief summary of the current, principal functions of the UBCBG.

1. Plant Collection and Conservation

Recognized as Canada's oldest university-based botanical garden, the UBCBG curates a collection of more than 12,000 different plants, all of which represent over 8000 species found from various regions around the world. With its vastness, the UBCBG actually encompasses

different gardens which highlight these unique taxa of plants. These gardens are popular among many visitors and they include: the Nitobe Memorial Garden (a traditional Japanese Tea and Stroll garden), the Asian Garden (including the Greenheart Canopy Walkway), the BC Rainforest Garden, the Alpine Garden, and the Food Garden. All of these collections of flora are capable of being expanded, although it has been noted by the UBCBG directors that relocation of plants is not ideal in the redevelopment process.

2. Research

Aside from being a botanical garden, the UBCBG is also a centre for research and thus provides tremendous opportunities for students and researchers who wish to conduct individual studies. The UBCBG also conducts their own research projects for national and international organizations. The Centre of Plant Research at the UBCBG is composed of three researchers and their graduate students and is a UBC campus academic research affiliate of the Botanical UBCBG. In the future, the research aspect may be improved upon by developing better coordination and collaborative efforts between researchers.

3. Education

The UBC Botanical Garden provides many different opportunities for people to be educated, such as learning spaces available for teaching and research. However, these spaces are currently found scattered throughout the UBCBG and there is an increasing need for a dedicated and centralized space for teaching. For students interested in horticulture, the UBCBG provides UBC's Horticulture Training Program to give students the opportunity to learn from some of the best horticulturalists available. For visitors, there are also various garden workshops and lectures held throughout the year. Lastly, the UBCBG provides school group tours for younger students and they are seasonally-themed tours designed to target different age groups. There are many opportunities for the UBCBG to solicit other faculties (such as Faculty of Applied Science in this project) to increase their integration with the overall campus.

4. Community Outreach

The UBCBG offers various community outreach initiatives in addition to the public display of unique flora collections. The best example of this is the Friends of the Garden Program (FOGs) which is group of people who volunteer their time to help and promote the UBCBG by planning and organizing major events such as special plant sales and the Apple Festival. They also provide different services for the UBCBG such as leading group tours, running the Shop and Garden Centre, and running "HortLine" and "Our Garden To Your Garden" programs.

The Shop and Garden Centre is operated by the FOGs and showcases various collections of botanical and gardening literature, as well as tools, gifts, and floral arrangements. All of the proceeds from the shop are directed towards research, education, and other improvements that may be required at the UBCBG. "HortLine" is a telephone advice service for local residents who may have questions regarding horticulture and their own personal gardens. Our Garden To

Your Garden Plant Program is a second initiative run by FOGs that allow visitors to purchase certain plants from the UBCBG that have been propagated and grown to be sold to the public. Lastly, the FOGs are the planners of the UBCBG's special program events, such as the popular Apple Festival, the Magnolia Day Tours, the Treasured Bulb Sale, and the bi-annual Collector's Plant Auction.

2.2.2 Area Analysis & Potential Solutions

In order to identify potential opportunities for the redevelopment of the UBCBG, specific areas of concern deemed important by stakeholders and speakers throughout the term were analyzed. The current conditions of the following areas and the respective design ideas that were proposed were analyzed in terms of total benefit to the client.

1. Entrance Area

- Existing area conditions
 - Entrance into the garden is not inviting; lacks enough signage to indicate where the entrance is actually located
 - Main security implemented at the entrance is a turnstile
 - Needs a café area or small visitor information centre located near the entrance area of the garden
- Design and concept ideas
 - Develop clearer and larger signs to indicate where the entrance of the garden is located and have it reflect the image of the garden better
 - Develop a small café area (see Sky Café concept) or visitor centre for people who may be visiting the garden for the first time or would like some refreshments

2. Four Corners (SW Marine Drive)

- Existing area conditions
 - Currently composed of a four-lane road (two lanes in each direction) with large traffic volumes at peak hours
 - Signage for the UBCBG is inadequate and hard to notice for passing drivers
 - No designated traffic intersection to allow for cars and pedestrians to cross from Stadium Road to the UBCBG
- Design and concept ideas
 - Decrease the number of lanes from four to two-lanes on the northern segment of SW Marine Drive from its intersection with W 16th Ave as a traffic-calming mechanism
 - Implement more decorative, captivating signage upstream of the Garden including at West 16th Ave and at the Garden itself

- Implement a signalized traffic intersection or roundabout at the intersection of Stadium Road and SW Marine Drive to allow for easier and safer access for pedestrians and cyclists
- Develop an overpass for pedestrians and cyclists to cross SW Marine Drive and into the UBCBG safely without disrupting the flow of traffic below

3. Botanical Garden Parking

- Existing area conditions
 - Parking available at the Garden is unsuitable for large visitor volumes
 - Visitors must park elsewhere on campus or take the community shuttle bus to the entrance of the garden during special events
 - Unable to pave any of the garden's land to create more parking space
- Design and concept ideas
 - Coordinate designated parking areas with UBC campus for days when the UBCBG is hosting a major event such as the Apple Festival
 - If SW Marine Drive is reduced to single lane traffic in each direction, some of the extra space acquired can be allocated to create more parking spaces at the garden
 - Coordinate more frequent shuttle bus schedules for days of major events
 - Implement a multi-level parkade

4. Old Marine Drive

- Existing area conditions
 - Drivers park in the shoulder along Old Marine Drive near the Garden, even where it is not allowed
 - Road provides view of the ocean and beach
 - Flow of traffic is low and not as frequent as SW Marine Drive
- Design and concept ideas
 - Develop some potential parking spots at the ends of the road if space can be properly allocated for Garden use
 - Implement more parking alternatives for visitors

5. Administrative Buildings

- Existing area conditions
 - Buildings are used as offices for staff members and volunteers (ie. FOGs) who work at the UBCBG
 - Some rooms are used for educational purposes
- Design and concept ideas
 - Have more dedicated buildings and rooms to suit specific needs
 - Use of a multi-purpose dome to allow for administration to be primarily located in the traditional buildings and have educational or miscellaneous events in dome

6. Tunnel Entrance

- Existing area conditions
 - Dimly lit pathway with no natural light
 - Its walls are undecorated and unattractive
 - It does not provide any form of stormwater drainage
 - Moongate on one side of the tunnel and a plain entrance on the other side
- Design and concept ideas
 - Allow for natural light on SW Marine Drive to illuminate the tunnel
 - Placement of smaller plants, information boards, or other artistic pieces to decorate the walls of the tunnel and increase aesthetics
 - Have stormwater route along side of tunnel pathway like a stream (serves dual purpose of stormwater conduit and aesthetics)
 - Revitalize the Moongate and recreate a similar themed entrance on the other side which is currently less appealing
 - Create a bigger resting area with different flora around the entrances

7. Wetlands Area

- Existing area conditions
 - Large, open, grass section of the garden where students and researchers go to collect samples of local invertebrate species
- Design and concept ideas
 - Create a boardwalk for students, researchers, and visitors to walk across the wetlands and explore it without physically disturbing it
 - Use the tent in front of the wetland area as a teaching space or for special event space

8. Garden Pavilion

- Existing area conditions
 - Elevated building was formerly for tea ceremonies and special functions
 - Small wedding parties are also hosted in the building
 - Basement area is used by UBCBG as storage area
 - Tea house does not house a large capacity of people (less than 50 people)
- Design and concept ideas
 - Use tea house for other events that occur at the garden
 - Host small educational lectures or workshops in the tea house
 - Develop a small café as part of the tea house
 - Store garden equipment at a more appropriate location to free up space in the basement area
 - Expand the tea house to hold a higher capacity

9. Great Lawn

- Existing area conditions
 - Attractive, wide, open grass area by the garden pavilion (tea house)
 - Used for large public events at the garden



- Design and concept ideas
 - Continue using the space for garden events or education
 - Add some different selections of trees to spruce up the area
 - Ideal location to set up a small sound stage and have local bands or artists perform for visitors (or other forms of entertainment)

3 MASTER PLAN

3.1 DESIGN PRINCIPLES

The following are principles which guided the brainstorming and development of our conceptual design for the UBC Botanical Garden. These are key elements which are seen as recurring motifs throughout our Master Plan.

3.1.1 Sustainability

The Redevelopment Plan will transform the UBCBG into a prime example of sustainable design. There are many initiatives presented in our proposal which will increase the sustainability of this institution.

In terms of water usage, the UBCBG currently satisfies 100% of its water demand for plants and ponds with potable water, which is both unnecessary and a waste of clean drinking water. In order to remediate this current problem, a stormwater management system has been proposed where rainwater will be collected in catch basins beneath pervious pathways as well as the Great Lawn. Also, runoff from UBC will be detained at the UBCBG (under the proposed parkade) and used as needed.

The proposed multi-purpose dome will be designed according to Leadership in Energy and Environmental Design (LEED) standards and considering Life Cycle Assessment (LCA) methods to ensure the building is sustainable throughout its life cycle and for a range of environmental impacts aside from global warming (including eutrophication and resource use).

3.1.2 Visitorship

The UBCBG is in need of new attractions to increase the number of visitors and generate more revenue to fund future projects. Visitor volume is low during winter months; therefore, the UBCBG would benefit substantially from an increase in year-round visitor volume.

A number of ideas have been proposed throughout our design process to increase the amount of visitor traffic. The proposed Sky Café will be a major attraction because of its unique placement amidst the canopy of the trees and the natural views it provides. It will serve high-quality food and gives guests the opportunity to dine in nature and enjoy the scenic beauty of the UBCBG. The sustainable developments mentioned in the previous section will set an example for green building design and water management which will in turn attract researchers and guests who are keen and interested in sustainability.

A multi-purpose dome has been proposed to attract more visitors during the winter months: a key solution to the UBCBG management's concerns for low winter visitor volume. The dome will have a dedicated space which can be rented out for events and weddings as well as feature a plant nursery under a glass roof. Improvements to the tunnel have been proposed to make it more aesthetically pleasing and an enjoyable experience in the UBCBG.

To accommodate the future increase in visitors across all timeframes as well as during special events where there are already current problems, a multi-level parkade has been proposed. It will consist of areas for functions as well as parking stalls, and will be phased in after other attractions begin to bring in higher revenues and funding the project is possible.

3.1.3 Funding

The proposed attractions will be a source of revenue to meet the UBCBG's financial constraints and allow it to thrive financially in the future. This new funding could be used to hire more staff for maintenance of collections and to import new plants.

The Sky Café would have a dedicated portion of proceeds from all sales funding initiatives of the UBCBG. In comparison, the multi-purpose dome would generate profit from the facility's rental and would allow the UBCBG to make more money with this new, unique space. All of the new attractions would increase entrance fees and money spent within the UBCBG.

As funding increases with time due to these proposed attractions, further improvements, maintenance, and expansion could occur with the increased financial power of the UBCBG.

3.2 THE MASTER PLAN

Various development options were considered during the preliminary conceptual design of the UBCBG Redevelopment Plan. However, it was neither practical nor economically feasible to implement all of the concepts presented. Therefore, the preliminary conceptual designs were critiqued and shortlisted based on our scope of work and design principles. The projects that followed our scope and design principles of providing interesting yet sustainable attractions to the UBCBG are presented in the sections below. Please refer to Figure 2 for the proposed layout and placement of the projects. The projects outlined below are the key features of our proposed Master Plan for the UBCBG.

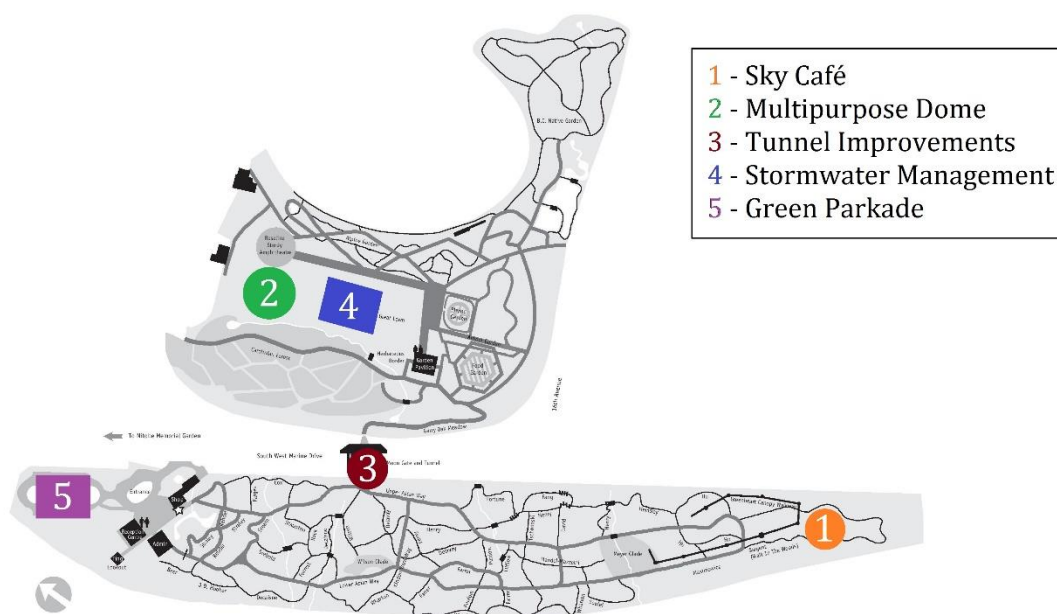


Figure 2. Map showing proposed location of conceptual projects

3.2.1 Sky Café

The proposed Sky Café will allow patrons to experience fine dining while enjoying the natural, serene beauty of the Asian Gardens from a vantage point within the trees. The Sky Café will feature a glass floor suspended 30 metres in the air and wrapped around a large tree in the Asian Gardens. The café can be accessed via the Canopy Walkway or by a spiral staircase (for patrons who choose not to experience the walkway and would like to access the café directly). Food and beverages will be prepared in a small building dedicated as a kitchen and food-preparation space. This will be located below and brought up to the Sky Café by way of a pulley system. Figure 3 is a conceptual model of a proposed layout for the Sky Café.

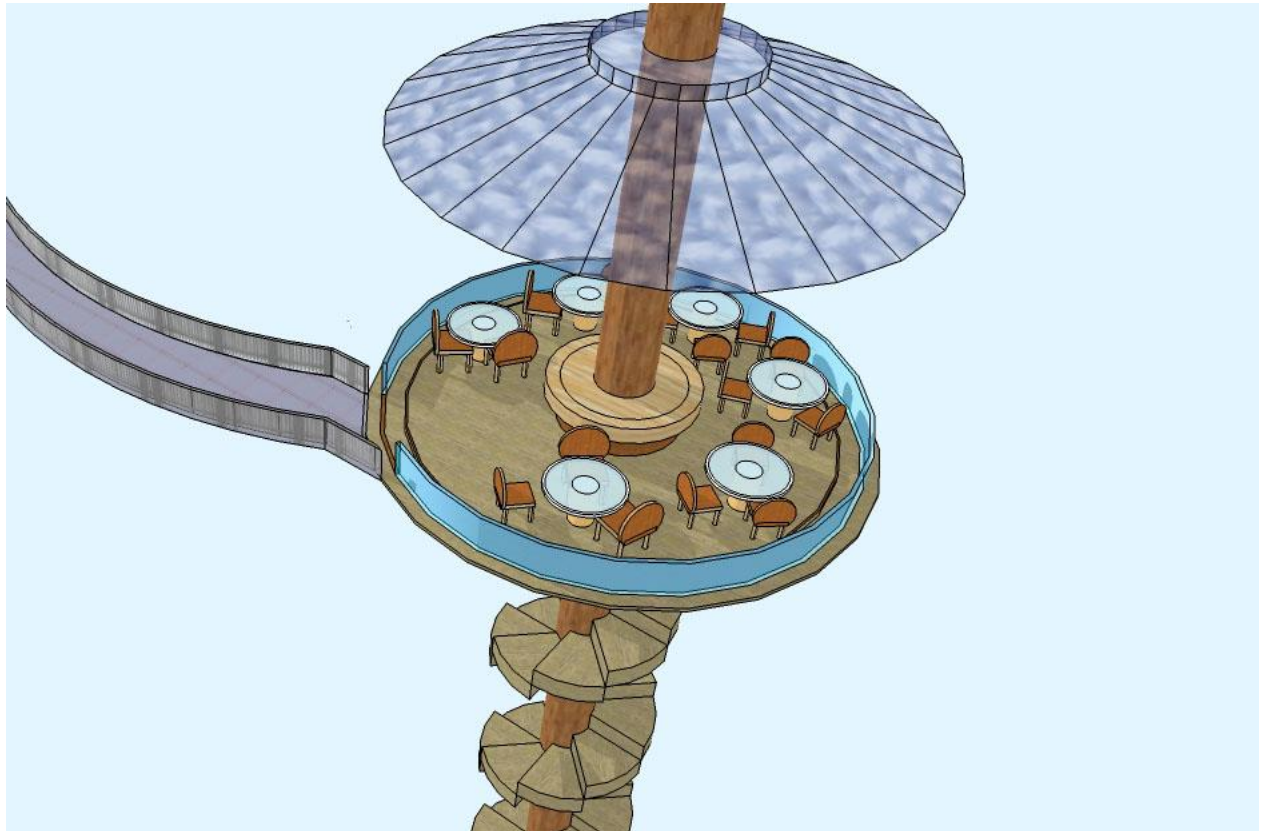


Figure 3. Conceptual design of Sky Café

The café will have a seating capacity of 20 people and provide a setting for visitors to relax after exploring the garden and to eat exquisite food. The scenery will provide a unique, unrivalled space in the realm of Vancouver dining experiences. The restaurant will have a café menu including sandwiches, wraps, crepes, salads, paninis, desserts, and other “lighter” meal selections. This will match the food to the delicate nature of the UBCBG and not provide any pungent aromas of frying oils to ruin this experience while being surrounded by nature. It will be crucial for the UBCBG to contract a third-party supplier for the café, as UBC Food Services will not be sufficient. We want to provide an “elevated” dining experience to the patrons that go beyond the services of UBC.

The Sky Café will provide steady revenue to the UBCBG with relatively little initial financial investment. It will entice customers who would typically not visit the UBCBG to visit and enjoy the dining experience, resulting in even more revenue and visitors. By providing such a unique dining experience, more individuals will be present in the gardens and will be interested in the main focus of the UBCBG; the plant collections.

As the Sky Café is a unique dining setting, it is very difficult to come up with an estimate of its proposed cost; therefore, only a rough approximation is given in the proposal. The closest

dining experience to the Sky Café is the “Dinner in the Sky” concept that is popular in Las Vegas and other parts of the world. However, even the exact costing information for the suspended platform itself is not provided. Therefore, a rental cost of \$12,385/8 hour is used (Dinner in the Sky, n.d.) to help estimate the cost to build such a suspended restaurant. The rental cost has been multiplied by 25 (assuming the rental cost is such that the cost of the Dinner in the Sky platform is recouped in 25 rentals) and a 50% contingency has been applied to account for the construction/installation of the connecting walkway, spiral staircase, as well as the on-ground kitchen facility. Therefore, it is estimated that the Sky Café will cost approximately \$465,000 to construct.

3.2.2 Stormwater Collection/Reuse System

Since the UBCBG currently uses potable water for watering the plants and for maintaining the water level of ponds and swamp areas, we have proposed the following stormwater management systems to promote their sustainability goals. Figure 4 provides an overview of the proposed areas (in blue) of the UBCBG to be used in the stormwater system.

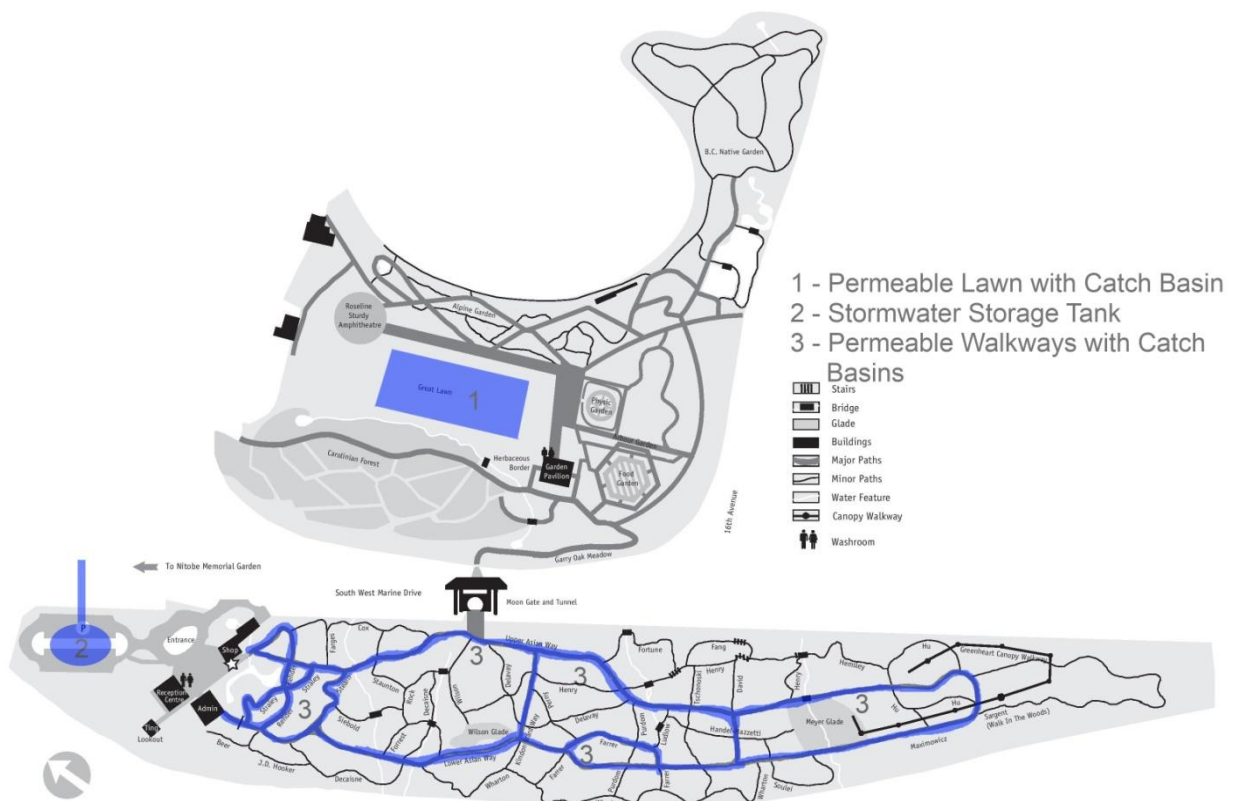


Figure 4. Proposed Stormwater management system

3.2.2.1.1 Permeable Walkways

The majority of existing pathways in the UBCBG consist of wood mulch that becomes saturated and soggy after periods of rainfall, tainting the visitor experience during wet weather conditions. We propose the modification of these pathways with permeable pavers and subterranean catch basins to collect all the stormwater/runoff for reuse within the irrigation system. The honeycomb/grid-shaped permeable pavers are compatible with gravel, soil, grass, or even wood mulch to enhance or maintain the aesthetics of the walkways. The top sections of the catch basin walls will consist of semi-permeable geotextile fabrics to allow additional flow of subsurface water from the surrounding area into the catch basin (Terrafirm Enterprises, 2013).

The permeable walkways will enhance the walking experience of the patrons by providing solid pathways that do not become soft and saturated during periods of heavy rainfall. The permeable walkways also provide a way to capture rainwater and reuse it in the irrigation system, helping the UBCBG become greener and environmentally sustainable. In addition, if the Municipality of Vancouver eventually enacts bylaws for water meter implementation, this system will also be economically beneficial to the UBCBG by limiting the amount of potable water used.

3.2.2.2 Permeable Great Lawn

The Great Lawn is a popular venue for large events and gatherings because of its large, exposed surface area. In this sense, it is a perfect location for the installation of a large, subterranean stormwater catch basin. The Great Lawn will be replaced with honeycomb/grid-shaped permeable pavers with grass overtop and large catch basins below. The rainwater captured under the Great Lawn will be used to refill the swamp area just west of the lawn.

As the swamp area is currently being refilled with potable water, its replacement with rainwater will significantly reduce the use of clean, fresh water by the UBCBG and help them take huge strides towards environmental sustainability. The permeable paver system of the stormwater collection system will also act to protect the Great Lawn from damage with its stronger and more rigid nature during periods of high visitor traffic (i.e. special events). During the installation process, as a value-added activity, the UBCBG may also choose to install geotextile fabrics along the banks of the swamp in order to protect the swamp edges from erosion.

3.2.2.3 Redirecting Existing Stormwater Runoff

There is currently stormwater runoff being diverted under Marine Drive and through the UBCBG that is not being utilized and discharged immediately into the ocean. We propose

redirecting the steady runoff from UBC to a large water storage tank located beneath the proposed parkade (see Section 3.2.3). The water from the storage tank can then be redirected around the garden according to demand (eg. to irrigate the plants in the UBCBG or to refill ponds). By implementing a stormwater management system for the campus in the UBCBG, the garden helps contribute a service to the campus, providing a means to gain more funding. This funding could stem from UBC as the UBCBG is providing an improved service of detaining stormwater and regulating flows of campus stormwater.

The proposed stormwater collection/reuse systems mentioned above will help the UBCBG become a leader when it comes to the sustainable operation of a botanical garden. It is believed that this will increase the amount of visitors to visit Vancouver and the garden and marvel at the stormwater management solutions implemented here at the UBCBG.

The cost of redirecting the water to the stormwater storage tank underneath the new multi-level parkade will not be substantial and will be included with the cost of the parkade. As for the installation of the permeable walkways and lawns, the exact cost cannot be determined as the total area of lawn/walkways to be replaced with permeable walkways and lawns is left to the client's discretion. This choice of area will affect the cost of the project greatly, as more area covered will decrease the cost by economies of scale in construction. However, to obtain a better picture of the cost to implement this system, an arbitrary area of 1000m² is used to provide a preliminary estimate for the cost of the project. The cost of eco-grids is approximately \$20/m² (Ecogrid, 2013). The cost is then tripled to account for the installation of the eco-grids as well as the supply/installation of the subterranean catch basins and a contingency of 20% for design/landscape architecture is added. Therefore, the final estimate of the implementation of the permeable walkways and lawns will cost approximately \$72,000/1000m² of paving.

3.2.3 New Multi-Level Parkade

The proposed parkade will be located at the site of the existing surface parking lot. The parkade will consist of five above-ground levels in addition to a basement level, which contains the large water storage tank used for stormwater collection. The walls of the parkade will be open to the surrounding air to promote circulation and to mitigate the unsightly nature of an enclosed parkade. The exterior walls will be covered with vines to blend the bare concrete with the natural environment and provide the illusion of a living, green building to the public. The ground level of the parkade will be double the height of other stories to increase the openness of the design and provide a large, open venue for special events such as the Apple Festival which occurs every October. Additionally, the UBCBG can choose to utilize the open-air fifth level to host special events. The parking stalls will all utilize eco-grids complete with luscious

grass to enhance the green appeal and sustainability of the parkade. Stormwater and runoff from all drainage systems within the garage will be directed to the large water storage tank in the basement for reuse elsewhere in the garden. Stormwater collection and reuse in the parkade will help the UBCBG achieve its environmental sustainability goals.

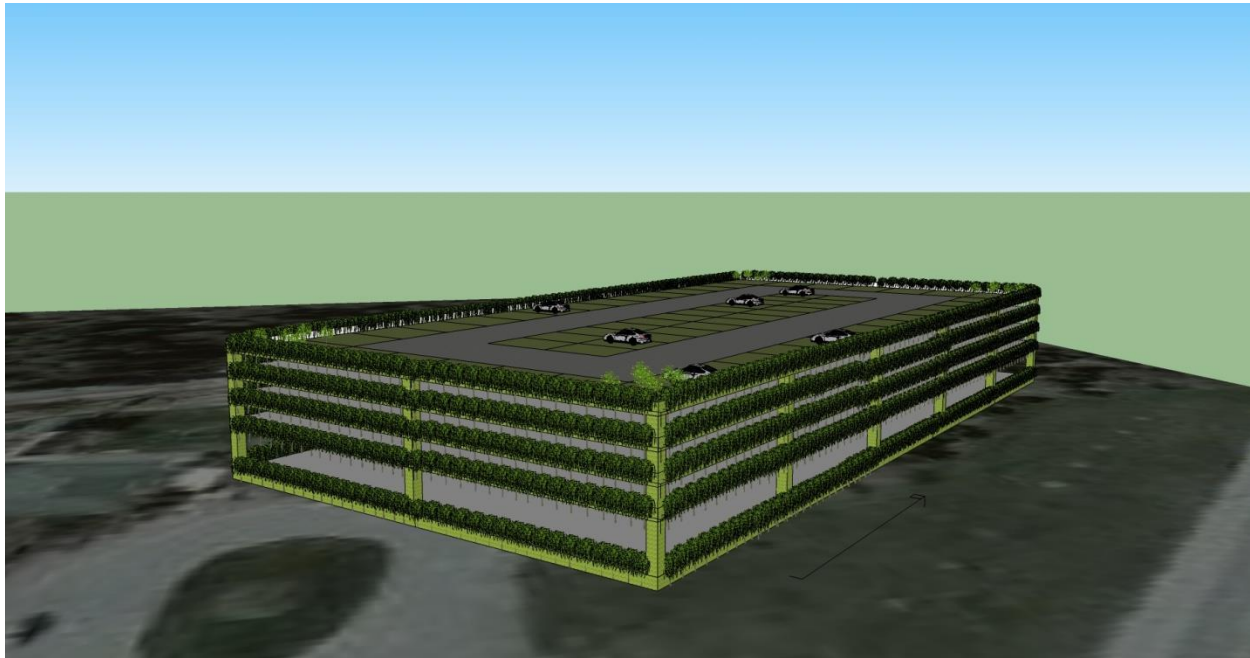


Figure 5. Proposed five-level parkade with green walls

The proposed multi-level parkade will increase the current parking capacity of the UBCBG five-fold and will relieve the parking-related issues during special events. The parkade also allows the UBCBG to host special events in two locations: the roof or the double-height ground level to accept more visitors at these high volume times. The UBCBG may also consider the implementation of pay-for-parking to help offset some of the initial costs of building the parkade. The UBCBG can implement fairly-priced annual passes to UBCBG patrons and also implement competitively priced daily parking prices, lower than other UBC parking lots, to entice students to park here as an added revenue stream during low-patron volume times. This will help prevent parking spaces from staying vacant and not generating revenue.

The proposed parkade encompasses the footprint of the existing surface lot and is approximately 50m by 100m. When completed, the parking garage will have more than 500 stalls (up from 96 stalls) and will be approximately 25,000m². As it is difficult to arrive at an accurate cost estimate for the project at this phase of design, an approximate cost has been determined by comparing the project to the Thunderbird Parkade (completed in 2007). Thunderbird parkade is a five-level 53,977m² parkade with 1650 parking stalls which cost

\$24,848,000 (UBC Properties Trust, 2009). Since the new parkade is approximately half the size of Thunderbird Parkade, the base estimate for the UBCBG parkade is half of the Thunderbird parkade cost with a 20% premium for the green features of the parkade. Our estimate for the cost of the new parkade is thus approximately \$14,908,800.

3.2.4 Improving the Tunnel and Signage



Figure 6. Existing Moon Gate Tunnel

The interior of the tunnel bridging the two sides of the UBCBG underneath SW Marine Drive does not match the entranceways on either side, which is a huge aesthetic problem. The inside of the tunnel connecting the garden is currently a corrugated sheet-metal pipe, in contrast to its decorative, Asian-inspired entrance gazebo that matches the Asian Gardens where the entranceway is located. In terms of signage, the entrance and wayfinding signs along SW Marine Drive currently provide little aesthetic value to come visit the Garden (see Figure 7 for the current signage at the entrance. As well, in the garden, current QR codes are an ineffective means of relaying information in this natural setting.

The inner walls of the tunnel will provide a large canvas for an engaging or educational attraction. A mural about the community and the history of the UBCBG will be painted inside the tunnel and educational content about the plants for all ages of visitors can be distributed

throughout the tunnel. In inclement weather, an attraction in the tunnel would provide visitors a reprieve from the rain. Decorating the tunnel would cost approximately \$50,000, making it one of the most economically-feasible options in the Master Plan.

Signs throughout the garden will be replaced from QR codes with written signage, as cellphone use and technology ruin the experience in nature of the UBCBG. The signs will provide information about the origins of plants, their importance, and other interesting facts as well as appeal to all visitor ages. It will be crucial that the signs are not too large or intrusive, in order to maintain the natural beauty of the garden. The cost for adding signs is estimated at less than \$5,000.

One final element of signage will be the implementation of new signage along SW Marine Drive and at the entrance of the garden to clearly notify passersby, students, and visitors that the UBCBG is located here and attract those who did not know its location. Attractive, clear signage will help direct visitors both to the garden, as well as lead them in their experience at the garden. The cost of the entrance signage is estimated to be \$10,000.



Figure 7. Existing UBCBG entrance

3.2.5 Multi-Purpose Space

A multi-purpose building in the UBCBG will provide a necessary indoor space that can be used by visitors and employees throughout the year. The proposed multi-purpose building will be constructed in a dome-shape and be separated by a wall that divides the dome into two equally-sized areas. One-half of the structure will contain a nursery while the other half will be an indoor space for banquets, seminars, educational classes and food preparation. There will be a “green roof” atop the multi-purpose space that will transition to a glass roof for the nursery. The green roof may include a terrace for cultivating herbs and other small vegetables. The unique design of the building will add architectural appeal that will also be functional for year-round attractions and the research of plants. Visitors to the building will enter the nursery and travel along a pre-defined pathway to the indoor space. There, they will find an open area that may be used for events and classes, with matching furniture and accessories to suit the occasion. A year-round attraction will increase revenue in the winter months, where currently patron volume is low, and provide an alternate area to facilitate banquets and weddings in the summer and winter.

The proposed multi-purpose dome will be designed according to LEED standards and considering LCA methods to ensure the building is sustainable throughout its life cycle from resource extraction to decommissioning. This will help minimize the environmental impact of the building. To meet the LEED standards, many factors such as energy, water use, and materials must be taken into account. Meeting all of these standards to design a LEED certified building, and considering its life cycle impacts and costs will help ensure a thorough, well-planned design. This building seeks to address the structural and environmental concerns of the UBCBG and provide a unique anchor point in the Garden.

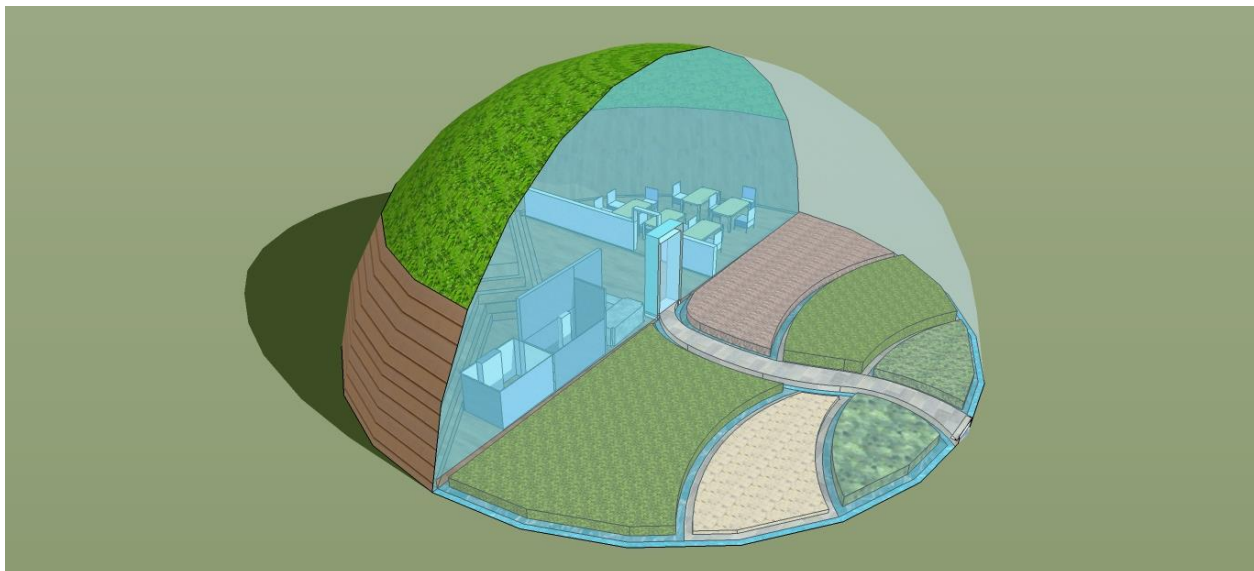


Figure 8. Proposed multi-purpose building, illustrating half greenhouse, half indoor events space

Similar multi-purpose domes have been implemented internationally. The Eden Project located in Cornwall, UK utilizes dome structures to present collections of plants which are not suitable for cold climates. Similarly, the botanical gardens at the Calgary Zoo have a less extravagant greenhouse and butterfly garden in an arched glass structure. By constructing a structure to cultivate plants year-round, this allows the garden to research exotic plant species and increase the educational nature of the institution. This structure serves as an educational space for students and employees of the botanical garden and also as a serene, peaceful meeting area (just at the Nitobe Memorial Gardens currently is at UBC). The humidity and warmer temperatures of a greenhouse like this is an attractive destination during the cold, wet winter months. This structure also lets in natural light in the summer months. The nursery portion of the dome can have water features and pathways that allow visitors to explore different tropical plants as well as seating areas to encourage visitors to stay. The Garden currently lacks attractions during the winter and reasons for visitors to stay and enjoy the scenery, and this structure helps to meet these needs.



Figure 9. The Eden Project in Cornwall, UK as seen from outside

(The Eden Trust, n.d.)



Figure 10. Inside of the butterfly gardens at the Calgary Zoo botanical garden (Calgary Zoo, n.d.)

The “green roof” segment of the structure will be an enclosed area that can be used as a banquet hall, an area for exhibits, classes and a plethora of other functions. The roof of the structure will be constructed as a green roof and will be primarily made of exposed wood overlain with soil and plants. Small terraces can be constructed to grow herbs, flowers and smaller plants. Curved glulam members may be used to support the green roof and create the arches necessary for the half dome structure. These timber elements not only meet the structural and aesthetic goals of the structure, but further expound the UBCBG goal of sustainability in designs. The UBCBG currently has indoor spaces for banquets and classes, but they do not serve as an attraction due to architecture or interior venues. A new and larger indoor area will allow more events and classes to take place throughout the gardens, offering a large revenue potential. The dome structure will be a desirable area for events and weddings in all seasons due to its uniqueness and natural beauty. By connecting the multi-purpose space to the greenhouse, potential renters have access to an indoor space with all the amenities and beauty of nature.

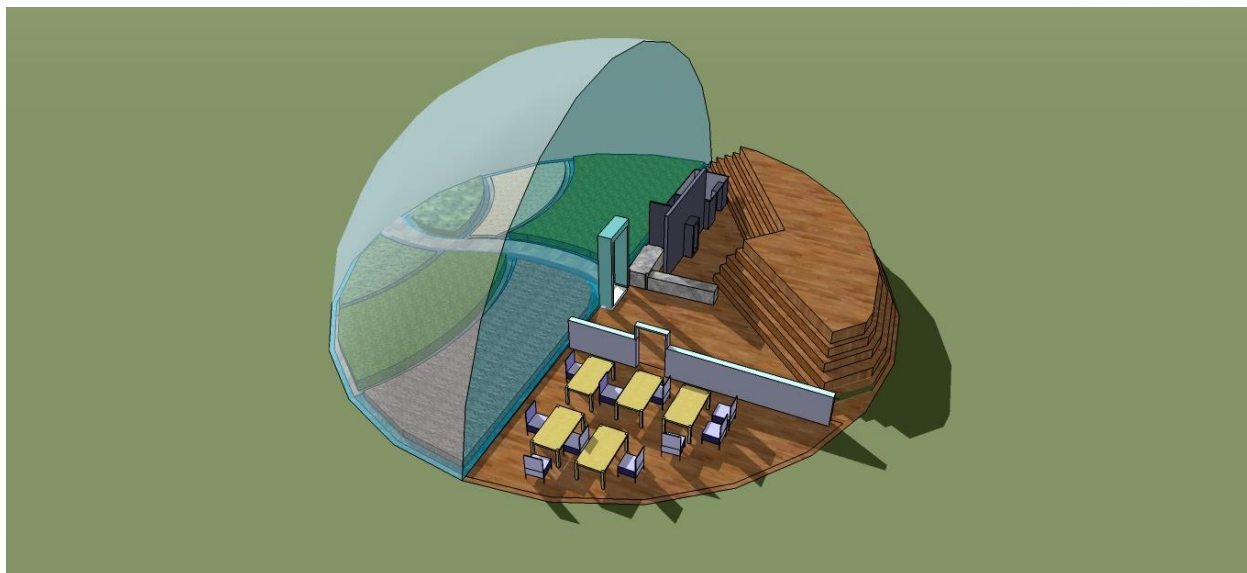


Figure 11. Multi-purpose building with emphasis on the interior of the wood structure

The multi-purpose dome location will be in the North Gardens next to the Great Lawn and Carolinian Forest. This will provide an anchor point for this area of the garden and add a visual attraction for passersby on SW Marine Drive. Locating the multi-purpose structure near the Great Lawn creates an outdoor space during the summer for weddings and events, and also adds an attraction to attract more visitors to this area. Building this second structure for events allows the UBCBG to multiple, simultaneous events and maximize revenue during the summer months. Since the current and proposed multi-purpose areas are separated by SW Marine Drive, privacy to renters is assured for any planned events.

The size of the proposed dome structure can be constructed according to the UBCBG's needs and available funding and no size constraints are noticed. Ideally, the building will be designed with a diameter of 25-35 metres at the base to accommodate each proposed feature. The height of the building will be 10-15 metres to allow the curvature of the glulam members. Without a completed design of the building and its components, only a preliminary estimate can be provided. However, by examining other similar buildings, an estimate can be made according to the conceptual design of the proposed building. A wood dome-house structure built by a licensed contractor may cost anywhere from \$500,000 to \$1,400,000, for a dome ranging from 25 m - 35 m (Natural Spaces Domes, n.d.). Given the custom design of the dome and emphasis on LEED standards, the cost of the dome is expected to be higher. By doubling the previous cost and adding 20% contingency, a more realistic estimate is obtained. The actual cost of the multi-purpose dome can be expected to range from \$1,200,000 and \$3,400,000. This estimate is preliminary and the actual cost of the project may differ.

3.3 PROPOSED PROGRAM

The new proposed program works in conjunction with the proposed buildings to increase visitor attraction and generate more revenue for the UBCBG. Visitor experience will be improved by offering interactive activities to visitors as they walk throughout the garden. Such activities may involve painting, photography, and educational tours around the UBCBG. Using the food plants harvested from the food garden, occasional cooking classes will take place in the kitchen at the base of the Sky Café. Public classes will be offered to children to encourage frequent family visits. The younger visitors will have the opportunity to be exposed to plant sciences and horticulture and high school students can obtain learning-based volunteer opportunities to promote youth outreach.

The UBCBG can partner with UBC faculties such as Land and Food Systems, Architecture, Science, and other related faculties to create a stronger connection between UBC students and the UBCBG. UBC will benefit extremely from the plant collections and the “living lab” opportunities that this unique institution provides. Visual art, landscape architecture, and horticulture classes can be offered in the classroom spaces provided in the Multi-purpose dome. This serves to further strengthen ties between the UBCBG and UBC in terms of academic partnerships.

The UBCBG will increase publicity by introducing more special events similar to the existing Apple Festival. Annual art shows will be hosted in the garden displaying the artwork of students and local artists. The multi-purpose dome and Great Lawn will allow both indoor and outdoor exhibits to be showcased. Additional parking spaces provided by the new parkade will have enough capacity to accommodate high visitor volumes during these events and meet demands for parking.

4 IMPLEMENTATION

4.1 FUNDRAISING & COST-SAVING PROGRAM

The multi-purpose dome, Sky Café and parkade are all capable of raising extra funds for the UBCBG. The initial cost of construction for these projects are high, but the revenue-generation potential will offset the costs within a few years of project completion. Attractions which bring more revenue will be developed to create continuous visitor traffic and thus a stable revenue stream for the UBCBG. The Sky Café and multi-purpose dome will increase income by attracting more visitors to the garden and through food sales and entry fees. The parkade will generate income if the garden decides to charge visitors for parking in this area. These funds will be used for maintenance, research, and further development of the UBCBG. The new attractions will also provide funds through the winter months when the garden does not currently charge for entry due to low visitor volumes.

The multi-purpose dome is one of the most expensive projects of this Master Plan, but also has the largest potential for profit generation. The “green roof” portion of the dome adds a space for the UBCBG to host events and can be used as a cafe or meeting area. The added indoor, multi-purpose space will be an ideal area to hold events due to its unique design and attached greenhouse. It will also serve as an interactive classroom with a “living lab” in the same building for the university community as well as local elementary classes. The attached nursery will provide an attractant to visitors during the cold, wet months of the winter as well as the summer when patron volumes are normally higher. Given that the UBCBG does not currently charge an entry fee during the winter months, an entrance fee could be levied during the winter for access to the multi-purpose dome. This will help to offset some of the costs of the structure and provide continued revenue in the winter. Given UBC’s firm commitment to sustainability, the relatively high cost of this structure may be offset by UBC due to its consideration of environmental impacts.

The Sky Café will generate funds through the sale of food, dinner parties or small events. Visitors who just want to eat at the café without using the Canopy Walkway will be levied a small fee, while those using the Walkway will have already paid a fee to use this amenity, thus getting into the café for free. This café will help generate more funds for the Canopy Walkway by attracting more visitors for their service, while also promoting the UBCBG’s own facility. The entry fee can be active until the capital costs of the café are covered. This entry fee will not apply to guests who purchase a meal: only those who use the café as an observation deck without purchase. It will be designed and constructed to operate with minimal variable costs to increase profits and lead to a rapid break-even point for the UBCBG. This unique design will

serve as a strong visitor attractant and anchor point in the garden. Potential funding arrangements and cost-sharing strategies exist for third-party contractors who want to operate the Sky Café and create a unique dining experience for their guests. The space can also be used for private parties and special seminars for the garden and other businesses. The simple, sustainable design of the cafe will have the potential to supply a long-term profitable attraction for the UBCBG.

The parkade is another project that has a high initial cost, but will produce ongoing income for the UBCBG. Given that the parkade does not provide an attraction for visitors, the UBCBG will first need to attract more visitors before its construction can be contemplated. Once the visitor volume meets an adequate level, the parkade will provide a viable option. The increased revenue created from other projects proposed in the Master Plan will help fund the parkade's initial capital costs. Once demand increases, the garden may also consider charging visitors for parking. The parkade has a sustainable design and will have low operational energy usages to further meet these sustainability goals.

Increasing volunteerism in the UBCBG is another measure to lower operating costs. Examples of this include students and community members operating the multi-purpose dome and managing the storm management system to maximize operational efficiency. By increasing volunteerism and adding new profit-generating attractions in the garden, more money can be used to help the garden research new plants and maintain existing collections. Providing buildings that can be utilized in the winter will minimize the current lack of revenue during these months. Though the initial cost is large for some of these projects, it is imperative that visitor attraction and generated income is increased.

4.2 PHASING

The redevelopment plan outlined in the previous sections would be carried out in phases to mitigate impact on the normal function of the garden as well as ensure there is adequate funding for each individual project. The project with the lowest project cost and shortest project completion time is the Tunnel and Signage Improvement project. The renovation project could be completed within one winter (to minimize disruption to the patrons of the garden during regular the regular spring/summer season) and would make an immediate impact on the appearance of the garden and education of the patrons.

The second phase of the redevelopment of the UBCBG should be the construction of the Sky Café to attract more visitors from a more diverse demographic. The increased visitorship to the garden and the extra revenue generated by the café would help increase the funds raised by the garden each year and would allow for the construction of the subsequent projects.

The third phase of the redevelopment should allow for the construction of the multi-purpose dome. The dome would allow patrons to hold large events in the building for a certain fee as well as allow UBC to hold lectures in the classroom facilities. The dome will also be able to help further facilitate plant research at the UBCBG and perhaps help the UBCBG obtain more research grants. The increased revenue from renting out the dome for University and public use would also help fund the construction of subsequent phases of the redevelopment plan.

The next phase of the plan would be to increase the parking capacity of the UBCBG by constructing a new multi-level parkade. The parkade would help the UBCBG meet all its increased parking needs as well as help generate more revenue for the UBCBG. Construction of an underground greywater storage tank would also allow for the future installation of a stormwater management/collection system on the UBCBG grounds.

The final phase of the UBC Botanical Garden redevelopment would be to install a stormwater management/collection system, including the installation of permeable walkways and lawns as well as the redirection of UBC stormwater runoff into the greywater storage tank for future UBCBG use. The funds raised by the other projects would fund this expensive project and allow the UBCBG to meet its long term sustainability goals of not using potable water for watering the UBCBG and maintaining water levels in the various ponds.

The table attached below summarizes the preliminary cost estimates provided for each individual design idea that was ultimately considered for implementation at the UBCBG.

Project Idea	Estimated Cost
Sky Café	\$465,000
Multi-purpose Dome	\$1,200,000 - \$3,400,000
Stormwater Management (Permeable Paving)	\$72,000/1000m ²
Multi-level Parkade	\$14,908,800
Moon Tunnel Renovations	\$50,000

Table 1 Cost estimates

APPENDIX A – PLAN OPTIONS

The table shown below is the Multi-Criteria Decision Matrix that was applied during the planning process of the project. The decision matrix helped prioritize the order of six main options based on the weights of the criteria that was included in the project scope. Ultimately, it was decided that the overhead walkway scored too low on the decision matrix and consequently it was not included in the final plan. A table of all the design ideas considered can be found in the latter half of Appendix B.

		Proposed Project					
Criterion	Weight	Multi-Purpose Dome	Sky Cafe	Tunnel Upgrade	Stormwater Management	Overhead Walkway	Parking Garage
Visitor Attraction	0.35	85	85	20	40	5	0
Sustainability	0.25	85	85	95	95	20	40
Cost	0.25	10	60	85	65	50	50
Visitor Accommodation	0.10	85	85	50	10	75	95
Park Mobility	0.05	0	5	80	0	80	25
Total Points		62	75	61	55	31	33

Table 2: Multi-Criteria Decision Matrix

The following table lists all the plan options that were considered for the UBC Botanical Garden during the early planning stages of the project, even options that were not utilized in the final plan. Many different ideas were established for various regions of the UBCBG that required redevelopment. The final plan consists of a multi-purpose dome, a Sky Café, a tunnel upgrade, a stormwater management system, and a multi-level parkade.

ALL PLAN OPTIONS	
LOCATION	POTENTIAL OPTIONS
General Area	<ul style="list-style-type: none"> ▪ Create an amusement park consisting of rides and games ▪ Develop a green high-rise building/hotel ▪ Build a playground area or daycare for children ▪ Have outdoor movie nights if weather permits ▪ Set up outdoor stages for local musicians or entertainers to perform for visitors
Entrance Area	<ul style="list-style-type: none"> ▪ Establish more distinguishable signs to indicate the location of the UBCBG's entrance ▪ Develop a small café area (see Sky Café concept) or visitor information centre
SW Marine Drive (Four Corners)	<ul style="list-style-type: none"> ▪ Establish more captivating signs to alert drivers of the UBCBGs' location ▪ Minimize the number of lanes to single lane traffic in each direction ▪ Implement a pedestrian-controlled traffic light system or roundabout at the intersection of Stadium Road and SW Marine Drive for traffic calming purposes ▪ Construct an overhead walkway for pedestrians and cyclists to cross SW Marine Drive to the Gardens safely and quickly
Botanical Garden Parking	<ul style="list-style-type: none"> ▪ Coordinate designated parking areas with UBC campus ▪ Allocate extra space from narrowing SW Marine Drive to create more parking spaces at the garden ▪ Extend existing parking lot area upwards to create a new parking garage (see Multi-Level Parkade)
Old Marine Drive	<ul style="list-style-type: none"> ▪ Keep existing road for access to the Botanical Garden ▪ Develop smaller parking lots for staff at the ends of the road if space can be properly allocated ▪ Implement more parking alternatives for visitors
Transit	<ul style="list-style-type: none"> ▪ Coordinate shuttle bus schedules to pass more frequently to provide transit options ▪ Establish a unique bus route to avoid conflict with Translink ▪ Have Translink make announcements advertising the UBCBG at stops close to the garden
Greenheart Canopy Walkway	<ul style="list-style-type: none"> ▪ Develop the Sky Café to attract more visitors to the Garden and the walkway ▪ Devise a zipline to attract a younger demographic of visitors



Administrative Buildings	<ul style="list-style-type: none"> ▪ Create dedicated buildings and rooms for administration needs ▪ Construct a multi-purpose dome to allow for administration to be primarily located in the traditional buildings and have educational or miscellaneous events in dome
Tunnel Underpass	<ul style="list-style-type: none"> ▪ Allow natural light on SW Marine Drive to shine down into the tunnel ▪ Placement of smaller plants, information boards, or other artistic pieces to decorate the walls of the tunnel to be more lively ▪ Allow stormwater to run along the sides of the path as an aesthetic touch ▪ Upgrade the Moongate (ie. add signs) as well as implement a more inviting entrance way on the other side of the tunnel ▪ Create a bigger resting area with different flora around the entrances
Wetlands Area	<ul style="list-style-type: none"> ▪ Create a boardwalk for students and researchers to conduct their research and explore the wetlands without disrupting the ecosystem ▪ Use tent in front of wetlands area as a teaching space or for special events
Garden Shop	<ul style="list-style-type: none"> ▪ Relocate the garden shop to a more central location ▪ Offer gardening classes or sessions for interested visitors
Great Lawn	<ul style="list-style-type: none"> ▪ Allow for the set up of a small sound stage and have local bands or artists perform for visitors (or other forms of entertainment) ▪ Set up an ice rink or iced pathway for visitors to skate on ▪ Build a playground area or daycare for children ▪ Set up outdoor movie nights when weather permits ▪ Continue using the space for garden events or education ▪ Add some different selections of trees to spruce up the area
Garden Pavilion	<ul style="list-style-type: none"> ▪ Use tea house for other events that occur at the garden ▪ Host small educational lectures or workshops in the tea house ▪ Develop a small café as part of the tea house

Table 3: List of all plan options considered

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