Prepared for Development Permit
September 27th 2018
DRAFT

Development Permit Report

TRIUMF
Institute for Advanced Medical Isotopes

4004 Wesbrook Mall, Vancouver, BC V6T 2A3.

Architecture: Architecture49
Landscape, Environmental and Sustainability: WSP Global
Structural: Bush Bohlman Consulting Engineers
Mechanical: AME Group
Electrical: AES Consultants
Acoustics: BAP Acoustics

TABLE OF CONTENTS

Project Description

Project Overview

TRIUMF is building the Institute for Advanced Medical Isotopes (IAMI) that will be a research hub and facility, built around a medium energy cyclotron, to enhance TRIUMF's Life Sciences research and radiopharmaceutical production program, and to ensure ongoing, reliable isotope supply security for British Columbia. By benefit of its location at TRIUMF, IAMI will be able to serve as a conduit for isotopes using TRIUMF's other accelerators; solidifying the province's status as a world leader in isotope-based life sciences research and radiopharmaceutical development. IAMI is primed to produce and develop isotopes with both life-saving applications and that will help to find answers to some of the most compelling questions in life sciences and medicine. IAMI will foster innovation in a wide range of fields, including radiopharmaceutical development, accelerator research, and advanced isotope development. There is a desire to improve the TRIUMF campus and as such the building is desired to be both highly functional and esthetically pleasing to staff and visitors that encounter it.

The facility is a five-level, four storey building of approximately 3400 m2 in a footprint of approximately 37 x 21 m, located in the southeast corner of the TRIUMF leased property, within the secured site. The location was chosen due to space availability for future expansion, and proximity to related laboratories. Access to the secured portion of TRIUMF's site is limited to authorized personnel carrying radiation dosimetry, and to escorted visitors. There are only two access points to the secured site, one dedicated to pedestrians & cyclists located on the north of the site and the other located on the west of the site, primarily for vehicles.

Of the five levels, two are below grade and house a cyclotron, substantial radiation shielding, and ancillary services, radioisotope processing laboratories are on the ground floor, and the two upper levels accommodate some office space and the extensive mechanical services required for the facility. The production and processing of radioactive isotopes that will occur in IAMI will be licensed by the Canadian Nuclear Safety Commission and by Health Canada. As such, the building program and design basis need to address requirements such as radiation shielding, air distribution, and cleanliness.

Introduction

The owner property address is 4004 Wesbrook Mall and the building for the Institute of Advanced Medical Isotopes (IAMI) is located on the south east corner of the site. The property is bordered with a greenway on the east adjacent to the Pacific Spirit Regional Park and a UBC electrical substation to the south. The IAMI building is adjacent to other TRIUMF buildings; the Meson Hall to the north, a hazardous materials storage building and a cooling tower for the TRIUMF Campus to the west. Beyond the substation, the Material Recovery Facility and the Library (PARC) buildings border immediately adjacent to the south of the TRIUMF property

3.8. Site parameters

The Site of the IAMI project is at the southeast corner of the TRIUMF property. A new TRIUMF leased property extends the south boundary and the southeast kink in the boundary to the east. The building is being design assuming the new property boundary extends, which is expected to be adopted in the next meeting of the UBC board of governors. The total area of TRIUMF property per after adoption of the new property line will be 5.30 Ha

3.9. Zoning

The TRIUMF property falls under the South Campus Research Plan as per the Vancouver Campus Update Plan Part 3. There is a potential Large Waste Heat Source identified to the west of the IAMI project. The Building falls under the Forest Character District as per UBC's Vancouver Campus Plan 2014 Part 3.

3.10. Land use plan

The Land use plan of 2015 designates the entire TRIUMF property outside the Frequent Transit Development Area (FTDA). The Site has a height restriction of 53m with which the building complies.

3.11. Vancouver Campus Plan

- The references below are applicable to the entire TRIUMF Property. No restrictions were found applicable to the IAMI building except height restriction of 53m

- The UBC Campus's Land Use plan designates the entire TRIUMF lease Property under UBC's Vancouver campus per Schedule A. The TRIUMF property is bordered by a collector road per schedule B of Land Use plan 2015. The Site is not part of any designed plan Areas per Schedule C. It is listed as part of the Forest Edge District.
- The Map 1-2 in the Vancouver Campus Plan Update from 2014 shows some academic infill sites around the TRIUMF property.
- The Map 1-2 Open space Network in the Vancouver campus Plan Update 2014 shows the site bordering Greenways and Green edges to the eastern edge of the property.
- The Map 2-1 Teaching, Learning and Research Land Use, shows some future infill sites 2030 for replacement post 2020 bordering the TRIUMF property.
- Map 2-4 Generalized Academic Communities and Social interaction opportunities Designates the entire TRIUMF property under South Campus Research
- A future arterial road and bike path is planned from UBC to the TRIUMF.
- Map 2-8 Service Access designates a circulation path near the TRIUMF property for Access to loading facilities
- Map 2-9 Potential waste Heat Sources, designates the site area west of IAMI as a Large Waste Heat source.
- No maximum lot coverage is stated in the Land Use plans

Note: From VCP requirements there are some items applicable to TRIUMF site and not specifically applicable to IAMI.

3.12. Occupant Load

- IAMI has 54 FTE with maximum occupancy of 40 FTE during regular working hours.
- The owner has assumed a visitor count of 15 nos.
- Note: these numbers refer to the change due to IAMI, not the TRIUMF facility as a whole.

3.13. Setbacks

- The Map 3-5 Maximum Building Heights in the Vancouver Campus Plan Update from 2014 shows the TRIUMF property permitted for Moderate + taller buildings.
- There are no Setback requirements per existing Zoning regulation.

3.14. Parking and Bicycle Requirements

- There are no minimum parking requirements. The IAMI project allocated 2 designated Accessible parking stalls. All visitor and staff parking are outside the TRIUMF property in a paid parking lot that is adjacent on the north of the TRUMF leased property.
- The IAMI building provides 3 number of long term bicycle parking stalls (5% of the FTE) and 6 number of short term bicycle parking stalls (more than 2.5% of the visitors) at the IAMI building.

Architectural Design

4.1. Massing concept

The underpinning of the concept for building massing is a morphological exploration of the different building masses that house the programmatic functions.

The design implements solid, transparent, perforated and a void form create an interplay of the masses. This interpretation of this interplay begins by placement of two static forms in a pie like arrangement- a two level basement buried in the slope housing the cyclotron vault and support areas and the ground floor above housing the hot-labs, laboratory, laboratory support placed above it.

In the next step a void form is removed from the ground floor mass that reveals the activity inside the building through the glazing on the north.

A taller mechanical block above the first floor houses the interstitial mechanical and penthouse mechanical space with mechanical rooftop units. This massing is animated as sliding bars over the static forms below.

The visible portion of the mechanical block and the office along the west face suggest the forms “sliding” past each other, while they seem to “latch” on to one another on the east

face The circulation volumes housing staircases, elevators and shafts on the east and west are articulated as taller volumes inserted between the sliding bars.

The stair tower on the southwest and southeast are transparent to align with UBC's Design guidelines that promotes transparency of the stairways so that they have ample natural light and are readily seen from exterior circulation paths.

4.2. Theoretical and Functional Underpinnings

The IAMI project is designed to distinguish itself from the buildings on the TRIUMF campus. The massing relationship is an honest expression of the functional requirements of the building elements based on the program of the facility.

The "parti" for the massing of the building is derived from "gerunds" to describe a static or dynamic relationship between the volumes. The opaque solid production block demonstrate the functional requirements for containment of radiological activity per CNSC or cleanroom standards per Health Canada, while the transparent office bar on the south serves to bring daylight into spaces with more frequent or continued occupancies like laboratory and laboratory support spaces.

4.3. Exterior treatment

By articulating a dynamic between the building skin and the volumes enclosed within, the relationship between the volumes of the building masses are enhanced.

The ground floor cladding is using a high density fiber reinforced cement panel on CMU or Stud wall back up with punched openings for the double glazed window units.

Above the first floor the southern office bar cladding is a transparent skin using curtain wall with deep mullion caps or sunshade louvers in combination with an interior light shelf.

The north mechanical block is treated with an opaque metal panel cladding.

The mechanical vent stacks are kept exposed to the exterior on the roof of the building.

Development of exterior details will reinforce the relationship of these masses as the building "meets the ground", "turns the corner" or "meets the sky"

4.4. Exterior Materials:

The selection of the cladding materials references the international style of architectural expression on campus. The portion where the void form is removed on the ground floor has a curtain wall to provide transparency to the exterior. The ground floor exterior is

treated with a high density fiber cement panels on a CMU/Stud backup cladding. The circulation and occupied laboratory spaces have punched window openings.

The larger opaque volume of the interstitial and mechanical room above the ground floor has an insulated metal panel cladding with horizontal ribs.

The two storey office space of the south has a combination curtain wall with horizontal louvers sun shading, frit pattern and deeper mullion caps to articulate the horizontal form of the office bar which overhangs the entrance.

Louvers have been extended inside the building to create light shelves for deeper penetration of daylight that will reduce artificial lighting.

Implementing a graded frit pattern on surface two of the double glazed unit may be explored in positions to cut glare from direct sunlight during low sun angles during winter and summer solstices or to hide the floor assembly.

Landscape Design (WSP Landscape)

The landscape approach was to provide a responsive plan that supported the functions of the IAMI building; and that was complementary to the building architecture.

TRIUMF will be actively using the IAMI building for advanced research in the discovery of medical isotopes and the development of cancer drug treatments and therapies.

A new entry promenade and parking/drop-off space is the focus of the design, flanked by lighting, bollards, and a promenade row of trees to visually guide users towards the entry. The highest quality materials of the landscape design and plantings are focused within this area. The remaining proposed landscape design surrounding the IAMI building is focused on connecting IAMI to the existing TRIUMF campus, and screening the facility's security fencing from the perspective of trail users along Pacific Spirit Regional Park's trail network; east of TRIUMF.

5.

5.1. Site Design

The building is located at the southeast corner of the TRIUMF property. The primary pedestrian route for most occupants of the building is the sidewalk leading to the southwest entrance.

The vehicular entrance to the building is also at the southwest corner and is served by a one-way entry and exit loop in a counter-clockwise direction.

The vehicular entrance serves as an entry for staff and visitors with wheelchair accessibility, providing a drop off and a 1+1 parking arrangement aligned to the southern edge of the property.

Immediately east of the drop off area is a temporary short term parking bay serving as a truck loading /unloading bay to facilitate material receiving and finished goods shipping. The exit loop connects back to the fire lane on the north.

A walkway from the south edge of the property leads down to the B1 level to facilitate service functions.

The building entry for staff and visitors is screened from the loading/ unloading area using the staircase massing and feature landscaping area.

The entry and exit loop creates a green space in the center that will serve as a rain-garden.

The Generator set with diesel tank and transformer is located south of the building between the fence and the southern perimeter fence and will be screened from the rest of the site and to the community.

A sidewalk leads from the northeast corner to the doors from the exit lobby and staircase on the southeast.

The basement slab, which is exposed at the ground level north of the hot cell labs are finished with landscape materials.

5.2. CPTED DESIGN

Enhancing the built environment will tackle the root causes of possible crime. Proper lighting along the main street axes will provide safety for both users and visitors on the site. The clear rectilinear volumetric design of the space allows for certain advantages that support the CPTED strategy. The CPTED Strategy implores best practices for creating a defined, illuminated, and clean entry free of hiding spaces and negative shadows. Landscape will be maintained at low, non-encroach able heights, and lights will be strategically placed between trees to mitigate the shadows cast from mature tree form. The entrance area is largely transparent, with free visibility to the bike parking from the interior and exterior views of the building. Illumination for the building elements will further accentuate pedestrian prominence and entry/exit connections, and allow for additional light to cast on surrounding walkways. The canopy of trees will remain upright and clear when trees are directly adjacent to walkways, and smaller shrub-like trees will have a level of canopy standard for clear views and visibility.

A perimeter fence prevents any outside intrusion to the property. A perimeter path for periodic walk down by TRIUMF security team are procedures implemented campus wide at TRIUMF.

Effort to create a neighborhood`s sense of “pride and place” for the TRIUMF stakeholders and community is augmented by territorial reinforcement that discourages unwanted activities. The maintenance and the “image” of the property is an extension of this concept. It encourages territorial concern, social cohesion and reinforces a general sense of security through the development of the identity and image of a community.

The project's sustainability strategy is governed by the standards noted above, and a forward-thinking design approach which anticipates the impact of future climate conditions on the building's occupants, including:

- Use of Pacific Climate Impacts Consortium's Plan2Adapt Online Tool
    - Presentation of climate variable changes for BC in 2050 and 2080 during the integrated design process
    - Assessment and inclusion of the following design strategies:
        - Plant species selected to withstand longer future drought periods and higher levels of intensive rainfall
        - Hybrid engineering and landscaped site infiltration strategy which features rain gardens, an infiltration bed, and stormwater capture on-site for irrigation use.
        - Green and blue roof feasibility assessment (not included due to non-compliance with CNSC)
        - Use of 2050 and 2080 weather files in design energy modelling
        - Flexible space layout and mechanical equipment redundancy, which allows for future hot lab and process load expansion
- Investigation of Labs 21, version 3.0, a series of operational prerequisites and credits which exceed best practices
        - Mechanical design is compliant with the majority of prerequisites and credits
- Investigation of UBC Green Labs Framework, a series of prescriptive operational strategies focused on behavioural norms
        - Triumf has already implemented some of these strategies; the remainder are under review

The IAMI project team has complied with the UBC Sustainability Process for Major Capital Projects, and conducted a comprehensive review of the UBC Sustainability Technical Guidelines. Where possible, the project team has incorporated UBC Sustainability Technical Guidelines into project design; however, the team has included a Request for Variance (attached) identifying targets which either do not apply to this facility type, or are in direct conflict with CNSC or cGMP standards.

6.

6.1. SUSTAINABILITY STRATEGY

The IAMI facility is LEED registered under the LEED v4 Building Design and Construction (BD+C) rating system. The project is currently targeting 41 points, and investigating an additional 5 points, which may allow the project to target a Certified threshold. The project is meeting these required UBC Sustainability Technical Guidelines:

- Integrated Stormwater Management Plan

A LEED site boundary has been established to clearly delineate the LEED site area and clarify compliance for Location & Transportation and Sustainable Sites credits.

6.2. PROJECT CONSTRAINTS

The IAMI facility has unique design and operational requirements, including a 24 hour operating schedule, clean room lab spaces which require a large amount of ventilation with humidification, an energy-intensive cyclotron process load which emits a large amount of heat and accounts for 1/3 of energy use, and radiation shielding cladding. The facility's design requirements constrain procurement, public access and occupant-centered design.

Where CNSC or cGMP standards conflict with UBC mandated LEED credits, CNSC and cGMP standards prevail, and we have added applicable notes to our Scorecard and our Request for Variance.

The following credits are under investigation for potential CNSC or cGMP conflicts:

- INc1.1: Education Program

The following credits are under investigation due to significant procurement constraints (conflicting standards, restricted budget, fixed occupancy date):

- MRc2: Building Product Disclosure and Optimization – Environmental Product Declaration, Option 1
- MRc3: Building Product Disclosure and Optimization – Sourcing of Raw Materials, Option 1
- EQc2: Low-Emitting Materials, Option 1
- INc1.2: Bird Friendly Design

6.3. ENERGY ANALYSIS

The project team recently completed a preliminary design energy model to assess the following:

- Ability to comply with EAp2: Minimum Energy Performance
- Model performance using 2050 and 2080 weather files
- Applicable Energy Use Intensity (EUI) target

Our preliminary design energy model results indicate that the project will meet EAp2 and is projected to achieve:

- 35% energy consumption savings
- 15% energy cost savings
- 77% GHG emissions reduction

- 5 points under EAc2: Optimize Energy Performance
- EUI of 1400 kWh/m²/yr

The current EUI represents a significant reduction over the schematic energy model (2016) outcome of 1600 kWh/m²/yr, and is a result of the following energy conservation measures:

- Condenser heat recovery from cooling of lab, cooling of cyclotron processes, and other miscellaneous loads for
- space heating and domestic hot water pre-heat
- Use of heat recovery ventilators (HRVs) and variable refrigerant flow (VRF) in office spaces
- Heating and hot water plant with 90+ % heating efficiency
- High efficiency lighting and substantial lighting controls
- Dedicated filter fans in clean lab spaces to reduce static pressure on main air handling units
- Design to BCBC 2018 and ASHRAE 90.1-2016
- Less than a 40% window-to-wall ratio
- Sun shading and fretting design on south exposure
- Manage thermal bridges
- Right-sizing laboratory equipment, high efficiency equipment

As ASHRAE does not have an appropriate facility type, and there are no existing energy consumption datasets (such as Energy Star Portfolio Manager) which could apply to IAMI, the project team is developing a benchmarking methodology to compare IAMI against other similar labs to establish a recommended EUI baseline for this type of facility.

6.4. SUMMARY

The IAMI project has chosen a forward-thinking holistic sustainability approach which goes beyond UBC

Sustainability Technical Guidelines and LEED requirements to address future climate constraints, and occupant

needs. The project incorporates operational considerations into the design by complying with Labs 21 and the UBC

Green Labs frameworks, and has made efforts to align with UBC goals of carbon emissions reductions.

Mechanical Design

Mechanical systems are designed to provide full thermal and pressure control of research and production laboratory spaces, enhanced with state of art controls systems. All required safety features to ensure safe operation of the building as well as its impact to environment are incorporated. The IAMI Building will be very energy efficient with 36% energy savings incorporated including many energy savings strategies commonly seen in high sustainable labs.

Electrical Design

The new electrical service to the IAMI building will be fed from the UBC substation yard at the south of the building. The high voltage service ducts will run underground to the new 1000/1250kVA ANN/ANF pad mounted transformer (PMT) servicing the building, located on the south end of the building. The secondary ducts from the PMT will run to the main electrical room service entrance, located in the B1 level of the building. A 350kW generator will be provided for standby power and emergency life safety power and will be located next to the PMT.

The entrance drive isle and walkway will be lit with pole lights to match UBC Vancouver campus plan specifications and will provide illumination for the drive isle and walkway towards the entrance of the building. Similarly pole lights will be provided on the north east end of the site to illuminate exterior stairs and walkway towards the rear entry/exit of the building. Wall mounted lighting will be provided around the perimeter of the building to illuminate all walkways and entry/exit doors.

The fixtures specified will be dark sky compliant, and provide proper illumination to support the CPTED strategy.

Security

7.

IAMI is to be constructed within the secure boundaries of TRIUMF, a Class IB Nuclear Facility. During construction, the secure boundaries may be adjusted such that contractors need not enter the secure areas. On completion new secure fencing will be constructed.

7.8.1. Security Design Approach

This subsection has been written to provide additional information regarding the approach to security design for this project. It is generally understood that by using a balance of electronic, physical (architectural) and operational security, a high level of security can be achieved while reducing overall capital and operational costs. These components can work independently or in conjunction with one another.

Electronic – Electronic methods include Access Control; Video Surveillance; Perimeter Detection, Intrusion Alarm and other electronic devices. The TRIUMF Main Control Room monitors perimeter video and perimeter detection systems 24-7.

Physical (architectural) – includes doors, gates, fencing, landscaping, lighting, glazing, infrastructure, vehicular stand-offs and protection, locking mechanisms, partitioning, and compartmentalization. Design should incorporate elements of crime deterrence utilizing CPTED principals (Crime Prevention through Environmental Design).

Operational – operational security includes, but not limited to guards, patrols, policies and procedures, training, emergency preparedness, and contingency factors.

7.8.2. Construction Security

A procedure will be developed to ensure only authorized personnel access the site during the construction. This will be achieved during most construction stages, given that the project site will be outside the TRIUMF perimeter fence until substantial completion. In any event, control of the site will be maintained and appropriate safeguards for personnel must be in place from the start of construction.

7.8.3. Control of Access

Control of access is intrinsically linked to the concept of zoning. Zoning involves organizing a facility into distinct areas in order to control access by the public and to a lesser extent by personnel (need to know). There are five recognized zones: Public Zone, Reception Zone, Operations Zone, Security Zone, and High Security Zone. Zones should be implemented in a progressively restrictive manner, proceeding from the least restrictive (Public) to the highest zone required by TRIUMF, so that sequential entry points must be passed.

7.8.4. Perimeter Fencing

Perimeter fencing is a security method which establishes a public access zone that is independent of the building(s) inside the compound. Upon completion, the new perimeter fencing will enclose IAMI within the CNSC secure area and will reduce the need for some specific security measures within the building.

Geotechnical Considerations

The underside of foundations would extend approximately 5 to 6m below existing grades. It is expected that dense to very dense silty SAND would be encountered at footing subgrade level below a majority of the building. The sand is considered suitable for direct support of conventional foundations. If encountered, unsuitable materials would be sub-excavated and replaced with lean mix concrete or controlled density fill (CDF) below the building footprint. Alternatively, foundations could be lowered to suitable soils or sized for a lower bearing pressure.

It is anticipated that the excavation can be achieved using slope cuts combined with conventional shotcrete with anchor tie-back shoring. Groundwater was measured at a depth of 6.0m within a piezometer installed within the footprint of the proposed building. As such, requirement for significant dewatering is not expected.

Civil Engineering Considerations

9.

9.1. Utility

9.1.1. Water Supply Network

McElhanney Consulting Services Ltd. has reviewed the UBC technical guidelines pertaining to water supply. The proposed building will be serviced from an existing 200 mm diameter CI water main that is located immediately north of the proposed building.

It was noted during discussions with UBC staff that UBC maintains a computational model of the water network and can provide residual pressures for given demands. It was also noted that there was no expectation that the proposed demands will cause an unacceptable drop in pressure.

McElhanney will provide demand estimates to UBC for the proposed site and will review the residual pressures with the project team. We anticipate no off-site upgrades will be necessary.

9.1.2. Sewer Network and City Waste Management

9.1.2.1. Sanitary

McElhanney Consulting Services Ltd. has reviewed the UBC Sewer Master Plan (Urban Systems Ltd., 2018) (SMP) to assess the impacts from the new building being proposed for the Institute for Advanced Medical Isotopes (IAMI). We have received sanitary loading estimates from the AME Consulting Group Ltd. which are a peak flow of 3.5 Lps from normal operation and an additional 12.6 Lps during emergencies. It is anticipated that these emergencies will be rare and relatively short term. Our review, therefore, proceeded with a design flow of 3.5 Lps.

The SMP has tabulated flow estimates for 2017, 2023, and 2030 design horizons along with pipe capacities. There will be sufficient capacity in the surrounding sanitary sewers to accommodate the design flow and emergency flow for all design horizons. By 2023, the 375 mm diameter connection to the Metro Vancouver system will cause a flow constriction. The backwater effects from this constriction will not impact the new IAMI building in all design horizons. The SMP recommends that this connection be upsized by 2023.

Based on this review, no upgrades are required to accommodate the new IAMI building as long as UBC complies with the SMP.

The new building will conflict with the existing sewer system which will be rerouted around the new building and tied back into the existing system. This design will comply with UBC Technical Guidelines (2018) and will not decrease the conveyance capacity of the system.

9.1.2.2. Drainage

McElhanney Consulting Services Ltd. has reviewed the UBC Integrated Stormwater Management Plan (ISMP) to assess the impacts from the new building being proposed for the Institute for Advanced Medical Isotopes (IAMI). The existing footprint being altered is comprised of impervious paving with temporary buildings and a portion of a vegetated slope. The existing footprint is approximately 87% impervious. The impervious area drains overland to the south and onto the pervious slope. The bottom of the slope terminates in a ditch with no channelized outlet. It is assumed that storm water infiltrates and evaporates during small events and floods during major events.

9.1.2.3. Stormwater Control

We used the modified rational method to estimate flows and detention volume requirements for the development. The ISMP recommends that new buildings detain the 10-year 24-hour storm and release it at the 2-year 24-hour rate. This resulted in a detention volume of 30 m^3. The ISMP gave no specific criteria for stormwater quality however, the proposed design will include raingardens to improve runoff quality.

The project team investigated the possibility of obtaining two LEED points for managing the 95th percentile of annual flows entirely on-site. The proposed site will have limited capacity for infiltration, reuse, and space available for retention. This indicates that obtaining the LEED credit will be difficult and expensive to comply with.

Any stormwater management infrastructure will be located within the new permanent lease boundary of the site

9.1.2.4. Stormwater Conveyance

The new building will conflict with the existing storm sewer system which will be rerouted around the new building and tied back into the existing system. This design will comply with UBC Technical Guidelines (2018) and will not decrease the conveyance capacity of the system.

At present, it is not clear if the criteria provided by UBC takes climate change into account. McElhanney will confirm this during a later design stage.

Conformance to Guidelines

As described in the text above, the project complies with the spirit and intent of the design guidelines for South Campus Research Neighbourhood Plan.

TRIUMF IAMI SUSTAINABILITY STRATEGY

TO: UBC

FROM: WSP Sustainability & Energy

SUBJECT: **Triumf IAMI Sustainability Strategy for Development Permit Application**

DATE: **November 26, 2018**

The Triumf Institute for Advanced Medical Isotopes (IAMI) aims to be a sustainable, adaptable facility designed to positively respond to current and future climate conditions on its site, located at 4004 Wesbrook Mall in Vancouver, BC in UBC's South Campus Research District. As a unique laboratory and manufacturing facility for nuclear isotopes in healthcare applications, with an intended service life of 100 years, the IAMI is governed by the Canadian Nuclear Safety Commission (CNSC) and Health Canada Good Manufacturing Practice Guidelines for Drug Products (cGMP), in addition to BC Building Code 2018 and UBC Sustainability Technical Guidelines.

APPROACH

The project's sustainability strategy is governed by the standards noted above, and a forward-thinking design approach which anticipates the impact of future climate conditions on the building's occupants, including:

- Use of Pacific Climate Impacts Consortium's Plan2Adapt Online Tool
  - Presentation of climate variable changes for BC in 2050 and 2080 during the integrated design process
  - Assessment and inclusion of the following design strategies:
    - Plant species selected to withstand longer future drought periods and higher levels of intensive rainfall
    - Hybrid engineering and landscaped site infiltration strategy which features rain gardens, an infiltration bed, and stormwater capture on-site for irrigation use.
    - Green and blue roof feasibility assessment (not included due to non-compliance with CNSC)
    - Use of 2050 and 2080 weather files in design energy modelling
    - Flexible space layout and mechanical equipment redundancy, which allows for future hot lab and process load expansion
- Investigation of Labs 21, version 3.0, a series of operational prerequisites and credits which exceed best practices
  - Mechanical design is compliant with the majority of prerequisites and credits
- Investigation of UBC Green Labs Framework, a series of prescriptive operational strategies focused on behavioural norms
  - Triumf has already implemented some of these strategies; the remainder are under review

The IAMI project team has complied with the UBC Sustainability Process for Major Capital Projects, and conducted a comprehensive review of the UBC Sustainability Technical Guidelines. Where possible, the project team has incorporated UBC Sustainability Technical Guidelines into project design; however, the team has included a Request for Variance (attached) identifying targets which either do not apply to this facility type, or are in direct conflict with CNSC or cGMP standards.

STRATEGY

The IAMI facility is LEED registered under the LEED v4 Building Design and Construction (BD+C) rating system. The project is currently targeting 41 points, and investigating an additional 5 points, which may allow the project to target a Certified threshold. The project is meeting these required UBC Sustainability Technical Guidelines:

- Integrated Stormwater Management Plan

A LEED site boundary has been established to clearly delineate the LEED site area and clarify compliance for Location & Transportation and Sustainable Sites credits.

PROJECT CONSTRAINTS

The IAMI facility has unique design and operational requirements, including a 24 hour operating schedule, clean room lab spaces which require a large amount of ventilation with humidification, an energy-intensive cyclotron process load which emits a large amount of heat and accounts for 1/3 of energy use, and radiation shielding cladding. The facility's design requirements constrain procurement, public access and occupant-centered design. Where CNSC or cGMP standards conflict with UBC mandated LEED credits, CNSC and cGMP standards prevail, and we have added applicable notes to our Scorecard and our Request for Variance.

The following credits are under investigation for potential CNSC or cGMP conflicts:

- INc1.1: Education Program

The following credits are under investigation due to significant procurement constraints (conflicting standards, restricted budget, fixed occupancy date):

- MRc2: Building Product Disclosure and Optimization – Environmental Product Declaration, Option 1
- MRc3: Building Product Disclosure and Optimization – Sourcing of Raw Materials, Option 1
- EQc2: Low-Emitting Materials, Option 1
- INc1.2: Bird Friendly Design

ENERGY ANALYSIS

The project team recently completed a preliminary design energy model to assess the following:

- Ability to comply with EAp2: Minimum Energy Performance
- Model performance using 2050 and 2080 weather files
- Applicable Energy Use Intensity (EUI) target

Our preliminary design energy model results indicate that the project will meet EAp2 and is projected to achieve:

- 35% energy consumption savings
- 15% energy cost savings
- 77% GHG emissions reduction
- 5 points under EAc2: Optimize Energy Performance
- EUI of 1400 kWh/m²/yr

The current EUI represents a significant reduction over the schematic energy model (2016) outcome of 1600 kWh/m²/yr, and is a result of the following energy conservation measures:

- Condenser heat recovery from cooling of lab, cooling of cyclotron processes, and other miscellaneous loads for space heating and domestic hot water pre-heat
- Use of heat recovery ventilators (HRVs) and variable refrigerant flow (VRF) in office spaces
- Heating and hot water plant with 90+ % heating efficiency
- High efficiency lighting and substantial lighting controls
- Dedicated filter fans in clean lab spaces to reduce static pressure on main air handling units
- Design to BCBC 2018 and ASHRAE 90.1-2016
- Less than a 40% window-to-wall ratio
- Sun shading and fretting design on south exposure
- Manage thermal bridges
- Right-sizing laboratory equipment, high efficiency equipment

As ASHRAE does not have an appropriate facility type, and there are no existing energy consumption datasets (such as Energy Star Portfolio Manager) which could apply to IAMI, the project team is developing a benchmarking methodology to compare IAMI against other similar labs to establish a recommended EUI baseline for this type of facility.

SUMMARY

The IAMI project has chosen a forward-thinking holistic sustainability approach which goes beyond UBC Sustainability Technical Guidelines and LEED requirements to address future climate constraints, and occupant needs. The project incorporates operational considerations into the design by complying with Labs 21 and the UBC Green Labs frameworks, and has made efforts to align with UBC goals of carbon emissions reductions.

We will continue to refine our sustainability targets as we move forward in the design development process, and we look forward to creating a unique, sustainable IAMI facility at UBC.

If you have any questions, please do not hesitate to contact the undersigned.

Sincerely,

Maeri Machado P.Eng., LEED AP, WELL AP
Director BC, Sustainability & Energy
604-631-9558

Veronica Owens BA, SMaRT/LEED AP O+M, Fitwel Amb.
Project Manager, Sustainability & Energy
604-631-9591

LEED® BD+C New Construction Scorecard

TRIUMF Institute for Advanced Medical Isotopes (IAMI)

Insufficient Points Targeted for Rating

UBC Mandated	Targeted	Pending	Decision Req'd	Not Pursued
62	38	14	0	58

Certified: 40 to 49 points **Silver:** 50 to 59 points **Gold:** 60 to 79 points **Platinum:** 80 or more points

1	1				**IPc1 Integrative Project Planning and Design:** Perform energy and water studies throughout design to identify synergies across disciplines and building systems, and document impact on building design. Tasks include "simple-box" energy modelling and a preliminary water budget analysis.	This credit is in progress. A LEED workshop was held on Mar 22, 2016 during schematic design to discuss credit targets, and included a detailed discussion of building loads, and required mechancial and electrical equipment. A preliminary energy study (simple box analysis) was conducted by AME. During design development (and project re-start), a second Sustainability Charrette was held on Sept 7, 2018 which included the full project team and representatives from UBC Sustainability. An energy modelling charrette with the owner, architect, mechanical, electrical, sustainability and UBC Sustainability team members was subsequently held on October 17, 2018 to present design energy model results.

8	4	2	0	10	LOCATION AND TRANSPORTATION	COMMENTS
				16	**LTc1 LEED for Neighbourhood Development Location:** Locate the project within the boundary of a development certified under LEED for Neighborhood Development. If credit is pursed, no other LT credits are eligible.	This credit cannot be achieved, as the project is not located within a LEED for Neighbourhood Development location.
1	1				**LTc2 Sensitive Land Protection:** **Option 1:** Locate the project on land that has been previously developed. (1 point) **Option 2:** Locate the project on land that has been previously developed or that is not defined as sensitive land (Prime farmland, floodplains, habitat, water bodies, or wetlands). (1 point)	This credit has been achieved, as the project is located on previously developed land with paving and existing maintenance buildings.
		2			**LTc3 High Priority Site:** **Option 1:** Locate the project on an infill location in a historic district. (1 point) **Option 2**: Locate the project on either a site listed by the EPA National Priorities List, a Federal Empowerment Zone site, a Federal Enterprise Community site, a Federal Renewal Community site, a Department of the Treasury Community Development Financial Institutions Fund Qualified Census Tract (QCT) or Difficult Development Area (DDA); or a local equivalent program administered at the national level for projects outside the U.S. (1 point) **Option 3:** Locate the project on a brownfield where soil or groundwater contamination has been identified, and where the local, state, or national authority requires its remediation. Perform remediation to the satisfaction of that authority. (2 points)	A Phase 1 Environmental Site Assesment was conducted and identified potential contamination. A Phase 2 Environmental Site Assessment is in progress.
5				5	**LTc4 Surrounding Density and Diverse Uses:** **Option 1:** Locate the project on a site whose surrounding existing density within a 400m radius of a development of a combined density of 5,050m per hectare of buildable land, 17.5 dwelling units per hectare, or 0.5 non-residential floor area ratio (2 points) OR 8,035m per hectare of buildable land, 30 dwelling units per hectare, or 0.8 non-residential floor area. (3 points) ***AND/OR*** **Option 2:** Construct or renovate a building or a space within a building such that the building's main entrance is within an 800m walking distance of the main entrance of four to seven (1 point) OR eight or more (2 points) existing and publicly available diverse uses.	This credit cannot be achieved as the site does not meet surrounding density and amenity requirements.

LEED® BD+C New Construction Scorecard

TRIUMF Institute for Advanced Medical Isotopes (IAMI)

Insufficient Points Targeted for Rating

UBC Mandated	Targeted	Pending	Decision Req'd	Not Pursued
62	38	14	0	58

Certified: 40 to 49 points **Silver:** 50 to 59 points **Gold:** 60 to 79 points **Platinum:** 80 or more points

1	3			2	**LTc5 Access to Quality Transit:** Locate any functional entry of the project within a 400m walking distance of existing or planned bus, streetcar, or rideshare stop with a daily service of 72 weekday, 40 weekend trips (1 point) OR 144 weekday, 108 weekend trips (3 points) OR 360 weekday, 216 weekend trips (5 points) ***OR*** Locate any functional entry of the project within 800m walking distance of existing or planned bus rapid transit stops, rail stations, or commuter ferry terminals with a daily service of 24 weekday, 6 weekend trips (1 point) OR 40 weekday, 8 weekend trips (2 points) OR 60 weekday, 12 weekend trips (3 points).	This credit has been achieved, as the site is located within walking distance of two bus routes with frequent service.
1				1	**LTc6 Bicycle Facilities:** Design or locate the project such that a functional entry or bicycle storage is within 180m walking distance or bicycling distance from a bicycle network that connects to at least one of the following: - at least 10 diverse uses - a school or employment center, if the project total floor area is 50% or more residential; or - a bus rapid transit stop, rail station, or ferry terminal.	This credit cannot be achieved as the site is not located within 180 m of a bicycle network. However, 6 exterior bike racks are provided on the building's east side, and consideration will be given to 1 shower facility for cycle commuters.
				1	**LTc7 Reduced Parking Footprint:** Do not exceed the minimum local code requirements for parking capacity. Provide parking capacity that is a percentage reduction below the base ratios recommended by the Parking Consultants Council, as shown in the Institute of Transportation Engineers' Transportation Planning Handbook (ITETPH), 3rd edition, Tables 18-2 through 18-4. Provide preferred parking for carpools for 5% of the total parking spaces, after reductions. Calculations include all existing, new, and off-street parking spaces leased or owned by the project.	This credit cannot be achieved as there is no parking on the project site. However, consideration will be given to developing a carpool management plan, and setting up a ride-matching system for employees.
				1	**LTc8 Green Vehicles:** Designate 5% of all parking spaces used by the project as preferred parking for green vehicles. Clearly identify and enforce for sole use by green vehicles and distribute preferred parking spaces proportionally among various parking sections. Green vehicles must achieve a minimum green score of 45 on the American Council for an Energy Efficient Economy (ACEEE) annual vehicle rating guide (or local equivalent). ***AND*** **Option 1:** Install Level 2 or higher electrical vehicle supply equipment (EVSE) in 2% of all parking spaces used by the project. Clearly identify and reserve these spaces for the sole use by plug-in electric vehicles. EVSE must be networked or internet addressable and be capable of participating in a demand-response program or time of-use pricing to encourage of-peak charging. **Option 2**: Install liquid or gas alternative fuel fueling facilities or a battery switching station capable of refueling a number of vehicles per day equal to at least 2% of all parking spaces.	This credit cannot be achieved as there is no parking on the project site.

6	6	2	0	2	**SUSTAINABLE SITES**	
▪	▪				**SSp1 Construction Activity Pollution Prevention:** Create and implement an erosion and sedimentation control plan. Must conform to 2012 U.S. Environmental Protection Agency (EPA) Construction General Permit (CGP) requirements or local equivalent, whichever is more stringent. Projects must apply the CGP regardless of size. The plan must describe the measures implemented.	This prerequisite will be achieved - erosion and sedimentation control measures are in progress, and will be added to civil engineering drawings.

LEED® BD+C New Construction Scorecard

TRIUMF Institute for Advanced Medical Isotopes (IAMI)

Insufficient Points Targeted for Rating

UBC Mandated	Targeted	Pending	Decision Req'd	Not Pursued
62	38	14	0	58

Certified: 40 to 49 points **Silver:** 50 to 59 points **Gold:** 60 to 79 points **Platinum:** 80 or more points

1				1	**SSc1 Site Assessment:** Complete and document a site survey or assessment that includes the following information: topography, hydrology, climate, vegetation, soils, human use and human health. The survey or assessment should demonstrate the relationships between the site features and topics listed above and how these features influenced the project design; give the reasons for not addressing any of those topics. **Labs21 p.3:** - For workers and public: Meet or exceed all exposure limits by the most stringent standard available (list in Labs21) American Conference of Industrial Hygienists (ACGIH), Occupational Safety and Health Administration (OSHA), Nuclear Regulatory Commission (NRC), American National Standards Institute (ANSI), local standards or best practice, whichever is most stringent) - Meet or exceed National Institutes of Health - Centers for Disease Control (NIH-CDC) for airborne effluent labs with biohazards (CDC-NIH. Biosafety in Microbiological and Biomedical Laboratories, latest edition)	This credit cannot be achieved due to the additional time and budget required to fully address this credit's scope. The project has completed Phases 1 and 2 Environmental Site Assessments in compliance with local regulations.
2	2				**SSc2 Site Development - Protect or Restore Habitat:** Preserve and protect 40% of greenfield area on site from development and construction (if such area exists). **AND** **Option 1:** Use native or adapted vegetation to restore 30% (including building footprint) of the previously developed areas of the site. Restore all disturbed or compacted soils that will be revegetated within the project's development footprint. (2 points) **Option 2:** Provide at least $4USD/m² for the total site area to a land trust or conservation organization meeting certain requirements. (1 point)	This credit is on track due to extensive vegetated areas at grade, aproximating 40% of the site area, including a 246 m² rain garden, which are designed to capture, treat and infiltrate rainwater. All native and adaptive plant species have been chosen for drought tolerance and adaptability to future climate conditions on the site. A green roof cannot be included due to incompatibility with Canadian Nuclear Safety Commission (CNSC) standards.
	1				**SSc3 Open Space:** Provide outdoor space greater than or equal to 30% of the total site area (including building footprint), a minimum of 25% of which (7.5% of total) must be vegetated (turf grass does not count) or have overhead vegetated canopy. Wetlands and ponds may qualify. High density projects have additional allowances. The outdoor space must accommodate one of: pedestrian-oriented paving, year-round garden spaces, recreation-oriented paving/turf area, community garden plots, or preserved/created habitat.	This credit is on track due to extensive vegetated areas at grade, approximating 40% of the site area. The site is pedestrian-oriented with paved areas and benches in multiple locations across the site; one seated area is immediately adjacent to a rain garden, which will provide visual interest year-round. Plant species meet the requirements of SSc2: Site Development - Protect or Restore Habitat.
2	2			1	**SSc4 Rainwater Management:** **Option 1:** Manage on site the runoff from the developed site for the 95th (2 points), 98th (3 points), 85th, (zero lot line projects only - 3 points) percentile of regional or local rainfall events using low-impact development (LID) and green infrastructure. **Option 2:** Manage on site the annual increase in runoff volume from the natural land cover condition to the post developed condition. (3 points)	This credit is on track with a hybridized civil and landscape architect solution, which includes rain gardens, and infiltration beds. The project will also meet UBC's Integrated Stormwater Management Plan requirements.
		2			**SSc5 Heat Island Reduction:** **Option 1:** Meet criteria for at-grade and roofing measures combined using a combination of shading, vegetated roof and high-reflectance materials. (2 points) **Option 2:** Place at least 75% of parking spaces under cover, and roofing to cover parking must either: have a 3-year aged SRI greater than 32, be vegetated roof, or be covered by energy generation systems. (1 point)	This credit is pending a feasibility assessment of incorporating a high-reflective roofing membrane in all roofing areas. A green roof cannot be included due to incompatibility with CNSC standards.

LEED® BD+C New Construction Scorecard

TRIUMF Institute for Advanced Medical Isotopes (IAMI)

Insufficient Points Targeted for Rating

UBC Mandated	Targeted	Pending	Decision Req'd	Not Pursued
62	38	14	0	58

Certified: 40 to 49 points **Silver:** 50 to 59 points **Gold:** 60 to 79 points **Platinum:** 80 or more points

1	1				**SSc6 Light Pollution Reduction:** **Uplight Requirement:** **Option 1:** Do not exceed mandated luminaire uplight ratings **Option 2:** Do not exceed mandated percentages of total lumens emitted above horizontal. **AND** **Light Trespass Requirement:** **Option 1:** Do not exceed mandated luminaire backlight and glare ratings **Option 2:** Do not exceed mandated vertical illuminances at the lighting boundary. **AND** Do not exceed a luminance of 200 cd/m2 (nits) during nighttime hours and 2000 cd/m2 (nits) during daytime hours for internally illuminated exterior signage.	This credit is targeted, as ASHRAE 90.1-2016 (adopted per BCBC 2018) mandates uplight and glare requirements.
6	8	0	0	3	**WATER EFFICIENCY**	**COMMENTS**
▪	▪				**WEp1 Outdoor Water Use Reduction:** **Option 1:** Show that landscape does not require a permanent irrigation system beyond a maximum two year establishment period. **Option 2:** Reduce the landscape water requirement by at least 30% from calculated baseline for site's peak watering month, using plant species selection and irrigation system efficiency based on EPA WaterSense Budget Tool.	This prerequisite is achievable due to drought-tolerant selection of native and emerging adaptive plant species which can adapt to future climate conditions.
▪	▪				**WEp2 Indoor Water Use Reduction:** Reduce fixtures and fittings water consumption by 20% from baseline. All newly installed toilets, urinals, lavatory faucets and showerheads must be WaterSense labelled, all residential clothes washers and dishwashers are ENERGY STAR, and there is no once-through cooling with potable water for any equipment/appliances that reject heat. Cooling towers and evaporative condensers are equipped with makeup water meters, conductivity controllers and overflow alarms, and efficient drift eliminators. **Labs21 p.4 -5** - Unless required as direct contact process water, reuse potable water for any laboratory equipment - Use closed-loop cooling for equipment - Use vacuum pumps instead of aspirator fittings for cold-water faucet unless required - Calculate and document baseline of annual process water use and discharge. -Install meter for total lab process water use. Submeter individual uses >30% of total process water. -Use technology and strategies to reduce process water use and wastewater generation by 20% (1 point) for 30% (1 point)	This prerequisite is acheivable due to low-flow plumbing fixtures throughout the building. In addition, the project is committing to achieving all Labs 21 version 3.0 prerequisites and credits.
▪	▪				**WEp3 Building-Level Water Metering:** Install permanent water meters to measure total potable water use for the building and associated grounds. Meter data must be compiled into monthly and annual summaries; meter readings can be manual or automated. Commit to sharing this data with the USGBC for five years from date of LEED certification or typical occupancy. Commitment must carry forward for 5 years or until the building changes ownership.	This prerequisite will be achieved by a building water meter. The project is committed to sharing utility data with the USGBC if the project is able to submit for certification.
1	2				**WEc1 Outdoor Water Use Reduction:** **Option 1:** Demonstrate landscape does not require permanent irrigation system beyond a maximum two-year establishment period. (2 points) **Option 2:** Reduce the landscape water requirement by at least 50% from the calculated baseline for the peak watering month through plant species selection and irrigation system efficiency based on EPA requirements. Reductions beyond 30% may be achieved using alternative water resources or smart scheduling technologies. (2 points)	This credit will be achieved due to drought-tolerant selection of native and emerging adaptive plant species. Irrigation will utilize rainwater.

LEED® BD+C New Construction Scorecard

TRIUMF Institute for Advanced Medical Isotopes (IAMI)

Insufficient Points Targeted for Rating

UBC Mandated	Targeted	Pending	Decision Req'd	Not Pursued
62	38	14	0	58

Certified: 40 to 49 points **Silver:** 50 to 59 points **Gold:** 60 to 79 points **Platinum:** 80 or more points

3	3			3	**WEc2 Indoor Water Use Reduction:** Reduce fixtures and fittings water consumption by 25% (1 point), 30% (2 points), 35% (3 points), 40% (4 points), 45% (5 points), or 50% (6 points). Reductions beyond 20% may be achieved using alternative water resources.	This credit will be achieved due to low-flow plumbing fixtures throughout the building. Credit achievement is pending selection of plumbing fixtures. Note: Greywater reuse is not possible due to Health Canada regulations for clean rooms where drug manufacturing is occuring for human consumption.
2	2				**WEc3 Cooling Tower Water Use:** For cooling towers and evaporative condensers, conduct a one-time potable water analysis, measuring the five mandated control parameters listed. (1-2 points)	This credit will be achieved. A range of water-saving and chemical management strategies are being explored, which will exceed LEED requirements.
	1				**WEc4 Water Metering:** Install permanent water meters for at least 2 of the following water subsystems: irrigation supply, indoor fixtures and fittings supply, domestic hot water heating, boiler (378,500L/yr or ≥150kW), reclaimed water, other process water.	This will be achieved. All water end uses, including process loads, will be sub-metered.

18	7	1	0	25	ENERGY AND ATMOSPHERE	COMMENTS
▪	▪				**EAp1 Fundamental Commissioning and Verification:** Commission (Cx) mechanical, electrical, plumbing, and renewable energy systems and assemblies, in accordance with ASHRAE Guideline 0-2005 and 1.1-2007 for HVAC&R Systems. Engage a commissioning authority to complete the Commissioning process. **Labs21 p.15:** See details in Labs21 Guideline -Conduct fume hood commissioning according to ASHRAE-110 Method of Testing Performance of Laboratory Fume Hoods.	This prerequisite will be achieved. The appointment of a third-party commissioning authority is in progress.
▪	▪				**EAp2 Minimum Energy Performance:** Using a simulation model, demonstrate 5% improvement in proposed building performance rating compared with specified baseline in ANSI/ASHRAE/IESNA Standard 90.1-2010, Appendix G or NECB 2011.	This prerequisite is on track per the results of the Energy Modelling Charrette conducted on October 17, 2018. The project team complies with ASHRAE 90.1-2016 (per BCBC 2018), CNSC and Health Canada Good Manufacturing Practices Guide for Drug Products. See EAc2 for further details.
▪	▪				**EAp3 Building-Level Energy Metering:** Install building-level energy meters, or sub-meters that can be aggregated to provide building-level data, to monitor energy consumption for at least monthly intervals. Utility-owned metres are acceptable. Commit to sharing this data with the USGBC for five years from date of LEED certification or typical occupancy. Commitment must carry forward for 5 years or until the building changes ownership.	This prerequisite will be achieved, as all major energy end uses in the building (including process loads) will be sub-metered.
▪	▪				**EAp4 Fundamental Refrigerant Management:** Use no CFC-based refrigerants in HVAC&R equipment. Existing smaller units (containing less than 1/2 pound of refrigerant) are exempt.	This prerequisite will be achieved, as no CFC-based refrigerants will be used.
4				6	**EAc1 Enhanced Commissioning:** **Option 1:** Complete the enhanced commissioning process in accordance with ASHRAE Guidelines 0-2005 and 1.1-2007 for HVAC&R systems (3 points) AND develop monitoring-based procedures and identify points to be measured and evaluated to assess performance of energy- and water-consuming systems (1 point) ***AND/OR*** **Option 2:** Complete additional commissioning processes for the building envelope in accordance with ASHRAE Guidelines 0-2005 and NIBS Guideline 3-2002. (2 points)	This credit is not targeted due to budget restrictions imposed by federal funding sources.

LEED® BD+C New Construction Scorecard

TRIUMF Institute for Advanced Medical Isotopes (IAMI)

Insufficient Points Targeted for Rating

UBC Mandated	Targeted	Pending	Decision Req'd	Not Pursued
62	38	14	0	58

Certified: 40 to 49 points **Silver:** 50 to 59 points **Gold:** 60 to 79 points **Platinum:** 80 or more points

10	**5**			**13**	**EAc2 Optimize Energy Performance:** Perform a whole-building energy simulation to analyze efficiency measures during the design process and account for the results in design decision making, demonstrating a percentage improvement in the proposed building performance rating compared with an ANSI/ASHRAE/IESNA Standard 90.1-2010 Appendix G or NECB 2011 baseline. (1-18 Points) **Labs21 p 7- 8:** - Develop baseline energy use for qualifying lab equipment -Reduce total energy use of said equipment by 10% (1 point) or 20% (2 points) -Measure base usage of equipment electric load -Obtain 7 continuous days of power metering at a distribution panel level of all lab equipment (plug load and hard-wired equipment included) while spaces are fully occupied (1 point) -Design electrical distribution system to provide for portable or permanent check metering of lab equipment electric consumption (1 point) -See Best Practice Guide on Right-sizing Laboratory Equipment Load and Technical Bulletin on Measured Equipment Loads	Per design energy model results shared at the team's Energy Modelling Charrette on October 17, 2018, the project is on track to achieve an EUI of 1400 kWh/m²/year and a 15% energy cost savings over ASHRAE 90.1-2010 (5 points), a significant improvement over schematic energy model results (2016) of an EUI of 1600 kWh/m²/year. An investigation is underway to benchmark IAMI EUI against other similar labs - the results will be communicated in our Building Permit application. The project team has incorporated the following energy conservation measures: -Design to BCBC 2018 and ASHRAE 90.1-2016 -<40% window to wall ratio -Sun shading and fretting design on south exposure -Manage thermal bridges -High efficiency heat pumps -Heat recovery coil on all exhaust air, used as heat rejection -Pre-heated water and domestic hot water -Reduced fan power -Right-sizing laboratory equipment, high efficiency equipment -High efficiency lighting -Substantial lighting controls The project will also comply with all Labs 21 prerequisites and credits.
1	**1**				**EAc3 Advanced Energy Metering:** Install advanced energy metering for whole-building energy sources and individual energy sources that represent at least 10% of the total annual consumption. All meters must be capable of reporting hourly, daily, monthly, and annual energy use. Provide a data collection system capable of storing meter data for 36 months. (1 Point)	This credit will be achieved, as all major energy end uses in the building (including process loads) will be sub-metered.
1	**1**			**1**	**EAc4 Demand Response:** **Case 1:** Design building and equipment for participation in demand response programs through load shedding or shifting, not including on-site electricity generation (2 points). **Case 2:** In cases with no demand response program available, providing infrastructure for potential future demand response programs (1 point)	This credit will be achieved, as load shedding has been incorporated into the mechanical design.
1				3	**EAc5 Renewable Energy Production:** Use on-site renewable energy systems to offset building energy costs by 1% (1 point), 5% (2 points), or 10% (3 points).	This credit cannot be achieved as the building is not connnecting the UBC district energy utility. The project is not investigating on-site solar pv due to the project's limited budget, and insufficient project area to meet this credit's minimum threshold (due to high EUI).
1		**1**			**EAc6 Enhanced Refrigerant Management:** **Option 1:** Do not use refrigerants, or only refrigerants with an ozone depletion potential (ODP) of 0 or global warming potential (GWP) of less than 50. (1 Point) **Option 2:** In HVAC&R equipment use refrigerants that minimize or eliminate emission of compounds that contribute to ozone depletion and climate change. (1 Point)	The office areas will use a variable refrigerant flow mechanical system, which may not meet credit requirements. This credit is pending confirmation of mechanical equipment refrigerant calculations.

LEED® BD+C New Construction Scorecard

TRIUMF Institute for Advanced Medical Isotopes (IAMI)

Insufficient Points Targeted for Rating

UBC Mandated	Targeted	Pending	Decision Req'd	Not Pursued
62	38	14	0	58

Certified: 40 to 49 points **Silver:** 50 to 59 points **Gold:** 60 to 79 points **Platinum:** 80 or more points

				2	**EAc7 Green Power and Carbon Offsets:** Engage in a contract for qualified resources to be delivered at least annually for five years. At least 50% (1 point) OR 100% (2 points) of the energy must come from green power, carbon offsets or renewable energy certificates.	This credit is pending a budget and risk review by Triumf, and will be added during construction if Triumf chooses to proceed with the purchase of a green power contract.

6	2	3	0	8	MATERIALS AND RESOURCES	COMMENTS
▪	▪				**MRp1 Storage and Collection of Recyclables:** Provide dedicated areas accessible by waste haulers and building occupants for the collection and storage of mixed paper, corrugated cardboard, glass, plastics, and metals. In addition, take appropriate measures for the safe collection, storage, and disposal of two of the following hazardous materials: batteries, mercury-containing lamps, and/or electronic waste. **Labs21 p.10 -11:** - Track and organize hazardous materials - Develop an action plan to eliminate, minimize, substitute, recycle, and dispose of harmful chemical handling	This prerequisite will be achieved with the use of a dedicated recycling location on-site. The project will also comply with all Labs 21 prerequisites and credits.
▪	▪				**MRp2 Construction and Demolition Waste Management Planning:** Develop and implement a construction and demolition waste management plan. The plan must establish waste diversion goals for the project, identify at least five materials targeted for diversion and their receiving facilities, as well as estimate a percentage of overall project waste that these materials represent.	This prerequisite will be achieved.
3				5	**MRc1 Building Life-Cycle Impact Reduction:** **Option 1:** Maintain the existing building structure, envelope, and interior non-structural elements of a historic building or contributing building in a historic district. Do not demolish any part of a historic building or contributing building in a historic district unless it is deemed structurally unsound or hazardous. (5 points) **Option 2:** Maintain at least 50%, by surface area, of the existing building structure, enclosure, and interior structural elements for buildings that meet local criteria of abandoned or are considered blight. (5 points) **Option 3:** Reuse or salvage 25% (2 points), 50% (3 points), or 75% (4 points) of structural elements, enclosure materials, and permanently installed interior elements. **Option 4:** Conduct a life-cycle assessment of the project's structure and enclosure that demonstrates a minimum of 10% reduction, compared with a baseline building. No impact category assessed as part of the life-cycle assessment may increase by more than 5% compared with the baseline building. (3 points)	This credit cannot be achieved due to several factors: -Lack of comparable structural materials within the Athena LCA calculator such as borate concrete used for exterior walls -Due to pricing model, where envelope components will be confirmed after tender, LCA analysis will hold no value in influencing building envelope materials -Insufficient time to conduct LCA analysis post-tender
		1		1	**MRc2 Building Product Disclosure and Optimization - Environmental Product Declarations:** **Option 1:** Use at least 20 different permanently installed products sourced from at least five different manufacturers that have an Environmental Product Declaration (EPDs) conforming to ISO 14025, ISO 14040, ISO 14044, and EN 15804 or ISO 21930 and have a cradle to gate scope minimum OR products that have a publicly available, critically reviewed life-cycled assessment conforming to ISO 14044 and have a cradle to gate scope minimum. (1 point) ***AND/OR*** **Option 2:** Use third party certified products for 50% of materials, by cost, that demonstrate reduction in one of the following criteria: global warming potential, depletion of stratospheric ozone layer, acidification of land and water sources, eutrophication, or formation of tropospheric ozone. (1 point)	The project is investigating Option 1, pending material selection.

LEED® BD+C New Construction Scorecard

TRIUMF Institute for Advanced Medical Isotopes (IAMI)

Insufficient Points Targeted for Rating

UBC Mandated	Targeted	Pending	Decision Req'd	Not Pursued
62	38	14	0	58

Certified: 40 to 49 points **Silver:** 50 to 59 points **Gold:** 60 to 79 points **Platinum:** 80 or more points

1		1		1	**MRc3 Building Product Disclosure and Optimization - Sourcing of Raw Materials:** **Option 1:** Use at least 20 different permanently installed products from at least five different manufacturers that have publicly released a report from their raw material suppliers which include raw material supplier extraction locations, a commitment to long-term ecologically responsible land-use, a commitment to reducing environmental harms from extraction and/or manufacturing processes, and a commitment to meeting applicable standard or programs voluntarily that address responsible sourcing criteria. (1 point) ***AND/OR*** **Option 2:** Use products for 25% of materials, by cost, that have a combination of bio-based materials, FSC-certified wood products, salvaged/refurbished/reused materials, recycled content, and/or provides extended producer responsibility for the life-cycle of the product. (1 point)	The project is investigating Option 1, pending material selection.
		1		1	**MRc4 Building Product Disclosure and Optimization - Material Ingredients:** **Option 1:** Use at least 20 different permanently installed products from at least five different manufacturers that demonstrate the chemical inventory of the product to at least 1000ppm using one of the following programs: Manufacturer Inventory, Health Product Declaration (HPD), Cradle to Cradle (C2C) Certification, or Declare. (1 point) ***AND/OR*** **Option 2:** Use products for 25% of materials, by cost, that comply with GreenScreen c1.2 Benchmark, Cradle to Cradle v2 Gold/Platinum, or Cradle to Cradle v3 Silver/Gold/Platinum. (1 point)	The project is investigating Option 1, pending material selection.
2	2				**MRc5 Construction and Demolition Waste Management:** **Option 1:** Divert a minimum of 50% of the total construction and demolition material using at least three material streams (1 point) OR divert a minimum of 75% of the total construction and demolition material using at least four material streams (2 points). ***OR*** **Option 2:** Do not generate more than 12.2 kilograms of waste per square meter of the building's floor area. (2 points)	This credit will be achieved.

7	7	4	0	5	INDOOR ENVIRONMENTAL QUALITY	COMMENTS
▪	▪				**IEQp1 Minimum Indoor Air Quality Performance:** Design ventilation systems to meet the minimum requirements of ASHRAE 62-2010, Sections 4-7, Ventilation for Acceptable Indoor Air Quality (with errata). ***AND*** For variable air volume systems, provide a direct outdoor airflow measurement device capable of measuring the minimum outdoor air intake flow with an accuracy of +/–10% of the design minimum outdoor airflow rate. For constant-volume systems, balance outdoor airflow to the design minimum outdoor airflow rate defined by ASHRAE Standard 62.1–2010 (with errata) and install a current transducer on the supply fan, an airflow switch, or similar monitoring device. **Labs21 p.6, 12, 14:** -Meet minimum requirement of ANSI/AIHA Z9.5 (latest version) -Determine necessary fresh air ventilation rate and number of fume hoods/exhaust devices according to code. Plan for the next 5 years -Develop a fume hood sash management plan -Conduct computational fluid dynamics (CFD) or physical modeling to optimize indoor airflow -See best practice guide: Optimizing Ventilation Rates	This prerequisite will be achieved as the project's required outdoor air volumes far exceed ASHRAE 90.1-2010. The project is also targeting all Labs 21 version 3.0 prerequisites and credits.
▪	▪				**IEQp2 Environmental Tobacco Smoke Control:** Mandate no smoking in building or within 7.5m of building entrances, windows, or pedestrian paths AND post signage within 3m of all building entrances indicating the no-smoking policy.	This prerequisite will be achieved.

LEED® BD+C New Construction Scorecard

TRIUMF Institute for Advanced Medical Isotopes (IAMI)

Insufficient Points Targeted for Rating

UBC Mandated	Targeted	Pending	Decision Req'd	Not Pursued
62	38	14	0	58

Certified: 40 to 49 points **Silver:** 50 to 59 points **Gold:** 60 to 79 points **Platinum:** 80 or more points

1	1	1			**IEQc1 Enhanced Indoor Air Quality Strategies:** **Option 1:** Provide entry way grilles at all building entrances (3m long), filtration media (MERV 13/Class F7) on all ventilation system providing outdoor air, and prevent cross contamination where hazardous gases or chemical are present (negative pressure, self-closing doors, and deck-to-deck partitions/hard lid ceilings. (1 Point) ***AND/OR*** **Option 2:** Provide one of the following: exterior contamination prevention, increased ventilation (30% above ASHRAE 62-2010), carbon dioxide monitoring in densely occupied spaces, OR additional source control and monitoring for contaminants aside from carbon dioxide. (1 Point) **Labs21 p.13:** - All alarm systems in lab must be self-identifying and failsafe - Incorporate occupant notification devices into fume hoods. - Install a notification system to lab occupants for all doors directly leading from pressure-controlled lab spaces to the outside - Fume hoods and equipment affected by cross-drafts must not be placed adjacent to exit doors except emergency-only doors	This credit is pending an investigation of design requirements for Option 2 exterior contamination prevention. All other Option 1 and 2 requirements are currently met. This project is also targeting all Labs 21 version 3.0 prerequisites and credits.
3	1	2			**IEQc2 Low-Emitting Materials:** **Option 1:** Use a combination of the following materials complying with emissions and content requirements. Projects which exclude furniture: compliance in 2 categories (1 point), compliance in 4 categories (2 points). compliance in 5 categories (3 points). **1. Adhesives and sealants** compliant with VOC content requirements and 90% compliant with the emissions evaluation outlined in the California Department of Public Health (CDPH) Standard Method v1.1-2010. UL GreenGuard Gold, SCS Indoor Advantage, Blue Angel, and Collaborative for High Performance Schools certified products meet this requirement. **2. Paints and coatings** compliant with VOC content requirements and 90% compliant with the emissions evaluation outlined in the California Department of Public Health (CDPH) Standard Method v1.1-2010. UL GreenGuard Gold, SCS Indoor Advantage, Blue Angel, and Collaborative for High Performance Schools certified products meet this requirement. **3. Flooring** products compliant with the emissions evaluation outlined in the California Department of Public Health (CDPH) Standard Method v1.1-2010. UL GreenGuard Gold, FloorScore, Green Label Plus, NSF-332, SCS Indoor Advantage, GUT, Blue Angel, and Collaborative for High Performance Schools certified products meet this requirement. **4. Composite wood** products that are California Air Resources Board (CARB) certified as ultra-low-emitting formaldehyde (ULEF) or products that do not contain -formaldehyde (NAF). **5. Ceilings, Walls, Thermal and Acoustic Insulation** products compliant with the emissions evaluation outlined in the California Department of Public Health (CDPH) Standard Method v1.1-2010. UL GreenGuard Gold, SCS Indoor Advantage, Blue Angel, and Collaborative for High Performance Schools certified products meet this requirement. **Option 2:** If some products in the categories outlined above do not meet the criteria, a budget calculation may be used.	This credit pursuing Option 1. As there is minimal furniture, all furniture will be excluded. This credit is pending interior finishes selection, and an investigation into potential conflicts between Health Canada and LEED requirements for paints and coatings. The project intends to meet requirements for adhesives, sealants, flooring, and insulation.
1	1				**IEQc3 Construction Indoor Air Quality Management Plan:** Develop and implement an indoor air quality (IAQ) management plan for the construction and preoccupancy phases. During construction, meet control measures of the Sheet Metal and Air Conditioning Nation Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, 2nd edition, 2009, Chapter 3.	This credit will be achieved.
1	1			1	**IEQc4 Indoor Air Quality Assessment:** **Option 1:** Install new filtration media and perform a building flush-out by supplying outdoor air at 4,267,140 L/S.m² while maintaining 15˚C-27˚C and 60% maximum relative humidity. (1 point) **Option 2:** After construction but before occupancy, conduct baseline IAQ testing for formaldehyde, particulates, ozone, total volatile organic compounds, carbon monoxide, and target chemicals listed in CDPH Standard Method v1.1, Table 4-1. (2 Points)	This credit will be achieved under Option 1.
1		1			**IEQc5 Thermal Comfort:** Design HVAC systems and the building envelope to meet ASHRAE 55-2010, Thermal Comfort Conditions for Human Occupancy, with errata. Provide individual thermal comfort controls for 50% of individual occupant spaces and 100% of shared multi-occupant spaces capable of adjusting one of: air temperature, radiant temperature, air speed, or humidity. (1 point)	This credit is pending an investigation into potential conflicts between Health Canada, CNSC and LEED requirements for thermal comfort requirements in regularly occupied spaces.

LEED® BD+C New Construction Scorecard

TRIUMF Institute for Advanced Medical Isotopes (IAMI)

Insufficient Points Targeted for Rating

UBC Mandated	Targeted	Pending	Decision Req'd	Not Pursued
62	38	14	0	58

Certified: 40 to 49 points **Silver:** 50 to 59 points **Gold:** 60 to 79 points **Platinum:** 80 or more points

	2				**IEQc6 Interior Lighting:** **Option 1:** Provide individual lighting controls with at least three lighting levels (on, off, midlevel) for at least 90% of individual occupant spaces AND for 100% of multi-occupant spaces provide multizone control systems, separate lighting for presentations, switches for manual controls must be within the same space as controlled luminaires. (1 Point) ***AND/OR*** **Option 2:** Select 4 strategies, as outlined in LEED V4 reference guide, that enhance lighting quality. (1 Point)	This credit will be achieved due to compliance with ASHRAE 90.1-2016 (per BCBC 2018).
				3	**IEQc7 Daylight:** Provide compliant glare-control devices for all regularly occupied spaces ***AND*** **OPTION 1:** Demonstrate through annualized, climate-based daylight simulations (in accordance with IES LM 83) that ASE1000,250 (annual sunlight exposure no more than 1000 lux for 250 hours) for no more than 10% of regularly occupied floor area is achieved, and that sDA300/50% (spatial daylight autonomy with minimum 300 lux for 50% of operating hours, 8am-6pm) for 55% (2 points) or 75% (3 points) of regularly occupied floor area is achieved. Calculation grids should be no more than 2 feet (600 millimeters) square at a work plane height of 30 inches (76 millimeters) above finished floor (unless otherwise defined) ***OR*** **OPTION 2:** Demonstrate through computer modeling that illuminance levels will be between 300 lux and 3,000 lux - for 9am and 3pm on a clear-sky day at the equinox - for 75% (1 point) or 90% (2 points) of regularly occupied floor area. Clear sky conditions must be calculated using actual local TMY weather data as indicated in the LEED Guide. ***OR*** **OPTION 3:** Demonstrate through two sets of direct measurements - with furniture, fixtures, and equipment in place - that illuminance levels are between 300 lux and 3,000 lux. Measurements must be taken at the work plane on a 10ft (3m) grid for spaces larger than 150sqft (14 sqm), or a 3ft (900mm) grid for spaces 150sqft (14sqm) or smaller. Furthermore, the first set of measurements may be conducted during any regularly occupied month and any hour between 9am and 3pm, but the timing of second set of measurements must occur per the directions of the LEED v4 Guide	This credit cannot be achieved due to insufficient daylight access within clean rooms, as daylight access is in conflict with Health Canada requirements.
				1	**IEQc8 Quality Views:** Achieve a direct line of sight to the outdoors through a clear view for at least 75% of all regularly occupied floor area (accounting permanent interior obstructions). ***AND*** Provide two kinds of quality views: multiple lines of sight in different directions (90 degrees apart); views that include flora, fauna, sky, movement or distant objects (at least 25ft (7.5m) from exterior of glazing); unobstructed views within the distance of three times the head height of the vision glazing; views with a view factor of 3 or greater, as defined in "Windows and Offices: A Study of Office Worker Performance and the Indoor	This credit cannot be achieved due to insufficient views access within clean rooms, as window access is in conflict with Health Canada requirements.
	1				**IEQc9 Acoustic Performance:** Achieve maximum background noise levels from HVAC systems per 2011 ASHRAE Handbook, HVAC Application, Chapter 48, Table 1; AHRI Standard 885-2008 Table 15 AND comply with design criteria for HVAC noise levels resulting from the sound transmission paths listed in ASHRAE 2011 Application Handbook Table 6. Meet the maximum STC ratings between adjacent spaces, and reverberation time requirements outlined in the LEED Reference Guide for specific building types.	BPA Acoustics Ltd. has conducted a background noise assessment and made recommendations for silencers on strobic exhaust fans to comply with the University Neighbourhoods Association Noise Bylaw, and overall compliance with ASHRAE and AHRI standards. Reviews of architectural drawings are ongoing.

6	3	2	0	1	INNOVATION	COMMENTS
1		1			**INc1.1 Education Program** Provide an educational program on the environmental and human health benefits of green building practices and how building occupants or the public can help improve green performance within the LEED space (such as recycling or appropriate use of efficient fixtures and equipment). The program must be actively instructional and include at least two instutional initiatives that have ongoing components, such as a signage program, case study, guided tours, educational outreach program through periodic events covering green building topics, and/or a website or electronic newsletter.	This credit is under investigation pending discussions with Triumf and the project team. Guided tours would not be appropriate, however, other options may be available.

LEED® BD+C New Construction Scorecard

TRIUMF Institute for Advanced Medical Isotopes (IAMI)

Insufficient Points Targeted for Rating

UBC Mandated	Targeted	Pending	Decision Req'd	Not Pursued
62	38	14	0	58

Certified: 40 to 49 points **Silver:** 50 to 59 points **Gold:** 60 to 79 points **Platinum:** 80 or more points

1		1			**INc1.2 Bird Friendly Design** Comply with the UBC Bird Friendly Guidelines and the USGBC Bird Collision Deterrence Innovation Credit. Building Façade and Site Structures -Calculatu Bird Collision Threat Rating, and design such that 15% of the façade or less has a Threat Factor higher than 75. -Meet exterior lighting requirements, per SSc6: Light Pollution Reduction -Develop a 3-year monitoring plan to monitor the effectiness of the building and site design in preventing bird collisions.	This credit will be achieved through the following strategies: -Glazing only located on southern exposure -Fretting on exterior glazing -Duct openings with mesh -No interior courtyards -Light Pollution credit will be achieved Further investigation is underway to determine if the project is compliant with the required Threat Factor, and if Triumf will adopt a monitoring plan.
1	1				**INc1.3 Low Mercury in Lamps** Implement a lighting purchasing plan that specifies an overall building average of 70 pg of mercury per lumen-hour or less for all mercury-containing lamps purchased for the building and associated grounds within the project boundary. Include lamps for both indoor and outdoor fixtures, and hard-wired and portable fixtures. Lamps containing no mercury may be counted only if their energy efficiency at least equals that of their mercury-containing counterparts.	This credit will be achieved through extensive use of LEDs.
1	1				**INc1.4 Adoption of Green Labs Framework** Adopt all UBC Green Labs Framework best practices, and monitor compliance using checklist.	This credit is targeted. Triumf is reviewing UBC Green Labs requirements.
1				1	INc1.5: Exemplary Performance	This credit is not targeted as the project does not achieve the exemplary performance threshold for any targeted credit.
1	1				**INc2 LEED Accredited Professional:** At least one principal participant of the project team must be a LEED Accredited Professional (AP) with a BD+C specialty.	Further investigation is underway to determine if this strategy will meet CaGBC requirements for Innovation.

					REGIONAL PRIORITY	COMMENTS
4	0	0	0	4		
1				1	RPc1 Regional Priority for SSc4: Rainwater Management	These credits will be achieved only if a minimum of 40 points is achieved.
1				1	RPc2 Regional Priority for WEc1: Outdoor Water Use	
1				1	RPc3 Regional Priority for WEc2: Indoor Water Use	
1				1	RPc4 Regional Priority for EAc1: Enhanced Commissioning	

** This scorecard is intended to serve as a benchmarking tool to assess potential LEED v4 Building Design + Construction: New Construction and Major Renovation performance. It does not confirm a LEED rating nor guarantee credit compliance. Thi above. This document is not to be used in any other capacity without the expressed consent of WSP.*

How to Submit a Request for Variance of Non-Conformance to the Technical Guidelines (TG):

1) State the existing section and wording of the TG that you would like to vary from.

2) State the exact modified wording or the additional wording required.

3) Submit the proposed change to the appropriate stakeholders and follow up to obtain their agreement and approval.

4) Submit the Variance, that has been approved by the Stakeholders, to Michael Thayer (michael.thayer@ubc.ca) for approval/discussion. This variance may be added as an addendum item which will be reviewed and incorporated at the next update of the TG.

SAMPLE : REQUEST for VARIANCE WORKSHEET

Date	No.	Type (Architectural, Mechanical or Electrical)	Status (Approved / Not Approved)	UBC Tech Guideline Waiver Needed	Capital Cost Savings	Tech Guideline Reference	Details of Proposed Variance and Comments	Operating Cost Impact	Maintenance Cost Impact
19/Nov/2018	1	Architectural			N/A	LEED LTc Surrounding Density and Diverse Uses	We request this credit be considered Optional for this project, rather than Mandatory. This credit cannot be achieved as the site does not meet surrounding density and amenity requirements. According to Appendix C UBC surrounding Density and Diverse Uses Maps in UBC LEED v4 Guide, the project is not within 800m of 4-7 uses.	No impact	No impact
19/Nov/2018	2	Architectural			N/A	LEED LTc Bicycle Facilities	We request this credit be considered Optional for this project, rather than Mandatory. This credit cannot be achieved as the site is not located within 180 m of a bicycle network according to Appendix E UBC Bicycle Network Map in the UBC LEED v4 Guide. However, 6 exterior bike racks are provided on the building's east side, and consideration will be given to 1 shower facility for cycle commuters.	No impact	No impact
19/Nov/2018	3	Civil			N/A	LEED SSc Site Assessment	We request this credit be considered Optional for this project, rather than Mandatory. The project has completed Phase 1 and 2 Environmental Site Assessments in compliance with local regulations; Phase 2 results are pending. Due to project budget and timeline constraints dictated by federal sources, site assessment scope which could result in project delays has been removed from consideration, including hydrologicall, climate, human use and human health effects, as these were estimated to require an additionl 6-8 weeks.	No impact	No impact
19/Nov/2018	4	Owner			N/A	LEED EAc Enhanced Commissioning	We request that this credit be considered Optional for this project, rather than Mandatory. This project has significant budget restrictions due to federal funding sources; pursuing Option1 and 2 for this project add high costs to this project which are not allowed for in the budget. The project will pursue Fundamental Commissioning.	No impact	No impact

19/Nov/2018	5	Mechanical			N/A	LEED EAc Optimize Energy Performance	We request that 10 points under this credit be considered Optional for this project, rather than Mandatory. This project is a medical lab working with nuclear isotopes for healthcare applications and must comply to standards such as the Canadian Nuclear Safety Commission (CNSC) and Health Canada Good Manufacturing Practice Guidelines (GMP) which supersede LEED. Nuclear isotopes are produced using a 24W cyclotron, which generates a significant process load; in addition, the clean rooms used to manufacture nuclear isotopes must meet significantly higher air changes than typically required under BCBC 2018. The project team's design energy model indicates a target EUI of 1400 kWh/m²/year, which is signiicantly higher than energy-intensitve hospitals, which typically see an EUI of 600 - 8oo kWh/m²/year. The project team has incorporated a range of energy conservation measures, including significant heat recovery over the cyclotron process load, and is desiging the proejct to BCBC 2018, Labs 21 3.0, and the Green Labs framework. The team is currently benchmarking the IAMI facility to other similarly performing labs (excluding the cyclotron process load), and will further refine energy modelling results during the design development process. The project' design energy model, based 30% design development drawings, indicates a 35% energy cost savings compared to ASHRAE 90.1-2010, and 4 points according to LEED.	No impact	No impact
19/Nov/2018	6	Electrical			N/A	LEED EAc Renewable Energy Production	We request this credit be considered Optional for this project, rather than Mandatory. The building is not connecting to the UBC district energy utility. Solar photovoltaic panels were considered, however, roof area is limited by CNSC standards which require fume hood exhausts to be located on the roof. Due to the large process load, it has been determined that available roof area is insufficient to meet the LEED credit's minimum thresholds for on-site renewable energy.	No impact	No impact
19/Nov/2018	7	Architectural			N/A	MRc Building Life-Cycle Impact Reduction	We request that this credit be considered Optional for this project, rather than Mandatory. There are multiple factors which prevent this credit from being a viable target for this project: -Lack of comparable structural materials within the Athena LCA calculator such as borate concrete used for exterior walls -Due to pricing model, where envelope components will be confirmed after tender, LCA analysis will hold no value in influencing building envelope materials -Insufficient time to conduct LCA analysis post-tender	No impact	No impact
19/Nov/2018	8	Architectural			N/A	MRc Building Product Disclosure and Optimization - Sourcing of Raw Materials	We request that this credit be considered Optional for this project, rather than Mandatory. Due to the federal funding constraints, there are minimal interior finishes for portions of the building. As the industry has not yet caught up to LEED v4 requirements, we anticipate difficulty sourcing sufficient product to achieve Option 1 under this credit. This credit is currently listed as Potential on our LEED Scorecard.	No impact	No impact
19/Nov/2018	9	Mechanical			N/A	EQc Thermal Comfort	We request that this credit be considered Optional for this project, rather than Mandatory. Due to potential conflicts between the CNSC and cGMP standards, we may not be able to achieve ASHRAE 55-2010 in all regularly occupied spaces. This credit is under investigation by our team is currently listed as Potential on our LEED Scorecard.	No impact	No impact
19/Nov/2018	10	Owner			N/A	IDc Education Program	We request that this credit be considered Optional for this project, rather than Mandatory. Due to potential security requirements for staff and visitors to the building, we are unsure if annual public access will be possible (and this is a requirement of the USGBC). There are other methods for achieving this credit, and therefore it is under investigation, and currently listed as Potential on our LEED Scorecard.	No impact	No impact
19/Nov/2018	11	Architectural			N/A	IDc Bird Friendly Design	We request that this credit be considered Optional for this project, rather than Mandatory. USGBC requirements for Bird Collision Deterrence (the accepted Innovation path) requires Threat Factor calculations and a 3-year bird collision deterrence monitoring plan. Although fretting has been incorporated into glazing, and exterior lighting will comply with light trespass, uplight and glare requirements, we are unsure if all requirements can be met. This credit is currently under investigation and is listed as Potential on our LEED Scorecard.	No impact	Potentially more maintenance
19/Nov/2018	12	Architectural			N/A	IDc Exemplary Performance	We request that this credit be considered Optional for this project, rather than Mandatory. We have completed a detailed analysis of exemplary performance thresholds for targeted credits, and have determined that the project is unable to meet such a threshold for any targeted credit.	No impact	No impact

ARCHITECTURE 49 INC.

PHASE I ENVIRONMENTAL SITE ASSESSMENT

PORTIONS OF 4004 WESBROOK MALL AND 6075 NURSERIES ROAD, VANCOUVER, BC

SEPTEMBER 06, 2018

PHASE I ENVIRONMENTAL SITE ASSESSMENT

PORTIONS OF 4004 WESBROOK MALL AND 6075 NURSERIES ROAD VANCOUVER, BC

ARCHITECTURE 49 INC.

PROJECT NO.: 189-00175-02
DATE: SEPTEMBER 2018

WSP
100-20339 96TH AVENUE
LANGLEY, BC, V1M 0E4

TEL.: 604-533-2992
WSP.COM

September 06, 2018

Mr. Som Bose
Architecture 49 Inc.
270 – 1075 West Georgia
Vancouver, BC V6E 3C9

Dear Mr. Bose:

Project: **Phase I Environmental Site Assessment**

Portions of 4004 Wesbrook Mall and 6075 Nurseries Road, Vancouver, British Columbia

WSP Canada Inc. (WSP) is pleased to submit two (2) copies of the Phase I Environmental Site Assessment (ESA) report for the above-referenced properties.

As a Canadian multi-national company, WSP is one of the world's leading engineering and consulting firms. Our scientific expertise spans a full range of services including environmental, geotechnical, metallurgical, materials and building sciences, as well as industrial hygiene, industrial compliance monitoring and other specialty scientific and engineering-related services. Please visit our website at www.wsp.com for details regarding our comprehensive services, our client testimonials, and our core values, which focus on serving and protecting our clients' best interests.

We trust that the enclosed report meets your current requirements. If you have any questions regarding this project, the enclosed reports, or our services, please do not hesitate to call the undersigned at (604) 533-2992.

Thank you for utilizing our professional services. We look forward to serving your future environmental and engineering needs.

Yours sincerely,

ORIGINAL SIGNED

Jenny Liu, B. Eng.
Environmental Scientist, Project Manager

WSP ref.: 189-00175-02

100-20339 96th Avenue
Langley, BC, V1M 0E4

Tel.: 604-533-2992
wsp.com

SIGNATURES

PREPARED BY

ORIGINAL SIGNED

Jenny Liu, B.Eng.
Environmental Scientist, Project Manager
Environment

REVIEWED BY

ORIGINAL SIGNED AND SEALED

Jas Minhas, M.E.T., R.P.Bio.
Environmental Toxicologist
Environment

This report was prepared by WSP Canada Inc. for Architecture 49 Inc., in accordance with the professional services agreement. The disclosure of any information contained in this report is the sole responsibility of the intended recipient. The material in it reflects WSP's best judgement in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. WSP accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. This limitations statement is considered part of this report.

The original of the technology-based document sent herewith has been authenticated and will be retained by WSP for a minimum of ten years. Since the file transmitted is now out of WSP's control and its integrity can no longer be ensured, no guarantee may be given with regards to any modifications made to this document.

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

1 INTRODUCTION

Mr. Som Bose, on behalf of Architecture 49 Inc. (the Client), retained WSP Canada Inc. (WSP) on 17 August 2018 to conduct a Phase I Environmental Site Assessment (ESA) for portions of two properties at 4004 Wesbrook Mall and 6075 Nurseries Road including a roadway adjacent to the east of these two properties within the University of British Columbia jurisdiction, British Columbia (henceforth referred to as "the Site"). The Site boundaries are shown on Figure 2 in Appendix A.

A Phase I ESA consists of evaluating and reporting the existing and historical information collected through a historical records search and review, a Site reconnaissance, and interviews with individuals knowledgeable about the Site. A Phase I ESA may assist in reducing uncertainty about the likelihood of potential environmental liability and may provide a basis for further investigation of the Site.

WSP understands that the Phase I ESA is required by the Client for due diligence purposes prior to redevelopment of the Site and is not intended for submission to the BC Ministry of Environment and Climate Change Strategy (ENV) for the purpose of a Ministry legal instrument or review.

This Phase I ESA report has been prepared in general accordance with the Canadian Mortgage Housing Corporation (CMHC) and Canadian Standards Association (CSA) guidelines and partial requirements of the BC Environmental Management Act (EMA), Contaminated Sites Regulation (CSR) and associated protocols, procedures and guidelines.

2 PHASE I PROCEDURE

2.1 OBJECTIVE

The objective of this Phase I ESA is to identify on-site and offsite areas of potential environmental concern (APECs) and associated potential contaminants of concern (PCOCs) which have the likelihood to impact the Site's subsurface and exceed the applicable remediation standards. If warranted, further investigation will be recommended.

2.2 SCOPE OF WORK

WSP's Phase I ESA scope of work included the following:

- Conducting historical records search and review, which included: reviewing fire insurance plans (if available), aerial photographs, criss-cross or city directories, historical and current land titles, municipal records, BC Assessment Authority and BC ENV records with respect to environmental concerns associated with the Site or surrounding properties that could potentially affect the environmental condition of the Site;
- Completing the Site and surrounding area reconnaissance and interviewing persons knowledgeable about past and present activities on the Site and surrounding properties. Items addressed included: chemical storage and handling, underground and aboveground storage tanks (USTs and ASTs), non-hazardous and hazardous wastes, air and water discharges, and dumping/landfilling activities;
- Identifying potential source(s) of environmental impacts due to historical and current land uses, activities, events or practices at the Site and surrounding properties; and
- Preparing a report outlining the findings of the investigation and providing conclusions and recommendations.

Note: A Phase I ESA does not include sampling or analysis of air, soil, groundwater, surface water or sediment/biota or a hazardous building materials survey.

2.3 REGULATORY FRAMEWORK

In British Columbia, a Phase I ESA is conducted to meet the requirements of the currently applicable provincial EMA and the CSR. Detailed background information regarding the EMA and the CSR are included in Appendix H.

2.4 METHODOLOGY

Table 2-1 Source of Historical Records

ITEM	SOURCE	YEARS / REMARKS
Historical Land Titles	West Coast Title Search, New Westminster, BC	Current
Environmental Site Registry	BC ENV Online Environmental Site Registry	August 2018
Assessment Report	BC Online Assessment Records	NA
Water Well & Aquifer Search	BC ENV Online Water Resources Atlas Database	August 2018
Fire Insurance Plans	University of British Columbia Library, Rare Books and Special Collections	1932, 1954 and 1962
City Directories	University of British Columbia Library, Rare Books and Special Collections	1960, 1965, 1970, 1975, 1980, 1985, 1990, 1995 and 2001
Aerial Photographs	UBC Department of Geography, Geographic Information Centre and the Google Earth online mapping system.	1932, 1938, 1949, 1954, 1963, 1970, 1973, 1977, 1980 and 1986
	City of Vancouver	1994, 2004 and 2015
Topography, Zoning and Utility Maps and Building Permits/Drawings	University of British Columbia, Infrastructure Development, Records Section	August 2018
Surficial Geology	Surficial Geology Map (Map 1486A, Vancouver, 1978) obtained from the Geological Survey of Canada	VCb – Vashon Drift and Capilano Sediments
Interviews	Mr. Ken Buckley (Deputy Associate Laboratory Director – IAMI)	Familiar with the Site for 31 years

Ms. Jenny Liu, B.Eng., of WSP completed a Site visit on 23 August 2018. Selected photographs taken during the Site visit are presented in Appendix B.

3 SITE DESCRIPTION

As required by the BC ENV, the Site's legal information is provided below:

Table 3-1 Summary of Site Information

ITEM	INFORMATION
Common Name	Triumf Facility Temporary Storage Yard and South Campus Substation
Municipal Addresses	4004 Wesbrook Mall and 6075 Nurseries Road, Vancouver, British Columbia
Legal Description[1]	District Lot 6494 Group 1 New Westminster District Except Parts in Plans 11345, 18645, 21966, BCP5864, BCP23588, BCP26848, 20570, BCP30252 and BCP45808
P.I.D.[2]	012-132-896
Latitude/Longitude[3]	N49° 14' 48.59 " W123° 13' 42.98"

3.1 LOCATION

The Site is located within the Triumf Facility and South Campus Substation within the University of British Columbia jurisdiction, BC (Figure 1, Appendix A). The Site is irregular in shape and approximately 0.58 hectares in total area. The Site is bounded by Triumf Facility to the north and west, Pacific Spirit Regional Park to the east, South Campus Materials Recovery Facility and a roadway to the south, and South Campus Substation to the southwest. Currently, the northern portion of the Site is occupied by Triumf Facility and utilized as a temporary storage yard. The southern portion of the Site is vacant and covered by vegetation. The eastern portion of the Site is a roadway for the public.

The Site plan is presented on Figure 2, Appendix A.

3.2 TOPOGRAPHY

Information obtained from UBC Infrastructure Development indicated that the Site is situated at the geodetic elevation ranging from 55 to 59.1m above the mean sea level. The northwest corner of the Site is approximately 4.1m higher than the southeast corner of the Site in elevation. In general, the subject Site and the surrounding area have a slight to moderate slope towards the south/southeast, see Figure 3.

The nearest surface water body is the Strait of Georgia, which is located approximately 530m to the south of the Site.

[1] Obtained from Land Title
[2] Obtained from Land Title
[3] Obtained from Google Earth™

3.3 GEOLOGY

The surficial sediments in the Site area, as identified by the Geological Survey of Canada[4], are underlain by Vashon Drift and Capilano Sediments with sub-unit "VCb". The Vashon Drift and Capilano Sediments are described as glacial drift including: lodgment and minor flow till, lenses and interbeds of substratified glaciofluvial sand to gravel, and lenses and interbeds of glaciolacustrine laminated stony silt; up to 25m thick; overlain by glaciomarine and marine deposits, normally less than 3m but in places up to 10m thick. Marine derived lag gravel normally less than 1m thick containing marine shell casts has been found mantling till and glaciomarine deposits up to 175m above sea level: above 175m till is mantled by bouldery gravel that may be in part ablation till, in part colluvium, and in part marine. Sub-unit "VCb" is described as bedrock more than 10m below surface.

3.4 SURFACE DRAINAGE AND HYDROGEOLOGY

Precipitation at the un-paved area of the Site would infiltrate locally into the ground surface. Precipitation at the paved area would typically generate surface runoff and discharge into the un-paved area.

Shallow local groundwater can be influenced by many factors such as underground utilities, building foundations, topography and fill material/soil type. Based on the general topography of the Site, WSP infers that the shallow local groundwater at the Site would flow south/southeast following local topography.

3.5 AQUIFERS

The Site is located at an area with one unconsolidated aquifer[5], which is considered to be of low demand and moderate vulnerability and productivity. The following table provides details of the aquifer in the area of the Site.

Table 3-2 Aquifer Characterization

NAME	DESCRIPTION/ LOCATION	MATERIALS	LITHOSTRATOGRAPHIC UNIT	CLASSIFICIATION	SIZE (KM2)	TYPE OF WATER USE	AQ. NO.
49 IIIB(9)	Vancouver-Quadra Sands	Sand and Gravel	Quadra Sands	U-IIIB	195.1	Potential Domestic	49

3.6 FLOOD ZONE POTENTIAL

The ENV and Fraser Basin Council map "Floodplain of the Lower Fraser River, Flood Hazards (copyright 2002)" indicated that the Subject Site is not located within the 100 years and 200 years flood zones. Therefore, there is a low potential for flooding on-site due to surrounding water bodies.

[4] Surficial Geology of Vancouver, British Columbia; Map No. 1486A; Printed 1978; Geological Survey of Canada; Ottawa, Ontario.
[5] BC ENV web site, "Aquifers and Water Wells of BC" aquifer data search.

3.7 PRECIPITATION RECORDS

The nearest inland climate station to the Site is known as “Vancouver Int’l A (N 49°11’42.00”/ W 123°10’55.00”)”. According to Environment Canada Canadian Climate Normals, the 29-year (1981-2010) mean-average annual precipitation for this area is 1189.0 millimetres. The greatest amount of precipitation occurs during the months of November and January, while the driest months are July and August.

The Site is located within the “Coastal Western Hemlock Zone” and is defined in climatic terms by heavy rainfall, cool summers and mild winters.

4 HISTORICAL RECORDS REVIEW

The results of the historical search and records review are summarized in the following sections.

4.1 CITY DIRECTORIES

At the University of British Columbia Library, Rare Books and Special Collections, the Vancouver city directories for the years 1960, 1965, 1970, 1975, 1980, 1985, 1990, 1995 and 2001 were reviewed for the Site and the surrounding properties, within an approximate 300m radius of the Site. The findings of the review of the city directory search for the Site and the surrounding properties are summarized in the following table.

Table 4-1 Summary of City Directory Search Results

CIVIC #	TENANT(S)	LISTED YEARS	DIST. FROM SITE (M)	DIR'N	INFERRED HYDROGEOLOGICAL POSITION
Subject Site					
Nurseries Road					
6075	Not listed	1960 - 2001	-	-	-
Wesbrook Mall					
4004	Not listed M D S Nordion Inc. Triumf Meson Facility of U Alberta University of British Columbia	1960 - 1980 2001 1985 - 2001 2001	-	-	-
Surrounding Properties					
Nurseries Road					
6000 and 6100 Blocks	Not listed	1960 - 2001		-	-
Wesbrook Mall					
4000 Block	Not listed	1960 - 2001		-	-

A review of the city directories indicates that the 4004 Wesbrook Mall portion of the Site was occupied by Triumf Meson Facility of U Alberta from circa 1985 to circa 2001. M D S Nordion Inc. and University of British Columbia were also listed at this portion of the Site circa 2001. The property at 6075 Nurseries Road was not listed in the city directories.

4.2 AERIAL PHOTOGRAPHS

Aerial photographs relevant to the Site and surrounding area dating from 1932, 1938, 1949, 1954, 1963, 1970, 1973, 1977, 1980 and 1986 were obtained from the UBC's Geographic Information Centre. The 1994, 2004 and 2015 aerial photographs obtained from the City of Vancouver online mapping system were also reviewed. Select aerial photographs reviewed by WSP are presented in Appendix C. Features observed at the Site and the surrounding areas in the aerial photographs are summarized in the following table.

Table 4-2 Summary of Reviewed Aerial Photographs

YEAR	SUBJECT SITE	NORTH	SOUTH	EAST	WEST
1932	The Site is covered by dense vegetation.	Land is covered by dense vegetation.	Land is covered by dense vegetation.	Land is covered by dense vegetation.	Land is covered by dense vegetation.
1938	-	-	-	-	-
1949	-	-	-	-	-
1954	-	-	-	-	-
1963	-	-	-	-	-
1970	A roadway is running through the Site from south to north. The area to the west of the roadway is cleared; while the area to the east of the roadway remains vegetated. Several vehicles are parked on-site.	The area to the northwest of the Site is cleared. Buildings are visible farther northwest and north of the Site. The area to the northeast of the Site remains vegetated.	The area to the southwest of the Site is cleared; while the area to the southeast of the Site remains vegetated.	-	Land is cleared.
1973	-	A warehouse building is constructed to the north of the Site.	South Campus Substation is constructed immediately to the southwest of the Site.	-	A building is constructed to the west of the Site.
1977	-	-	-	-	-
1980	Several structures, possibly trailers, are visible at the northern portion of the Site.	-	-	-	-

1986	Additional trailers are present at the northern portion of the Site, which appears to be paved. Outdoor storage is also observed at the paved area. The roadway area on-site and portion of the central portion of the Site appear to be cleared.	-	-	-	Additional buildings are visible to the west of the Site.
1994	One additional trail is visible at the northern portion of the Site.	-	-	-	-
2004	-	-	-	-	-
2015	-	-	-	-	-

Note: "-" Aerial photograph generally similar to the previous photograph

Site

A review of the aerial photographs indicated that the Site is covered by dense vegetation prior to circa 1963. Circa 1970, a roadway was running through the Site from south to north. Circa 1980, the Site was occupied by several trailers and the Site appeared to be used as a storage area. The northern portion of the Site was paved in the mid-1980s. The Site has remained generally similar since 1994.

Surrounding Properties

The surrounding areas were undeveloped and covered by dense vegetation prior to circa 1963. Circa 1970, some surrounding areas to the northwest, southwest and west of the Site were cleared and some buildings (Triumf Facility) were developed to the farther northwest and north of the Site. Circa 1973, additional buildings were constructed in close vicinity of the Site and the South Campus Substation was also developed immediately southwest of the Site. The area to the east of the Site has remained vegetated since at least 1932.

4.3 FIRE INSURANCE PLANS

The 1932, 1954 and 1962 fire insurance plans obtained from the UBC Library Special Collections Division were reviewed by WSP. However, the Site and the surrounding area were not mapped.

4.4 GOVERNMENT RECORDS

4.4.1 UNIVERSITY OF BRITISH COLUMBIA

WSP visited the UBC Infrastructure Development and the Energy & Water Services to obtain information regarding the historical development of the Site on 23 August 2018. Copies of relevant documents collected from the UBC are attached in Appendix D.

Building Permits and Construction Drawings

There are no building permits or construction drawings for the Site available for WSP to review. However, the UBS records indicated that the Triumf Facility was developed in 1970 and the South Campus Substation was developed in 1971.

Water and Sewer Connections

UBC records indicated that water service and sanitary sewer system were connected to both properties and might be available to the subject Site area.

Spills or Leakages

The Energy & Water Services confirmed that there have been no historical spills or leakages from the South Campus Substation.

Zoning

There are no zoning plans or bylaws available within the UBC jurisdiction.

4.4.2 HISTORICAL LAND TITLES

Current land title information for the Site was obtained from West Coast Title Search in New Westminster, BC. The current title indicated that the University of British Columbia has retained the ownership of the Site since at least 2010. Copies of the current land title and legal plan provided by the Client are included in Appendix E.

4.4.3 BC ASSESSMENT RECORD

The BC Assessment Roll Report was obtained using a PID search for the Site. The report is summarized in the following table. A copy of the report is included in Appendix F.

Table 4-3 BC Assessment Summary

PID	MANUAL CLASS	ACTUAL USE	LAND DIMENSION
012-132-896	Non-Manualized Structures	Schools & Universities, College Or Technical Schools	927.903 Acres

Information of an environmentally sensitive nature was not noted in the BC Assessment record for the Site.

4.5 MINISTRY OF ENVIRONMENT AND CLIMATE CHANGE STRATEGY

4.5.1 BC AQUIFER AND WELL DATABASE

The existence and location of groundwater wells near the Site was searched on the BC ENV Water Resources Atlas database. The online database of the Water Management Division of BC ENV indicated that there were no water wells located within 500m radius of the Site boundary. The result of the BC ENV water well search are included in Figure 5, Appendix A.

4.5.2 BC ONLINE SITE REGISTRY SEARCH

A search of the online BC ENV Environmental Site Registry for the Site and surrounding properties within a radius of 500m from the Site was conducted on 20 August 2018. According to the BC ENV Online Site Registry, there are no properties within a 500m radius of the Site which are registered or "listed". The BC Online Site Registry search results are presented Appendix F.

5 INTERVIEWS

Mr. Ken Buckley, the Deputy Associate Laboratory Director - IAMI, was interviewed and he provided the following information:

- He has been familiar with the Site for 31 years.
- Triumf has occupied the property since 1970. Before that, the property was unoccupied. Main activities associated with Triumf is research, which includes the production of ion beams for use in nuclear & particle physics, materials characterisation and radioisotope production.
- The building located immediately to the north of the Site houses the main proton cyclotron, the electron linac, beamlines and support services as well as laboratories.
- The Site is used as a temporary storage yard.
- There is a hazmat building located to the west of the Site where hazardous chemicals & oil are stored.
- He was not aware of the presence of any water wells or septic systems on-site.
- He was not aware of the presence of any UST currently or historically used at the Site.
- He was not aware of any fill material brought onto the Site.
- He was not aware of any landfilling having occurred at the Site.
- He was not aware of any waste disposal areas at the Site or any environmentally sensitive issues.
- He was not aware of any third party notification letters issued by the owners of the surrounding properties.

6 SITE RECONNAISSANCE

Ms. Jenny Liu, B.Eng. of WSP completed a Site and surrounding area reconnaissance on 23 August 2018. The Site reconnaissance consisted of a walk-through to observe conditions at accessible areas onsite.

During the Site visit, WSP used a checklist to identify the presence of possible sources of contamination at the Site. A copy of the checklist, completed during the Site visit, is attached in Appendix G. Selected photographs taken during the Site visit are presented in Appendix B. Observations and on-site conditions recorded during the Site visit are discussed in the following sections.

6.1 SUBJECT SITE

Site Description

— The subject Site (which is irregular in shape) was located within the Triumf Facility and South Campus Substation within the UBC jurisdiction, BC.

— The north portion of the Site was accessible from Nurseries Road, which was located approximately 130m to the west of the Site. The south portion of the Site was accessible from Imperial Trail, which was located approximately 80m to the south of the Site.

— The Site and the surrounding area have a slope towards the south/southeast.

Site Buildings and Uncovered Areas

— During the Site visit, the northern portion of the Site, which was situated at the 4004 Wesbrook Mall, was fence-linked and occupied by two office trailers, a trailer housing fridges, a marquee used for storage of recycling materials and several cargo containers for temporary storage purposes. The remainder of this portion was asphalt-paved.

— The southern portion of the Site, which was situated at 6075 Nurseries Road, was vacant and covered by vegetation.

— A roadway was located at the eastern portion of the Site.

— The northern portion of the Site (i.e., 4004 Wesbrook Mall) was approximately 2 to 4m higher in elevation than the remainder area of the Site.

Aboveground and Underground Storage Tanks

— WSP did not observe any ASTs or indications of USTs at the Site (such as vent lines or fill pipes).

Air and Water Discharges

— No issues regarding any air discharges were identified at the time of the Site reconnaissance.

— Water discharge on-site is limited to surface run-off, which is expected to infiltrate locally into the ground surface, pond at the depressions, or evaporate.

Non-Hazardous Waste Generation, Storage and Disposal

— The Site generates non-hazardous waste and recyclables. The non-hazardous waste was stored in the bins which was removed offsite as needed.

Hazardous Waste Generation, Storage, Handling and Disposal

— No hazardous waste was observed to be generated, stored, and handled on-site during the Site visit.

Chemical Storage and Handling

— No chemicals were observed to be stored or handled on-site during the Site visit.

Spill and Stain Areas

— No spills or stained areas of a potential environmental concern were observed at any of the areas visited at the Site.

Soils and Fills

— The 4004 Wesbrook Mall portion of the Site was approximately 2 to 4m higher in elevation than the remainder area of the Site, which indicated that fill materials have been brought onto this area. The source and quality of the fill material was unknown.

Radon Gas

— The Ministry of Health[6] has completed a regional study of radon in buildings in British Columbia. The results of the study indicated that radon is not typically a concern in the Lower Mainland and in the Coastal Region of British Columbia. Greater concern with respect to radon geographically starts in areas east of Hope, British Columbia (especially the Okanagan Valley and West Kootenays). WSP, therefore, does not expect radon gas to be an environmental issue at the Site.

Methane Gas

— WSP did not observe any substantial areas of organic landfilling on-site during the Site visit. Therefore, there is a low potential that methane gas is an environmental issue at the Site.

6.1.1 HAZARDOUS BUILDING MATERIALS

Based on the visual observation, there is a low potential for hazardous building materials to be present on-site. Detailed background information of hazardous building materials is included in Appendix H.

[6] Memorandum; Dated 8 December 1992; Mr. Brian Phillips, Director, Radiation Protection Services Branch; Ministry of Health; Burnaby, British Columbia.

6.2 SURROUNDING PROPERTIES

During the 23 August 2018 Site visit, WSP conducted a reconnaissance of the surrounding area. WSP observed and photographed the surrounding properties from either the Site or from areas accessible to the public. Figure 5, Appendix A, and Site Photographs, Appendix B, show various features of the surrounding area.

The Site and surrounding area are situated within the UBC jurisdiction. Areas to the north and west of the Site were occupied by Triumf Facility. A hazardous material storage building, which was used for storage of chemicals and oils, for the Triumf Facility was located immediately to the west of the Site, where oil stain was observed on the asphalt-paved ground surface. To the east of the Site, across the roadway, was Pacific Spirit Regional Park. South Campus Substation was located immediately southwest of the Site. South Campus Materials Recovery Facility was located farther southwest.

7 SUMMARY OF HISTORICAL SITE AND AREA DEVELOPMENT

Based on the review of historical records, Site visit and interview information, WSP inferred the following historical Site and area development.

7.1 SITE DEVELOPMENT

The Site was covered by dense vegetation and was undeveloped prior to circa 1963. Circa 1970, a roadway was running through the Site from south to north. The northern portion of the Site has been occupied by Triumf Facility and used as a temporary storage yard with several trailers present since circa 1980. The remainder of the Site area has remained vegetated and unoccupied.

7.2 SURROUNDING AREA DEVELOPMENT

The surrounding areas were undeveloped and covered by dense vegetation prior to circa 1963. Circa 1970, Triumf Facility were developed at the surrounding areas to the northwest, southwest and west of the Site with some buildings present to the farther northwest and north of the Site. Circa 1973, additional buildings were constructed in close vicinity of the Site and the South Campus Substation was also developed immediately southwest of the Site. The area to the east of the Site has remained vegetated since at least 1932.

8 APPLICABLE STANDARDS

No zoning information was available from the UBC jurisdiction. We understand that a new Institute for Advanced Medical Isotopes, which consists of totalling 4 storeys, is proposed to be constructed on the Site in the foreseeable future. Therefore, the BC CSR soil standards for High Density Residential Land Use (RL_{HD}) will apply. For soil classification/disposal purposes, the BC Hazard Waste Regulation (HWR) standards/criteria would also apply to the Site. Site-specific factors that would apply at the Site are outlined in the following table.

Table 8-1 Applicable Regulatory Standards

SITE SPECIFIC FACTORS	APPLICABILITY	RATIONALE
Intake of contaminated soil	Yes	Applicable at all sites.
Groundwater used for drinking water (DW)	Yes	The drinking water standards are applicable at all sites unless the underlying aquifers' hydraulic conductivity, quality and/or yield proves that it is not capable of being a drinking water source.
Toxicity to soil invertebrates and plants	Yes	Applicable at all sites.
Groundwater flow to surface water used by marine aquatic life (AWm) or freshwater aquatic life (AWf)	No	No surface water body located within 500m of the Site.
Groundwater used for livestock watering (LW)	No	No livestock watering wells located within 500m of the Site.
Groundwater used for irrigation (IW)	No	No irrigation water wells located within 500m of the Site.

Therefore, the following standards apply to the Site based on proposed future land use:

Soil

- CSR RL_{HD} standards

  Site Specific factors include:

  - Intake of contaminated soil;
  - Toxicity to soil invertebrates and plants; and
  - Groundwater used for drinking water

Groundwater

- CSR Drinking Water (DW)

Soil Vapour

- CSR RL standards

9 AREAS OF POTENTIAL ENVIRONMENTAL CONCERN

Upon review of the historical information for the Site and surrounding area and current conditions, WSP identified two on-site and two offsite areas of potential environmental concern. A summary of the identified APECs and associated PCOCs in soil and groundwater is provided in the following table. The locations of the APECs are shown on Figure 6, Appendix A.

Table 9-1 Summary of Identified APECs and PCOCs

APEC NO.	APEC DESCRIPTION	REGULATED PCOCS IN SOIL/GROUNDWATER	REGULATED PCOCS IN SOIL VAPOUR
APEC #1 (On-site)	The 4004 Wesbrook Mall portion of the Site, where fill materials have been placed. The source and quality of the fill materials were unknown and needs to be characterized. Environmental risk: Low to moderate	Metals*	*
APEC #2 (On-site)	The current and historical roadway area on-site, where fill material might have been brought onto and placed. The source and quality of the fill materials were unknown and needs to be characterized. Environmental risk: Low to moderate	Metals*	*
APEC #3 (Offsite)	The area along the western Site boundary at the 4004 Wesbrook Mall portion of the Site, which might have been impacted by the hazardous materials stored within and near the Hazmat storage building. Environmental risk: Low to moderate	Metals, LEPH, HEPH, PAHs, VPHs, VOCs and PCBs	Naphthalene, VPHs and VOCs
APEC #4 (Offsite)	The area along the southwest Site boundary at the 6075 Nurseries Road portion of the Site, which might have been impacted by the South Campus Substation. This substation has been developed in 1971 and is located up-gradient of the Site. Environmental risk: Low to moderate	Metals, LEPH, HEPH, PAHs, VPHs, VOCs and PCBs	Naphthalene, VPHs and VOCs

*Additional PCOCs may be identified depending on field observation.

Notes

LEPH/HEPH	Light / heavy extractable petroleum hydrocarbons
PAHs	Polycyclic aromatic hydrocarbons
PCBs	Polychlorinated Biphenyls
VPHs	Volatile petroleum hydrocarbons
VOCs	Volatile organic compounds

10 CONCLUSIONS

From information gathered to date, WSP concluded the following:

1 Based on our historical records review, interview information and Site reconnaissance, WSP identified two on-site and two offsite areas of potential environmental concern (APECs #1 through 4) that are considered to pose a low to moderate potential to adversely impact the environmental condition at the Site.

11 RECOMMENDATIONS

Based on the available information and current Site conditions, the following is recommended:

1. Based on WSP's Phase I ESA findings, an intrusive subsurface investigation in the form of a Phase II ESA is recommended at the Site to confirm or refute the presence of PCOCs in the subsurface media related to the identified on-site and offsite APECs.
2. If any hidden source(s) of contamination or any suspected/odorous soils are discovered during future redevelopment, WSP should be contacted prior to the source removal to initiate contaminant characterization.

12 PROFESSIONAL STATEMENT

As required under Part 16, Section 63 of the "Environmental Management Act", Contaminated Sites Regulations (CSR, BC Reg. 375/96 including amendments up to BC Reg. 253/2016, November 1, 2017), WSP confirms that:

1. The Site investigation report has been prepared in accordance with the requirements of the Act and its regulations, policies, procedures and protocols; and
2. The person(s) signing this report has (have) demonstrable experience in conducting investigations of this type and are familiar with the investigation completed at the Site.

13 CLOSURE

No environmental site assessment or investigation can wholly eliminate uncertainty regarding the potential for recognized environmental conditions in connection with a site. Performance of a standardized preliminary site investigation protocol is intended to reduce, but not eliminate, uncertainty regarding the potential for recognized environmental conditions in connection with the Site, given reasonable limits of time and cost.

This report has been prepared by WSP Canada Inc. (WSP) exclusively for Architecture 49 Inc. and is intended to provide an assessment for potential presence of contamination at the Site. The conclusions made in this report reflect WSP's best judgement in light of the information available at the time of writing this report. No other warranty, expressed or implied, is made. Any use which a third party makes of this report, or any reliance on or decisions to be made or actions based on this report, are the responsibility of such third parties. WSP accepts no responsibility for damages, if any, suffered by a third party as a result of decisions made or actions based on this report. The standard limitations of this report are specified in Section 14.

14 STANDARD LIMITATIONS

1 The findings and conclusions documented in this Report have been prepared for specific application to this Project and have been developed in a manner consistent with that level of care normally exercised by environmental professionals currently practicing under similar conditions in the area.

2 The findings of this Report are based solely on data collected on Site during this investigation and pertain only to the locations that have been investigated and on the conditions of the Site during the completion of the work and services. WSP Canada Inc. has relied on good faith on information provided by individuals and sources noted in the Report. No other warranty, expressed or implied, is made.

3 If new information is developed in future work that affects the conclusions of this Report, WSP Canada Inc. should be contacted to re-evaluate the conclusions of this Report and provide amendments as required.

4 The service provided by WSP Canada Inc. in completing this Report is intended to assist the Client in a business decision. The liability of the Site is not transferred to WSP Canada Inc. as a result of such work and services, and WSP Canada Inc. does not make recommendation regarding the purchase, sale, or investment in the property.

5 This document is intended for the exclusive use of Architecture 49 Inc., for whom it has been prepared. WSP does not accept responsibility to any third party for the use of information presented in this Report, or decisions made or actions taken based on its content.

6 The information presented in this Report is based on, and limited by, the circumstances and conditions acknowledged herein, and on information available at the time of its preparation. WSP has exercised reasonable skill, care, and diligence to assess the information acquired during the preparation of this Report, but cannot guarantee or warrant the accuracy or completeness of the information. Information provided by others, whether represented or otherwise utilized, is believed to be accurate but cannot be guaranteed.

7 The report intended to be used in their entirety. No excerpts may be taken to be representative of the findings in the assessment / investigation.

8 The Report may not be reproduced in whole or in part, except as required by your accountants, regulators or legal advisors, without our prior written consent. In any event, the Report shall be provided in its entirety.

9 This report is not assignable and does not confer any right or benefit upon any third party unless written agreement is made between WSP and the third party. We accept no responsibility for any loss or damage suffered by a third party as a result of decisions made or actions based on the Report. In the event that a third party has a concern about the Property and seeks a report upon which it may rely, it is obligated to hire an environmental consultant at its own cost.

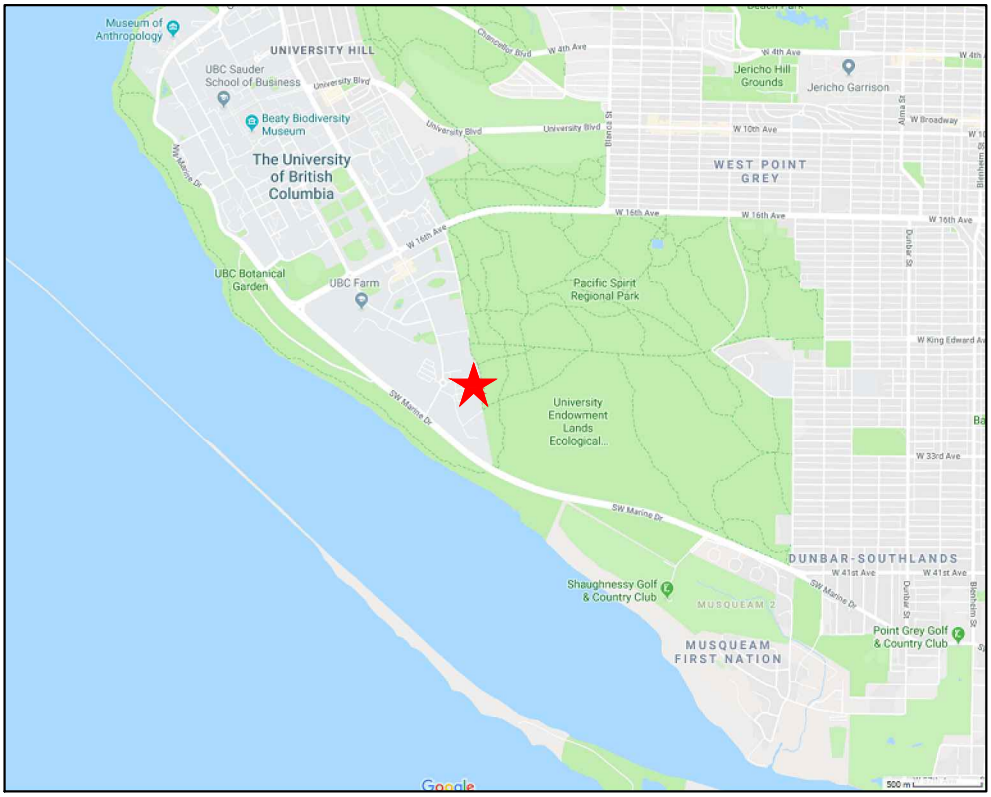
REFERENCES

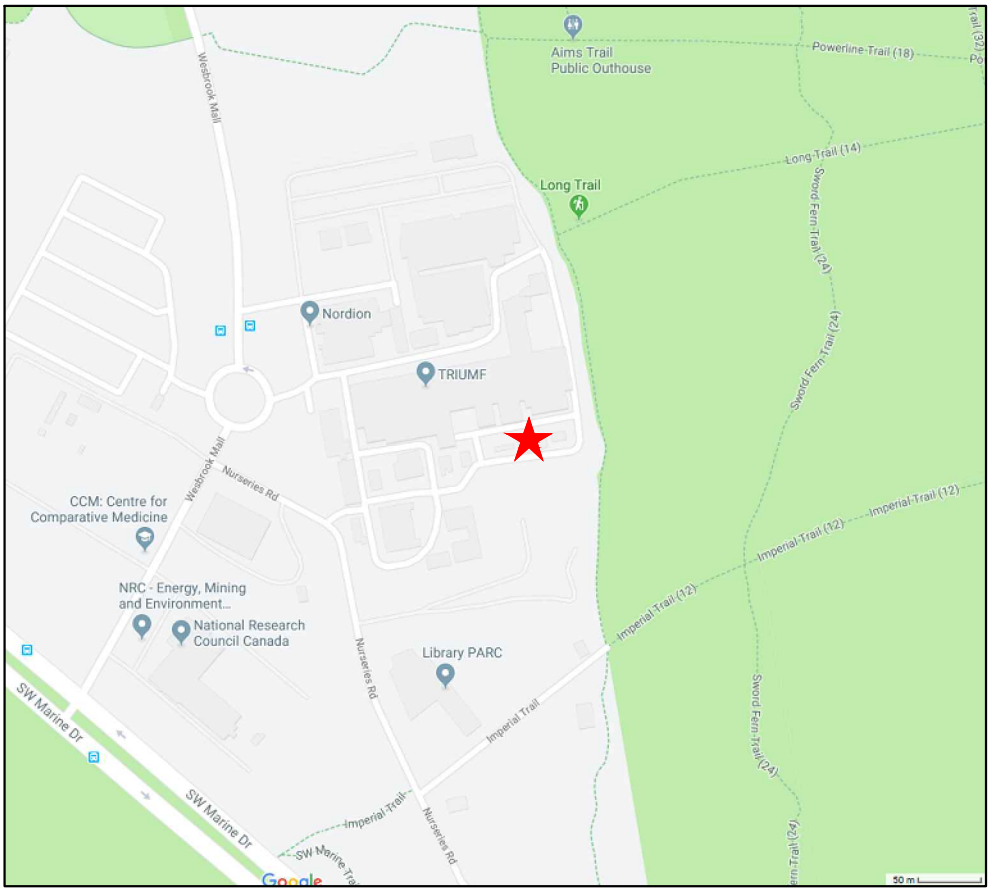
Other sources of information that contributed to this investigation were:

1 Contaminated Sites Regulation (CSR, BC Reg. 375/96 including Omnibus Stage 10 and 11 Amendments (BC Reg. 253/2016, November 1, 2017), effective 1 April 1997. British Columbia Ministry of Environment and Climate Change Strategy, Victoria, British Columbia.

APPENDIX

A FIGURES





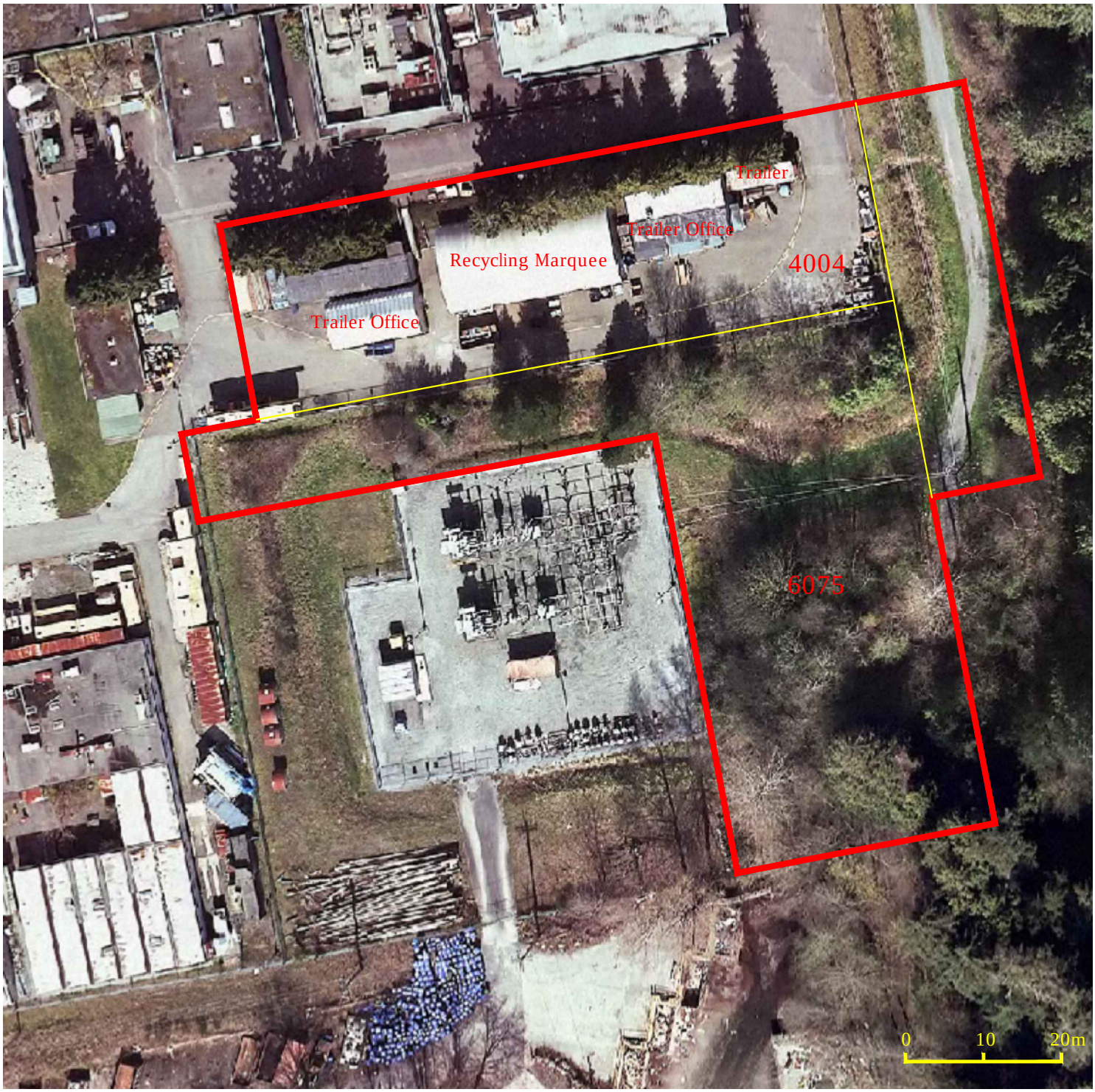
LEGEND

★ – SUBJECT SITE

WSP CANADA INC. #100 - 20339 96 AVENUE, LANGLEY, BC V1M 0E4 PHONE: 604 533-2992 - FAX: 604 533-0768 - WWW.WSP.COM	TITLE:	Site Location Map	DES. / DR. JL
	PROJECT:	Phase I Environmental Site Assessment Portions of 4004 Wesbrook Mall and 6075 Nurseries Road Vancouver, BC	CH. / SCALE AS SHOWN
	CLIENT:	Architecture 49 Inc.	APP. / DATE SEP 2018
			FILE NO. 189-00175-02
			DWG. NO. FIGURE 1

LEGEND

– SUBJECT SITE



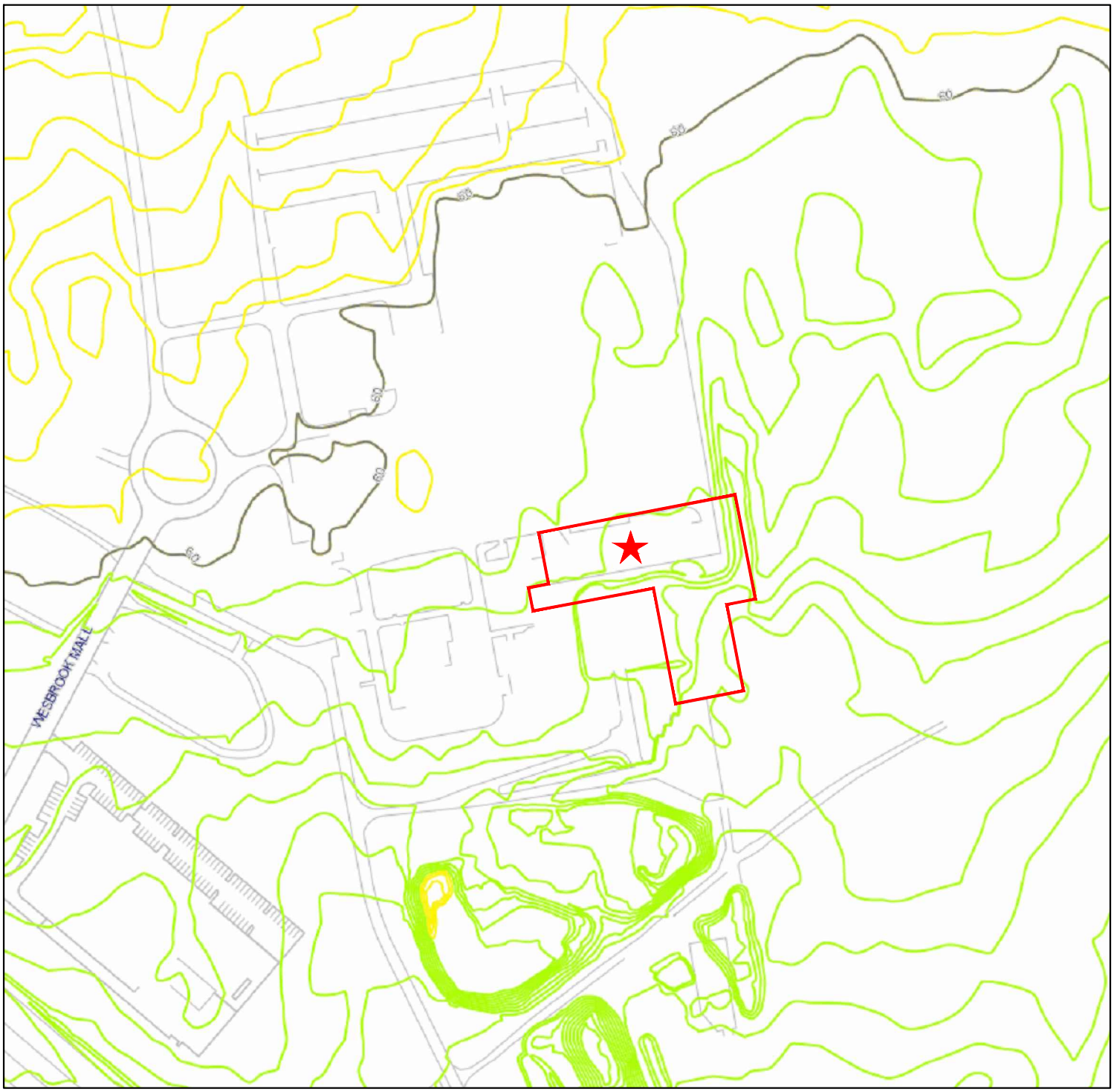
WSP CANADA INC.
#100 - 20339 96 AVENUE, LANGLEY, BC V1M 0E4
PHONE: 604 533-2992 - FAX: 604 533-0768 - WWW.WSP.COM

TITLE: Site Plan

PROJECT: Phase I Environmental Site Assessment
Portions of 4004 Wesbrook Mall and 6075 Nurseries Road
Vancouver, BC

CLIENT: Architecture 49 Inc.

DES.	DR. JL
CH.	SCALE AS SHOWN
APP.	DATE SEP 2018
FILE NO. 189-00175-02	
DWG. NO. FIGURE 2	



WSP

WSP CANADA INC.
#100 - 20339 96 AVENUE, LANGLEY, BC V1M 0E4
PHONE: 604 533-2992 - FAX: 604 533-0768 - WWW.WSP.COM

TITLE: Topography Map of the Site and Surrounding Area

PROJECT: Phase I Environmental Site Assessment
Portions of 4004 Wesbrook Mall and 6075 Nurseries Road
Vancouver, BC

CLIENT: Architecture 49 Inc.

DES.	DR. JL
CH.	SCALE AS SHOWN
APP.	DATE SEP 2018
FILE NO. 189-00175-02	
DWG. NO. FIGURE 3	

WSP CANADA INC.
#100 - 20339 96 AVENUE, LANGLEY, BC V1M 0E4
PHONE: 604 533-2992 - FAX: 604 533-0768 - WWW.WSP.COM

TITLE: Water Well Search Results

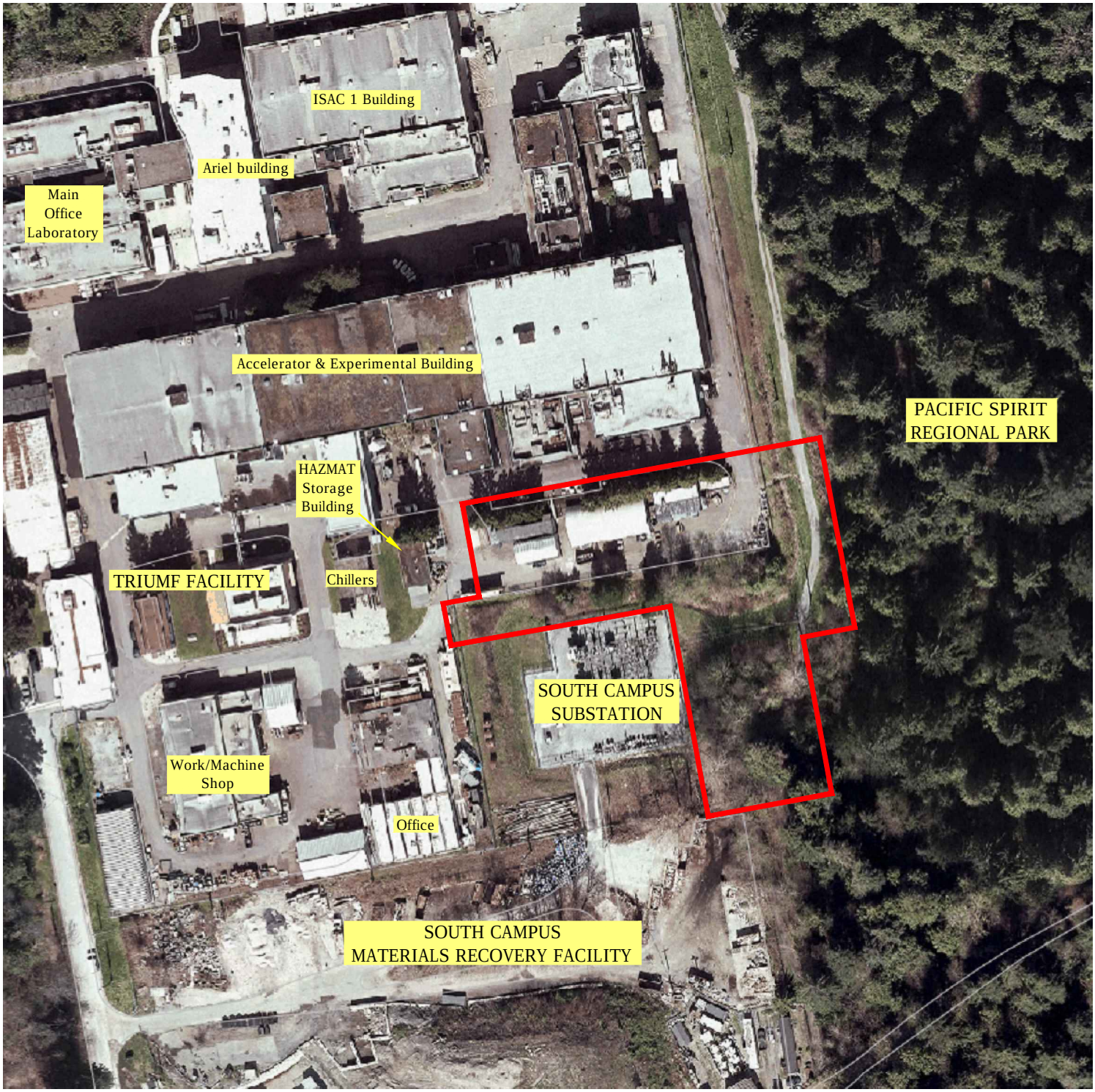
PROJECT: Phase I Environmental Site Assessment
Portions of 4004 Wesbrook Mall and 6075 Nurseries Road
Vancouver, BC

CLIENT: Architecture 49 Inc.

DES.	DR. JL
CH.	SCALE AS SHOWN
APP.	DATE SEP 2018
FILE NO. 189-00175-02	
DWG. NO. FIGURE 4	

LEGEND

– SUBJECT SITE



WSP CANADA INC.
#100 - 20339 96 AVENUE, LANGLEY, BC V1M 0E4
PHONE: 604 533-2992 - FAX: 604 533-0768 - WWW.WSP.COM

TITLE: Surrounding Land Use

PROJECT: Phase I Environmental Site Assessment
Portions of 4004 Wesbrook Mall and 6075 Nurseries Road
Vancouver, BC

CLIENT: Architecture 49 Inc.

DES.	DR. JL
CH.	SCALE AS SHOWN
APP.	DATE SEP 2018
FILE NO. 189-00175-02	
DWG. NO. FIGURE 5	

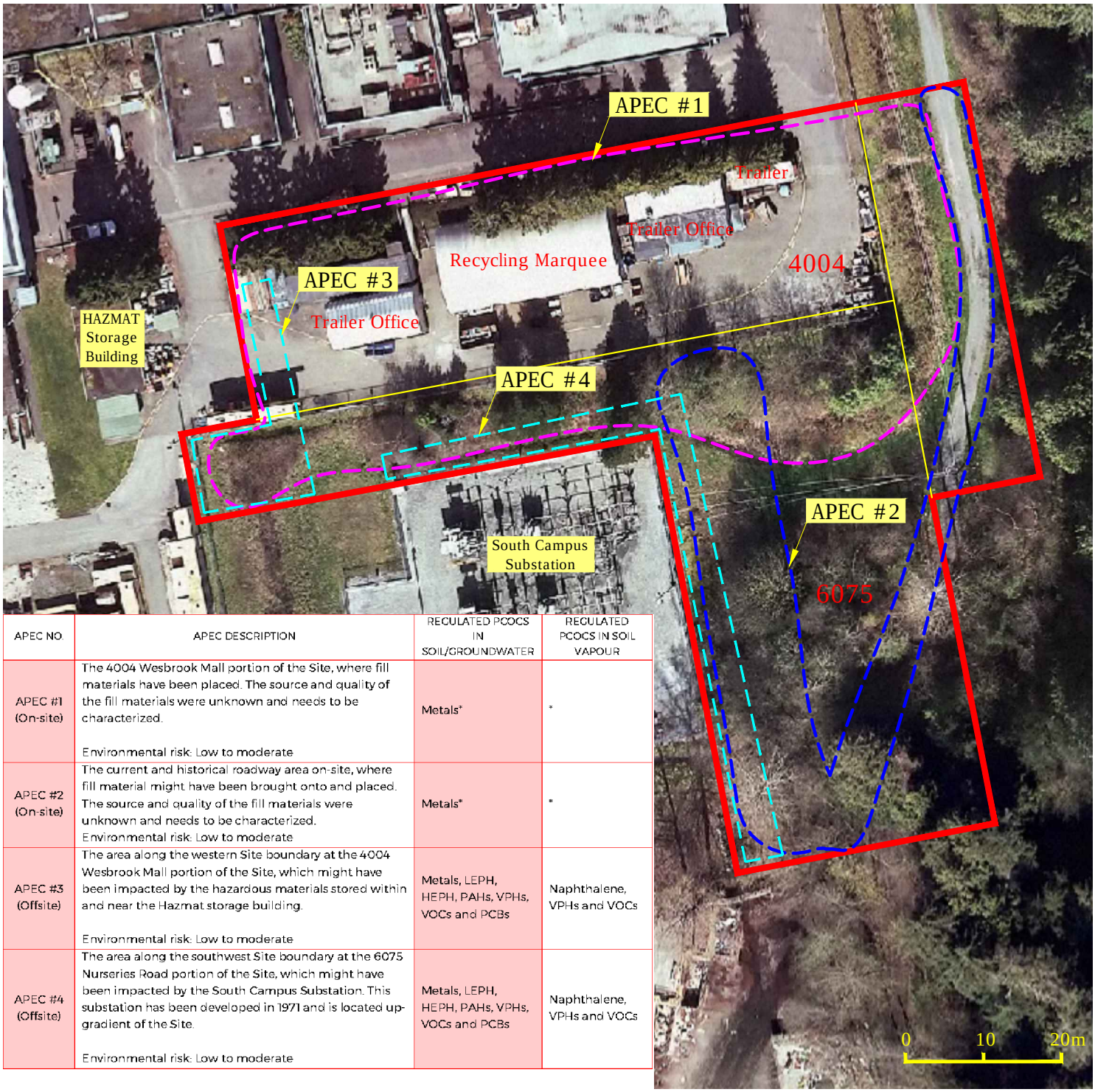
LEGEND

— SUBJECT SITE

— APEC #1

— APEC #2

— APEC #3 & 4



APEC NO.	APEC DESCRIPTION	REGULATED PCOCS IN SOIL/GROUNDWATER	REGULATED PCOCS IN SOIL VAPOUR
APEC #1 (On-site)	The 4004 Wesbrook Mall portion of the Site, where fill materials have been placed. The source and quality of the fill materials were unknown and needs to be characterized. Environmental risk: Low to moderate	Metals*	*
APEC #2 (On-site)	The current and historical roadway area on-site, where fill material might have been brought onto and placed. The source and quality of the fill materials were unknown and needs to be characterized. Environmental risk: Low to moderate	Metals*	*
APEC #3 (Offsite)	The area along the western Site boundary at the 4004 Wesbrook Mall portion of the Site, which might have been impacted by the hazardous materials stored within and near the Hazmat storage building. Environmental risk: Low to moderate	Metals, LEPH, HEPH, PAHs, VPHs, VOCs and PCBs	Naphthalene, VPHs and VOCs
APEC #4 (Offsite)	The area along the southwest Site boundary at the 6075 Nurseries Road portion of the Site, which might have been impacted by the South Campus Substation. This substation has been developed in 1971 and is located up-gradient of the Site. Environmental risk: Low to moderate	Metals, LEPH, HEPH, PAHs, VPHs, VOCs and PCBs	Naphthalene, VPHs and VOCs

WSP CANADA INC.
#100 - 20339 96 AVENUE, LANGLEY, BC V1M 0E4
PHONE: 604 533-2992 - FAX: 604 533-0768 - WWW.WSP.COM

TITLE: Site Plan showing APECs and PCOCs

PROJECT: Phase I Environmental Site Assessment
Portions of 4004 Wesbrook Mall and 6075 Nurseries Road
Vancouver, BC

CLIENT: Architecture 49 Inc.

DES.	DR. JL
CH.	SCALE AS SHOWN
APP.	DATE SEP 2018
FILE NO. 189-00175-02	
DWG. NO. FIGURE 6	

APPENDIX

B PHOTOGRAPHS

Photograph 1: View of the northern portion of the Site, looking east near the western Site boundary.

Photograph 2: View of the southern portion of the Site, looking south near the property line between 4004 Wesbrook Mall and 6075 Nurseries Road.

Photograph 3: View of the roadway at the eastern portion of the Site, looking south from the northeast corner of the Site.

Photograph 4: A slope near the roadway at the eastern portion of the Site, which indicates that fill materials have been brought onto the Site.

Photograph 5: View of the recycling marquee on-site.

Photograph 6: View of the structures at the northern portion of the Site.

Photograph 7: Typical view inside of one trailer on-site.

Photograph 8: View of the hazardous materials storage building located to the west of the Site.

Photograph 9: View of the chiller system located to the west of the Site.

Photograph 10: View of the buildings located to the west of the Site.

Photograph 11: View of the South Campus Substation located immediately to the southwest of the Site.

Photograph 12: View of the South Campus Material Recovery Facility Substation located to the south of the Site.

Photograph 13: View of the roadway to the north of the Site, looking north from the northeast corner of the Site.

Photograph 14: View of the Accelerator & Experimental Building located to the north of the Site.

APPENDIX

C AERIAL PHOTOGRAPHS

LEGEND

– SUBJECT SITE

WSP CANADA INC.
#100 - 20339 96 AVENUE, LANGLEY, BC V1M 0E4
PHONE: 604 533-2992 - FAX: 604 533-0768 - WWW.WSP.COM

TITLE:	Aerial Photograph - 1963
PROJECT:	Phase I Environmental Site Assessment Portions of 4004 Wesbrook Mall and 6075 Nurseries Road Vancouver, BC
CLIENT:	Architecture 49 Inc.

DES.	DR. JL
CH.	SCALE NTS
APP.	DATE SEP 2018
FILE NO.	189-00175-02
DWG. NO.	AP-1963

LEGEND

– SUBJECT SITE

WSP CANADA INC.
#100 - 20339 96 AVENUE, LANGLEY, BC V1M 0E4
PHONE: 604 533-2992 - FAX: 604 533-0768 - WWW.WSP.COM

TITLE: Aerial Photograph - 1970

PROJECT: Phase I Environmental Site Assessment
Portions of 4004 Wesbrook Mall and 6075 Nurseries Road
Vancouver, BC

CLIENT: Architecture 49 Inc.

DES.	DR. JL
CH.	SCALE NTS
APP.	DATE SEP 2018
FILE NO. 189-00175-02	
DWG. NO. AP-1970	

LEGEND

– SUBJECT SITE

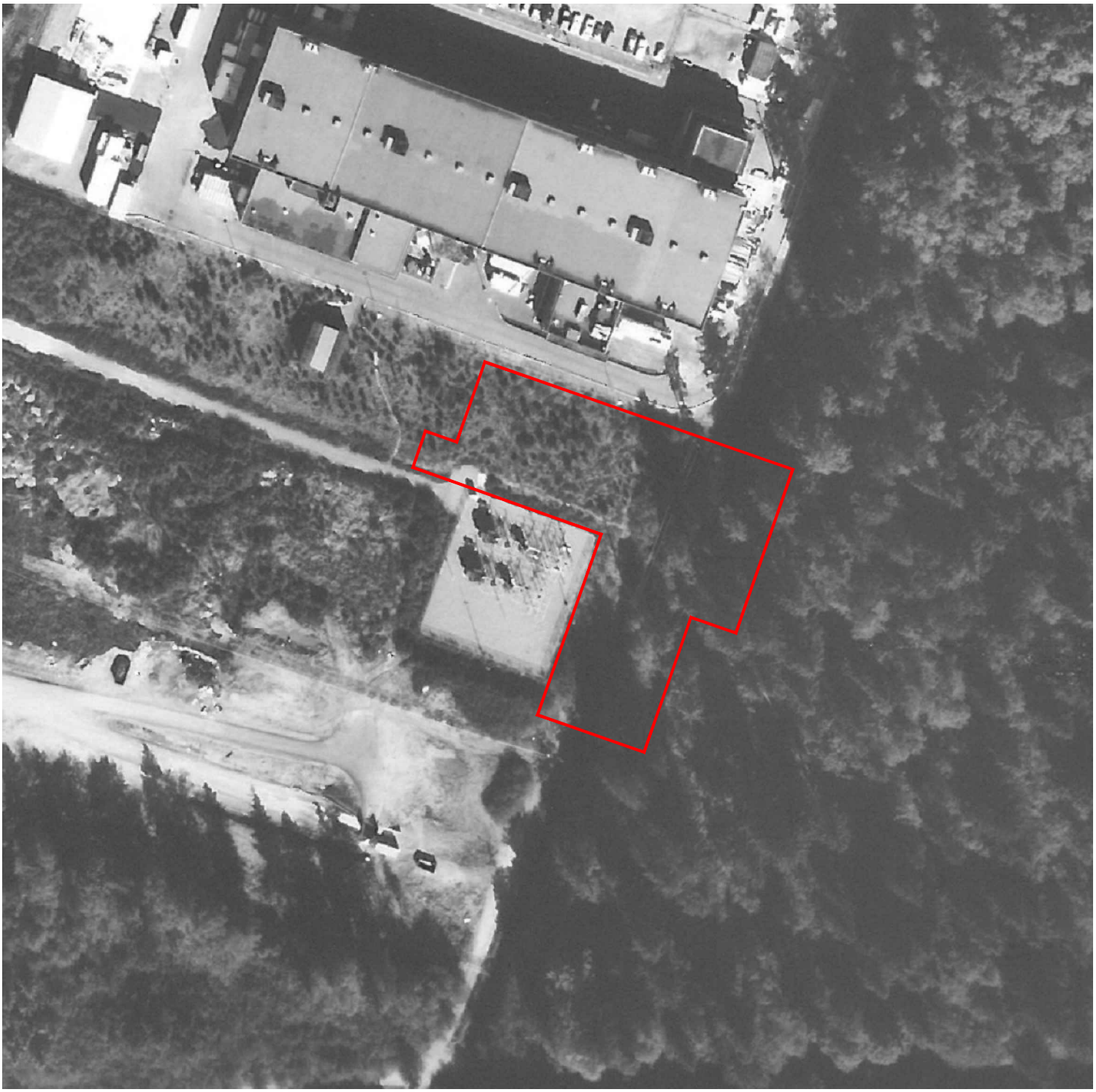
WSP CANADA INC.
#100 - 20339 96 AVENUE, LANGLEY, BC V1M 0E4
PHONE: 604 533-2992 - FAX: 604 533-0768 - WWW.WSP.COM

TITLE:	Aerial Photograph - 1973
PROJECT:	Phase I Environmental Site Assessment Portions of 4004 Wesbrook Mall and 6075 Nurseries Road Vancouver, BC
CLIENT:	Architecture 49 Inc.

DES.	DR. JL
CH.	SCALE NTS
APP.	DATE SEP 2018
FILE NO.	189-00175-02
DWG. NO.	AP-1973

LEGEND

– SUBJECT SITE



WSP CANADA INC.
#100 - 20339 96 AVENUE, LANGLEY, BC V1M 0E4
PHONE: 604 533-2992 - FAX: 604 533-0768 - WWW.WSP.COM

TITLE: Aerial Photograph - 1977

PROJECT: Phase I Environmental Site Assessment
Portions of 4004 Wesbrook Mall and 6075 Nurseries Road
Vancouver, BC

CLIENT: Architecture 49 Inc.

DES.	DR. JL
CH.	SCALE NTS
APP.	DATE SEP 2018
FILE NO. 189-00175-02	
DWG. NO. AP-1977	

LEGEND

– SUBJECT SITE

WSP CANADA INC.
#100 - 20339 96 AVENUE, LANGLEY, BC V1M 0E4
PHONE: 604 533-2992 - FAX: 604 533-0768 - WWW.WSP.COM

TITLE: Aerial Photograph - 1980

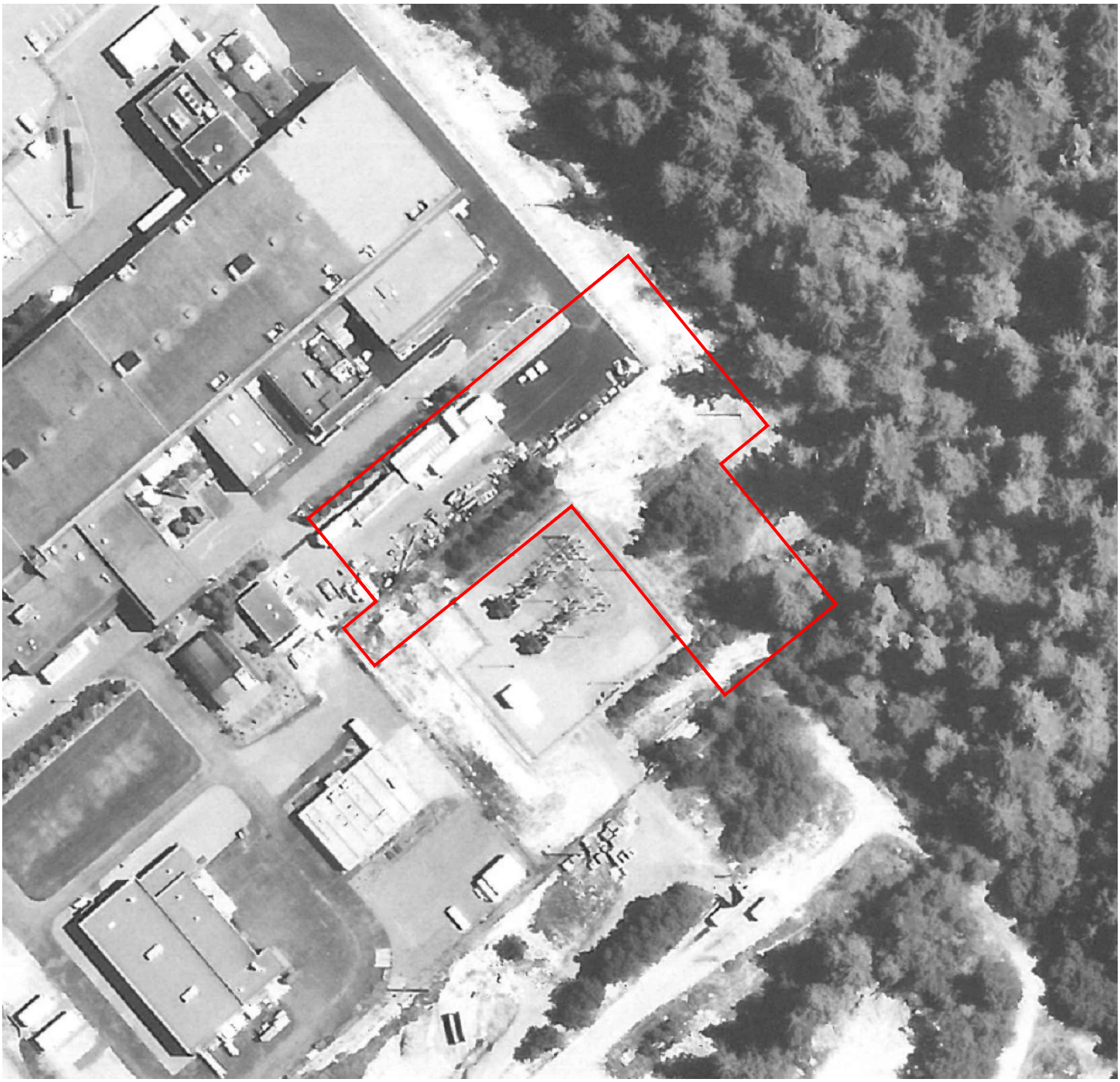
PROJECT: Phase I Environmental Site Assessment
Portions of 4004 Wesbrook Mall and 6075 Nurseries Road
Vancouver, BC

CLIENT: Architecture 49 Inc.

DES.	DR. JL
CH.	SCALE NTS
APP.	DATE SEP 2018
FILE NO. 189-00175-02	
DWG. NO. AP-1980	

LEGEND

– SUBJECT SITE



TITLE:	Aerial Photograph - 1986	DES.	DR. JL
PROJECT:	Phase I Environmental Site Assessment Portions of 4004 Wesbrook Mall and 6075 Nurseries Road Vancouver, BC	CH.	SCALE NTS
		APP.	DATE SEP 2018
CLIENT:	Architecture 49 Inc.	FILE NO.	189-00175-02
		DWG. NO.	AP-1986

WSP CANADA INC.
#100 - 20339 96 AVENUE, LANGLEY, BC V1M 0E4
PHONE: 604 533-2992 - FAX: 604 533-0768 - WWW.WSP.COM

LEGEND

– SUBJECT SITE

WSP CANADA INC.
#100 - 20339 96 AVENUE, LANGLEY, BC V1M 0E4
PHONE: 604 533-2992 - FAX: 604 533-0768 - WWW.WSP.COM

TITLE: Aerial Photograph - 1994

PROJECT: Phase I Environmental Site Assessment
Portions of 4004 Wesbrook Mall and 6075 Nurseries Road
Vancouver, BC

CLIENT: Architecture 49 Inc.

DES.	DR. JL
CH.	SCALE NTS
APP.	DATE SEP 2018
FILE NO. 189-00175-02	
DWG. NO. AP-1994	

LEGEND

– SUBJECT SITE

WSP CANADA INC.
#100 - 20339 96 AVENUE, LANGLEY, BC V1M 0E4
PHONE: 604 533-2992 - FAX: 604 533-0768 - WWW.WSP.COM

TITLE:	Aerial Photograph - 2004
PROJECT:	Phase I Environmental Site Assessment Portions of 4004 Wesbrook Mall and 6075 Nurseries Road Vancouver, BC
CLIENT:	Architecture 49 Inc.

DES.	DR. JL
CH.	SCALE NTS
APP.	DATE SEP 2018
FILE NO.	189-00175-02
DWG. NO.	AP-2004

LEGEND

– SUBJECT SITE

WSP CANADA INC.
#100 - 20339 96 AVENUE, LANGLEY, BC V1M 0E4
PHONE: 604 533-2992 - FAX: 604 533-0768 - WWW.WSP.COM

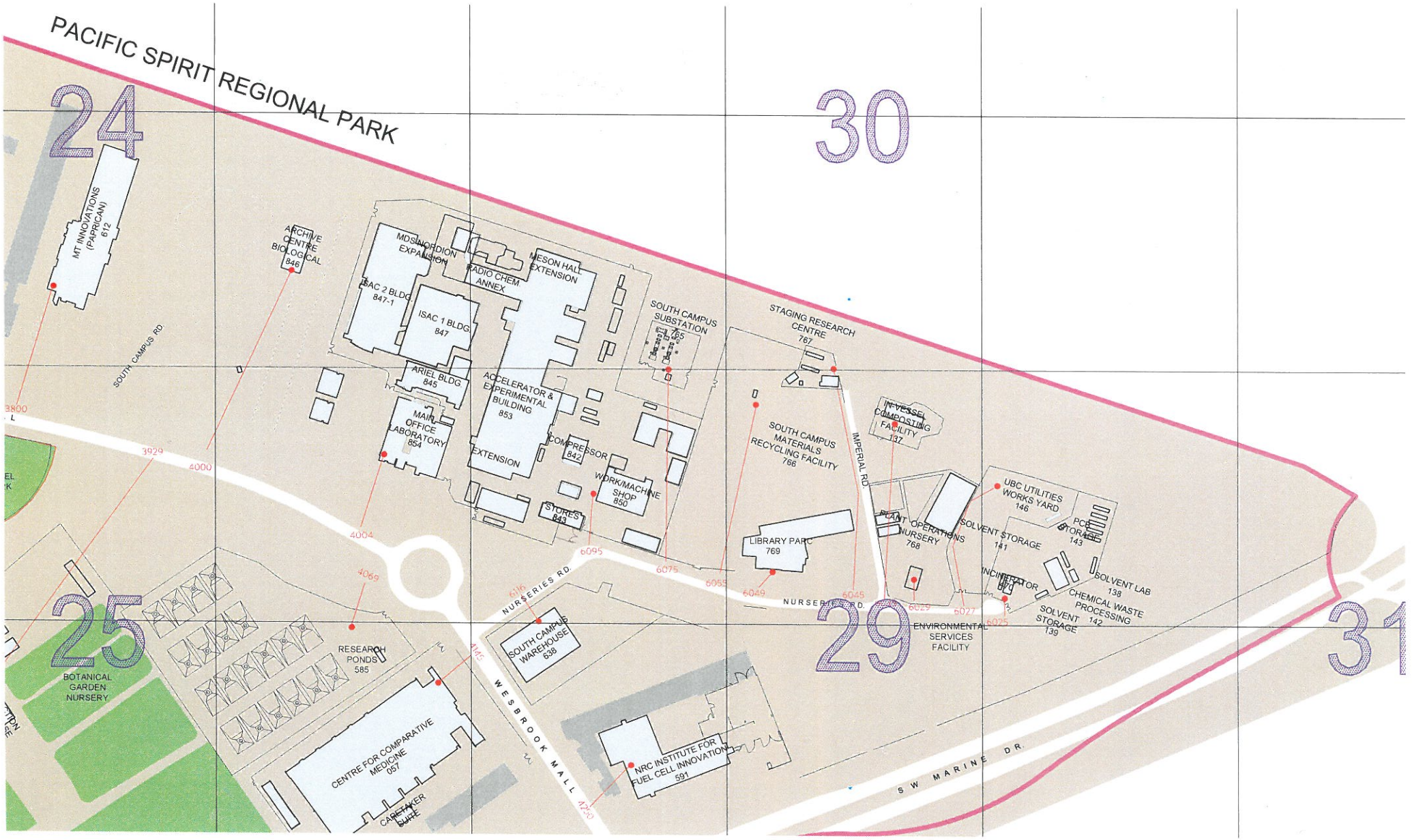
TITLE:	Aerial Photograph - 2015
PROJECT:	Phase I Environmental Site Assessment Portions of 4004 Wesbrook Mall and 6075 Nurseries Road Vancouver, BC
CLIENT:	Architecture 49 Inc.

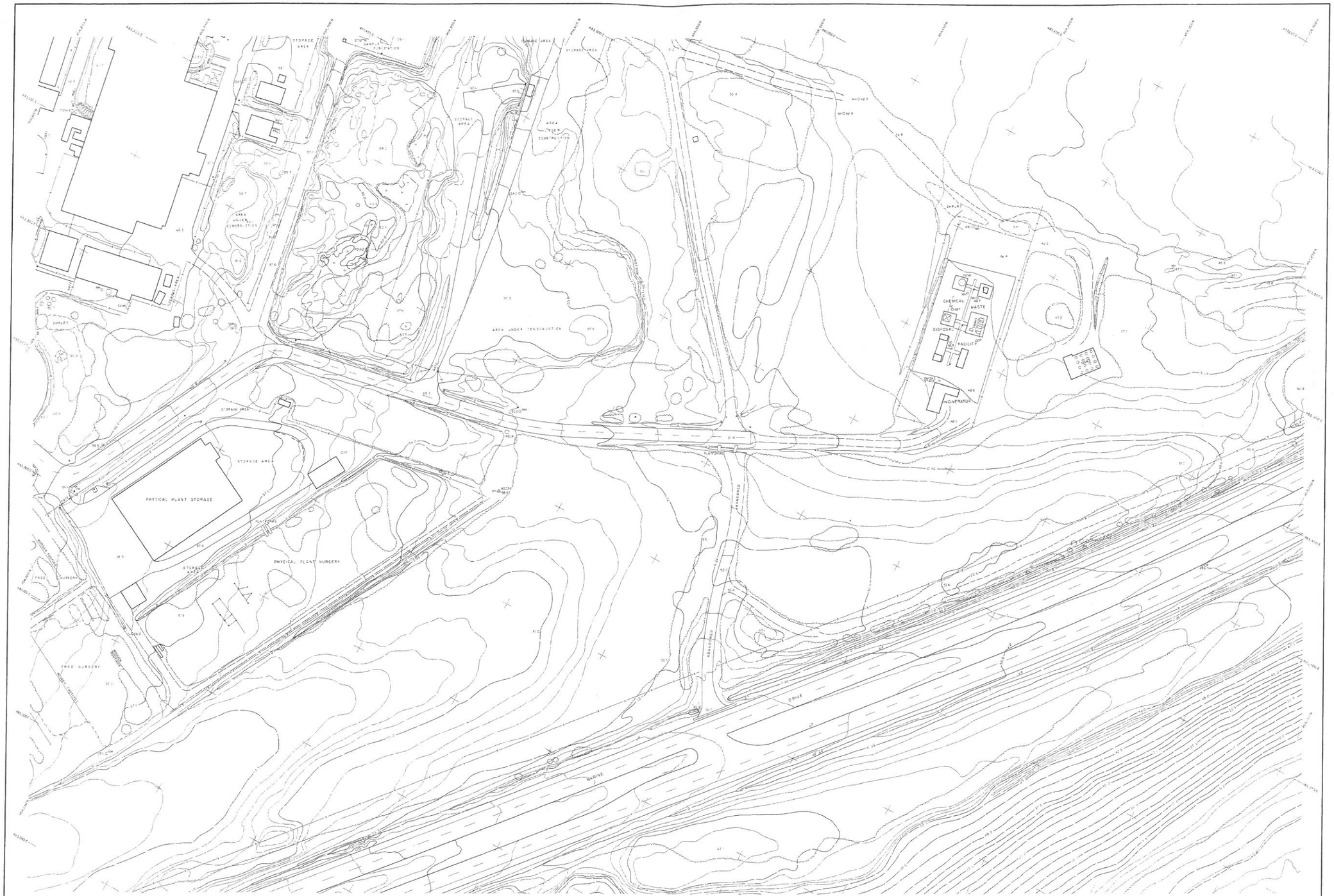
DES.	DR. JL
CH.	SCALE NTS
APP.	DATE SEP 2018
FILE NO.	189-00175-02
DWG. NO.	AP-2015

APPENDIX

D UBC INFORMATION

ADDRESS MAP)


PACIFIC SPIRIT REGIONAL PARK
24
30
25
29
31
MT INNOVATIONS (PAPPICAN) 612
ARCHIVE CENTRE BIOLOGICAL 846
MDS NORDION EXPANSION
ISAC 2 BLDG 847-1
ISAC 1 BLDG 847
RADIO CHEM ANNEX
MESON HALL EXTENSION
SOUTH CAMPUS SUBSTATION 765
STAGING RESEARCH CENTRE 767
ARIEL BLDG 845
ACCELERATOR & EXPERIMENTAL BUILDING 853
MAIN OFFICE LABORATORY 854
EXTENSION
COMPRESSOR 842
WORK/MACHINE SHOP 850
STORES 843
SOUTH CAMPUS MATERIALS RECYCLING FACILITY 766
IN-VESSEL COMPOSTING FACILITY 137
IMPERIAL RD.
LIBRARY PARC 769
PLANT OPERATIONS NURSERY 768
UBC UTILITIES WORKS YARD 146
SOLVENT STORAGE 141
PCB STORAGE 143
INCINERATOR
SOLVENT LAB 138
CHEMICAL WASTE PROCESSING 142
SOLVENT STORAGE 139
ENVIRONMENTAL SERVICES FACILITY
NURSERIES RD.
NURSERY RD.
SOUTH CAMPUS WAREHOUSE 638
RESEARCH PONDS 585
BOTANICAL GARDEN NURSERY
CENTRE FOR COMPARATIVE MEDICINE 057
CARETAKER SUITE
WESBROOK MALL
NRC INSTITUTE FOR FUEL CELL INNOVATION 591
S W MARINE DR.
SOUTH CAMPUS RD.
3800
3929
4000
4004
4069
4145
4250
6095
6075
6055
6049
6045
6029
6027
6025
616



REVISED TO LATEST DATE

COMPILED BY
brunnett mcrae & associates ltd.
PHOTOGRAMMETRIC PHOTOGRAMMETRY ETC SURVEYORS

SHEET INDEX

12	15	22	24	30	
		21	25	29	31
		20	26	28	
		19	27		

The University of British Columbia
Department of Physical Plant

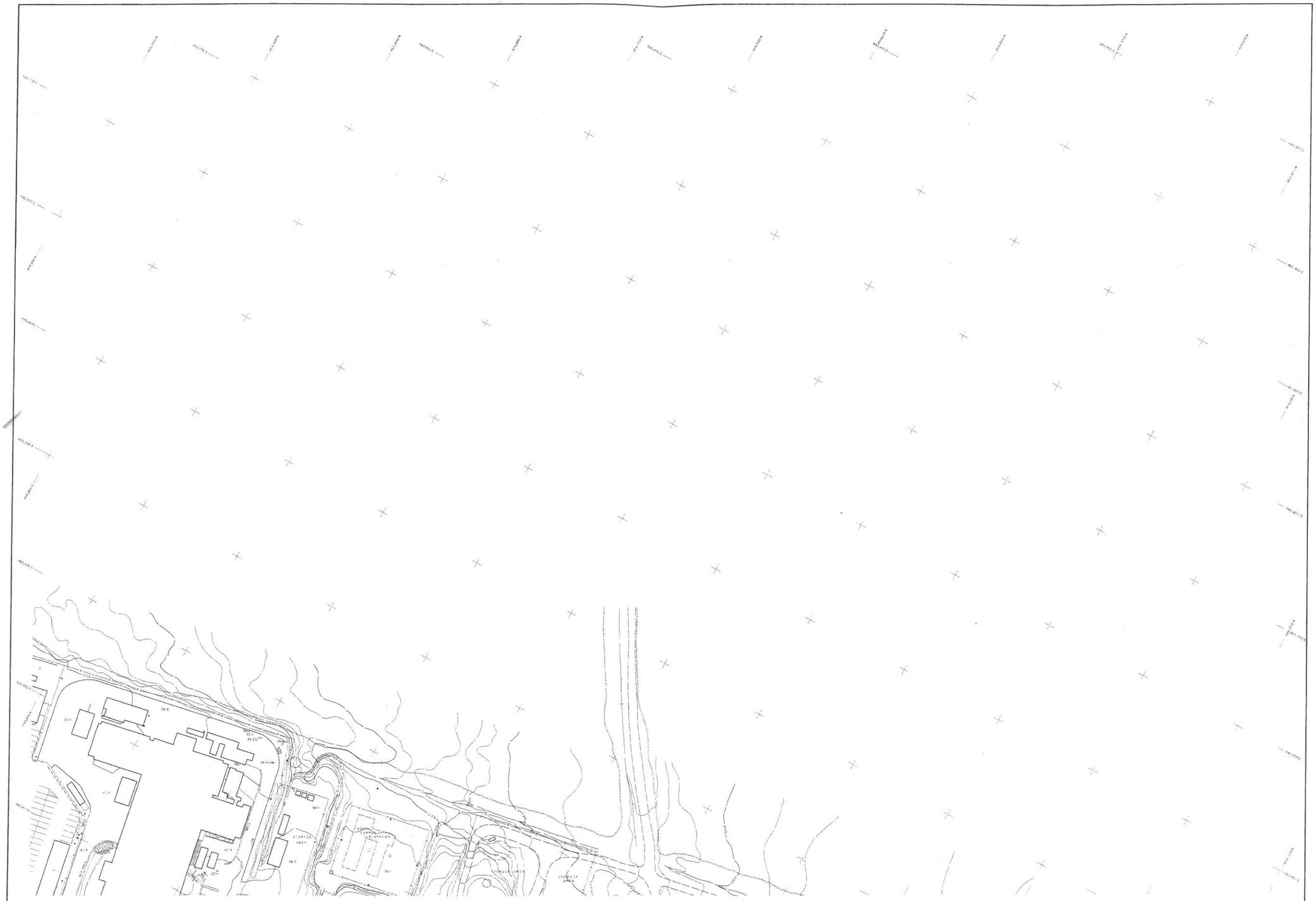
MAP COMPILED FROM AERIAL PHOTOGRAPHS TAKEN APRIL 1981
CONTROL : BURNETT RESOURCE SURVEYS LTD
DATUM : GEODETIC
GRID : UTM
CONTOUR INTERVAL : 0.5 METRES

SCALE : 1:600 1" = 50'

0 10 20 30 40 50 METRES
0 50 100 150 FEET

TOPOGRAPHIC

29



REVISED TO LATEST DATE

COMPILED BY
bennett resource surveys ltd.

SHEET INDEX

0		2	3

The University of British Columbia
Department of Physical Plant

MAP COMPILED FROM AERIAL PHOTOGRAPHS TAKEN APRIL 1980.
CONTROL : BURNETT RESOURCE SURVEYS LTD.
DATUM : GEODETIC
GRID : UTM
CONTOUR INTERVAL : 0.5 METRES

SCALE: 1:600 1"=50'

0 10 20 30 40 50 METRES
0 50 100 150 FEET

TOPOGRAPHIC

30

APPENDIX

E LEGAL PLAN AND LAND TITLE

TITLE SEARCH PRINT 2018-08-21, 12:02:49

File Reference: Requestor: Pamela Hunken

CURRENT AND CANCELLED INFORMATION SHOWN

Title Issued Under	SECTION 189 LAND TITLE ACT
Land Title District	VANCOUVER
Land Title Office	VANCOUVER
Title Number	BB1280350
From Title Number	BB405685
Application Received	2010-10-06
Application Entered	2010-10-06

Registered Owner in Fee Simple

Registered Owner/Mailing Address: THE UNIVERSITY OF BRITISH COLUMBIA
ROOM 107 - 6328 MEMORIAL ROAD
VANCOUVER, BC
V6T 1Z2

Taxation Authority Vancouver Assessment Area

Description of Land

Parcel Identifier: 012-132-896

Legal Description:

DISTRICT LOT 6494 GROUP 1 NEW WESTMINSTER DISTRICT EXCEPT PARTS IN PLANS 11345, 18645, 21966, BCP5864, BCP23588, BCP26848, 20570, BCP30252 AND BCP45808

Legal Notations

NOTICE OF INTEREST, BUILDERS LIEN ACT (S.3(2)), SEE BB4031804
FILED 2012-01-04

NOTICE OF INTEREST, BUILDERS LIEN ACT (S.3(2)), SEE BM82495A
FILED 1998-03-19

NOTICE OF INTEREST, BUILDERS LIEN ACT (S.3(2)), SEE BN327965
FILED 1999-12-09
CANCELLED BY CA2344555 2012-01-11

NOTICE OF INTEREST, BUILDERS LIEN ACT (S.3(2)), SEE BN327966
FILED 1999-12-09
CANCELLED BY CA2344556 2012-01-11

NOTICE OF INTEREST, BUILDERS LIEN ACT (S.3(2)), SEE BN327967
FILED 1999-12-09
CANCELLED BY CA2344560 2012-01-11

NOTICE OF INTEREST, BUILDERS LIEN ACT (S.3(2)), SEE BN327968
FILED 1999-12-09
CANCELLED BY CA2344561 2012-01-11

HERETO IS ANNEXED EASEMENT BV454507 OVER (VOLUME "A" CONTAINING 666 CUBIC METERS ON PLAN BCP8063) THE COMMON PROPERTY OF STRATA PLAN BCS571

HERETO IS ANNEXED EASEMENT BV454508 OVER (VOLUME "B" CONTAINING 76 CUBIC METERS ON PLAN BCP8063) THE COMMON PROPERTY OF STRATA PLAN BCS571

HERETO IS ANNEXED EASEMENT BV454509 OVER (VOLUME "C" CONTAINING 84 CUBIC METERS ON PLAN BCP8063) THE COMMON PROPERTY OF STRATA PLAN BCS571

HERETO IS ANNEXED EASEMENT BV454510 OVER (76 CUBIC METERS ON PLAN BCP8063) THE COMMON PROPERTY OF STRATA PLAN BCS571

HERETO IS ANNEXED EASEMENT GD85135 OVER PARTS LOTS 6 AND 7 PLAN 22697 SHOWN ON EXPLANATORY PLAN 20323

Charges, Liens and Interests

Nature:	EASEMENT
Registration Number:	BJ167134
Registration Date and Time:	1995-04-18 10:01
Remarks:	PART DARK OUTLINE AND CROSS-HATCHED (CONTAINING .255 HA) SHOWN ON PLAN LMP22687 APPURTENANT TO LEASE BJ111729 (SEE DISTRICT LOT 4805) SEE BJ111729 ACCESS BY EASEMENT ONLY PURSUANT TO BC REG 334/79

Nature:	EASEMENT
Registration Number:	BN327964
Registration Date and Time:	1999-12-09 14:52
Remarks:	INTER ALIA PART (0.255 HA) SHOWN ON PLAN LMP44331 APPURTENANT TO LEASE BN327963

Nature: EASEMENT
Registration Number: BT414660
Registration Date and Time: 2002-11-12 15:01
Remarks: PART (0.255 HA) PLAN BCP2188
APPURTENANT TO LEASE BT414659

Nature: EASEMENT
Registration Number: BV439647
Registration Date and Time: 2003-10-24 09:41
Remarks: PLAN BCP7955
APPURTENANT TO LOT 1 DISTRICT LOT 6494
PLAN BCP5864

Nature: EASEMENT
Registration Number: BV439648
Registration Date and Time: 2003-10-24 09:41
Remarks: PLAN BCP7955
APPURTENANT TO LOT 2, EXCEPT PART IN AIRSPACE PLAN
BCP7954, PLAN BCP5864

Nature: EASEMENT
Registration Number: BV439649
Registration Date and Time: 2003-10-24 09:41
Remarks: PLAN BCP7955
APPURTENANT TO AIRSPACE PARCEL 1
AIRSPACE PLAN BCP7954

Nature: COVENANT
Registration Number: BB264439
Registration Date and Time: 2007-05-28 15:03
Registered Owner: THE CROWN IN RIGHT OF BRITISH COLUMBIA
Remarks: PLAN BCP30253

Nature: CLAIM OF BUILDERS LIEN
Registration Number: BB1476914
Registration Date and Time: 2011-02-22 12:35
Registered Owner: PACIFIC FORTRESS CONTRACTING AND MANAGEMENT LTD.
Cancelled By: **CA1927870**
Cancelled Date: **2011-03-08**

Nature: CLAIM OF BUILDERS LIEN
Registration Number: CA2264755
Registration Date and Time: 2011-11-08 15:17
Registered Owner: THERMEDICS GLASS & WINDOWS INC.
INCORPORATION NO. BC0649016
Cancelled By: **CA2429772**
Cancelled Date: **2012-03-09**

Nature: CLAIM OF BUILDERS LIEN
Registration Number: CA2272191
Registration Date and Time: 2011-11-15 16:16
Registered Owner: TIM LOCKE
Cancelled By: CA2298185
Cancelled Date: 2011-12-01

Nature: CLAIM OF BUILDERS LIEN
Registration Number: CA2273807
Registration Date and Time: 2011-11-16 16:12
Registered Owner: STANDARD BUILDING SUPPLIES LTD.
INCORPORATION NO. BC0803871
Cancelled By: CA2672887
Cancelled Date: 2012-07-23

Nature: CLAIM OF BUILDERS LIEN
Registration Number: CA2285791
Registration Date and Time: 2011-11-25 09:49
Registered Owner: J.A.W. CONCRETE LTD.
INCORPORATION NO. BC0880446
Cancelled By: CA2325294
Cancelled Date: 2011-12-21

Nature: CLAIM OF BUILDERS LIEN
Registration Number: BB2018658
Registration Date and Time: 2012-07-30 13:51
Registered Owner: MEGA CRANES LTD.
INCORPORATION NO. A0057925
Remarks: INTER ALIA
Cancelled By: BB3000682
Cancelled Date: 2012-08-09

Nature: CLAIM OF BUILDERS LIEN
Registration Number: CA2786508
Registration Date and Time: 2012-09-25 11:17
Registered Owner: ESC AUTOMATION INC.
INCORPORATION NO. BC0207247
Cancelled By: CA2972562
Cancelled Date: 2013-01-29

Nature: CLAIM OF BUILDERS LIEN
Registration Number: CA2806874
Registration Date and Time: 2012-10-04 17:40
Registered Owner: WOLSELEY CANADA INC.
INCORPORATION NO. A0078025
Remarks: INTER ALIA
Cancelled By: CA2968208
Cancelled Date: 2013-01-25

Nature: CLAIM OF BUILDERS LIEN
Registration Number: CA2897473
Registration Date and Time: 2012-12-03 09:47
Registered Owner: BARTLE & GIBSON CO. LTD.
INCORPORATION NO. BC0018748
Remarks: INTER ALIA
Cancelled By: CA2968210
Cancelled Date: 2013-01-25

Nature: CLAIM OF BUILDERS LIEN
Registration Number: CA2904164
Registration Date and Time: 2012-12-06 14:09
Registered Owner: HD SUPPLY CANADA INC.
INCORPORATION NO. A0067161
Remarks: INTER ALIA
Cancelled By: CA2968211
Cancelled Date: 2013-01-25

Nature: CLAIM OF BUILDERS LIEN
Registration Number: CA2957253
Registration Date and Time: 2013-01-17 17:12
Registered Owner: B.A. ROBINSON CO. LTD.
INCORPORATION NO. A0073915
Remarks: INTER ALIA
Cancelled By: CA2968212
Cancelled Date: 2013-01-25

Nature: CLAIM OF BUILDERS LIEN
Registration Number: CA2978662
Registration Date and Time: 2013-02-01 09:52
Registered Owner: ESC AUTOMATION INC.
INCORPORATION NO. BC0207247
Cancelled By: CA3034894
Cancelled Date: 2013-03-15

Nature: CLAIM OF BUILDERS LIEN
Registration Number: CA2998582
Registration Date and Time: 2013-02-19 10:06
Registered Owner: WESCO DISTRIBUTION CANADA LP
INCORPORATION NO. XP0378181
Remarks: INTER ALIA
Cancelled By: CA3034891
Cancelled Date: 2013-03-15

Nature: CLAIM OF BUILDERS LIEN
Registration Number: CA3004841
Registration Date and Time: 2013-02-22 12:10
Registered Owner: FRASER ELECTRIC CO. LTD.
INCORPORATION NO. BC0041697
Remarks: INTER ALIA
Cancelled By: CA3034892
Cancelled Date: 2013-03-15

Nature: CLAIM OF BUILDERS LIEN
Registration Number: CA3360922
Registration Date and Time: 2013-09-20 13:57
Registered Owner: 0772497 B.C. LTD.
INCORPORATION NO. 0772497
Cancelled By: CA3384824
Cancelled Date: 2013-10-03

Nature: CLAIM OF BUILDERS LIEN
Registration Number: CA3364425
Registration Date and Time: 2013-09-24 10:35
Registered Owner: FRIESEN FLOOR & WINDOW FASHIONS LTD.
INCORPORATION NO. BC0289803
Remarks: INTER ALIA
Cancelled By: CA3388476
Cancelled Date: 2013-10-04

Nature: STATUTORY RIGHT OF WAY
Registration Number: CA5039546
Registration Date and Time: 2016-03-11 16:03
Registered Owner: SHAW CABLESYSTEMS LIMITED
INCORPORATION NO. A0075382
Remarks: PARTIAL RELEASE CA5040524 RECEIVED ON 2016-03-14
AS TO ALL EXCEPT PART ON PLAN EPP48501

Nature: CLAIM OF BUILDERS LIEN
Registration Number: CA5102111
Registration Date and Time: 2016-04-12 09:28
Registered Owner: DRYCO DRYWALL SUPPLIES LTD.
INCORPORATION NO. 0117304
Cancelled By: CA5109593
Cancelled Date: 2016-04-14

Nature:	CLAIM OF BUILDERS LIEN
Registration Number:	CA5102112
Registration Date and Time:	2016-04-12 09:28
Registered Owner:	DRYCO BUILDING SUPPLIES INC. INCORPORATION NO. A0053112
Cancelled By:	**CA5109594**
Cancelled Date:	**2016-04-14**

Nature:	CLAIM OF BUILDERS LIEN
Registration Number:	CA5411200
Registration Date and Time:	2016-08-09 15:57
Registered Owner:	ARGUS CONTROL SYSTEMS LTD. INCORPORATION NO. BC0276448
Cancelled By:	**CA5499408**
Cancelled Date:	**2016-09-13**

Nature:	CLAIM OF BUILDERS LIEN
Registration Number:	CA6694488
Registration Date and Time:	2018-03-22 17:41
Registered Owner:	FUSION PROJECT MANAGEMENT LTD. INCORPORATION NO. A0095344

Duplicate Indefeasible Title NONE OUTSTANDING

Transfers NONE

Pending Applications NONE

Corrections

CA2882225 2012-11-23 11:57:32 LEGAL NOTATION REMOVED CV1077500

CR25792 2016-03-22 13:05:07 CHARGE REMARKS CORRECTED CA5039546

PARCEL INFORMATION & MISCELLANEOUS NOTES PRINT 2018-08-21, 12:02:49

File Reference: Requestor: Pamela Hunken

PARCEL IDENTIFIER (PID): 012-132-896

SHORT LEGAL DESCRIPTION:U/NEW WESTMINSTER////1//6494
MARG:REM

TAXATION AUTHORITY:
1 Vancouver Assessment Area

FULL LEGAL DESCRIPTION: CURRENT
DISTRICT LOT 6494 GROUP 1 NEW WESTMINSTER DISTRICT EXCEPT PARTS IN PLANS 11345, 18645, 21966, BCP5864, BCP23588, BCP26848, 20570, BCP30252 AND BCP45808

MISCELLANEOUS NOTES:
CLSD RD DF GC90232
SRW PLAN VAP20570
HWY GAZ DF G75798
SRW PL. BCP13254
SRW PLAN BCP18665
SRW PLAN BCP21468

ASSOCIATED PLAN NUMBERS:
STATUTORY RIGHT OF WAY PLAN BCP13254
STATUTORY RIGHT OF WAY PLAN BCP18665
STATUTORY RIGHT OF WAY PLAN BCP21468
PLAN BCP2188
SUBDIVISION PLAN BCP23588
SUBDIVISION PLAN BCP30252
PLAN BCP30253
SUBDIVISION PLAN BCP45808
SUBDIVISION PLAN BCP5864
SUBDIVISION PLAN BCP7954
PLAN BCP7955
PLAN LMP22687
PLAN LMP44331
REFERENCE PLAN VAP18341RX
PLAN VAP18342
PLAN VAP20570
STATUTORY RIGHT OF WAY PLAN EPP48501

AFB/IFB: MN: Y PE: 0 SL: 1 TI: 1

REFERENCE PLAN OF LEASEHOLD (BOLD OUTLINED)
AND ACCESS (BOLD OUTLINED AND HATCHED)
OVER PORTIONS OF
DISTRICT LOT 6494, GROUP 1, NEW WESTMINSTER DISTRICT
EXCEPT PARTS IN PLANS 11345, 18645, 21966, BCP5864,
BCP23588, BCP26848, 20570, BCP30252 AND BCP45808

PLAN EPP81427

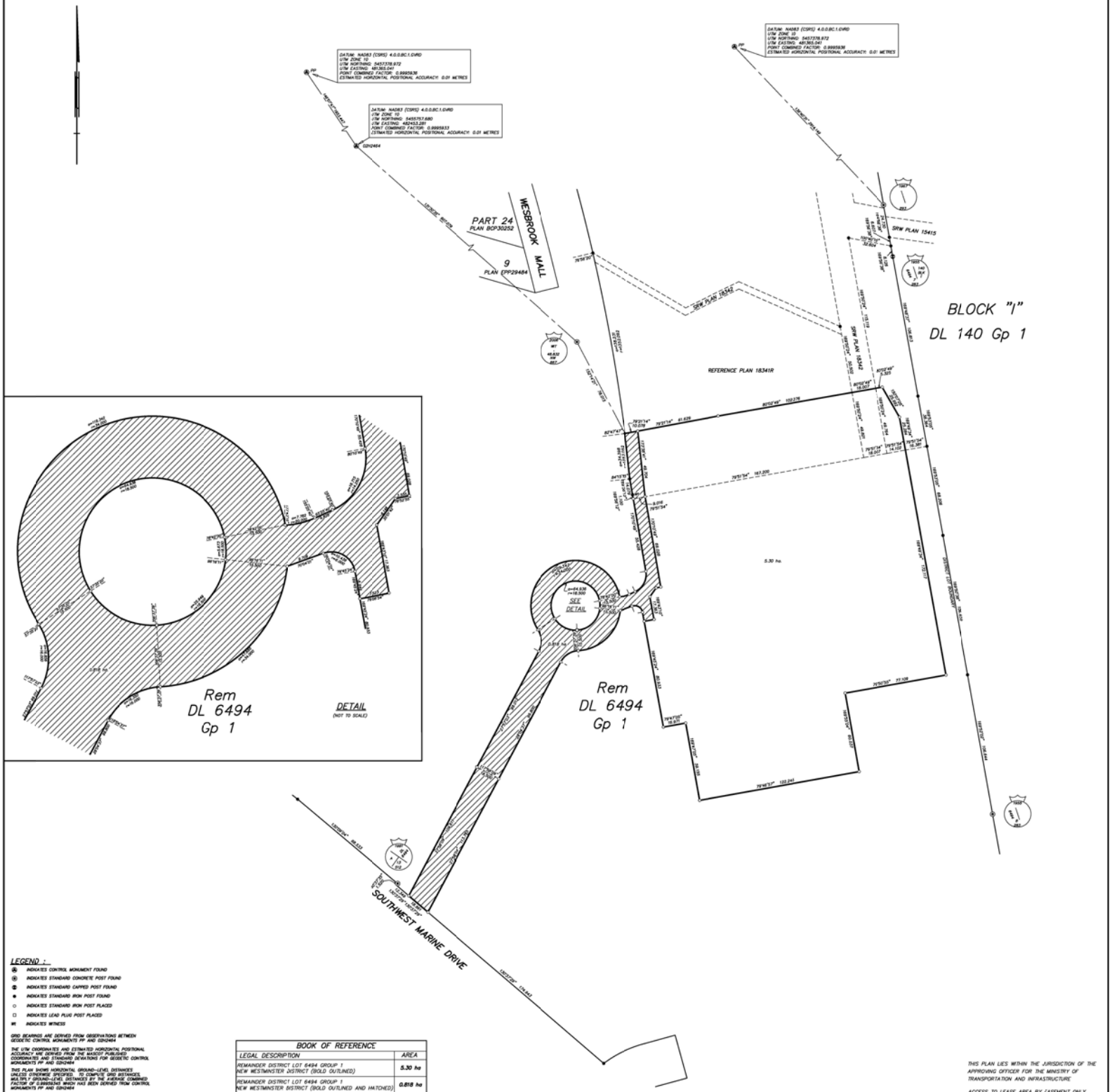
BCGS 92G.024

20 10 0 10 30 50
DISTANCES ARE IN METRES

THE INTENDED PLOT SIZE OF THIS PLAN IS 560mm IN WIDTH BY 1120mm IN HEIGHT (E SIZE) WHEN PLOTTED AT A SCALE OF 1:1000

PURSUANT TO SECTIONS 99 (1)(e) AND 99 (1)(k) OF THE LAND TITLE ACT

FOR LEASEHOLD AND ACCESS PURPOSES



LEGEND :

- ⊕ INDICATES CONTROL MONUMENT FOUND
- ⊙ INDICATES STANDARD CONCRETE POST FOUND
- ⊜ INDICATES STANDARD CAPPED POST FOUND
- ● INDICATES STANDARD IRON POST FOUND
- ○ INDICATES STANDARD IRON POST PLACED
- □ INDICATES LEAD PLUG POST PLACED
- WI INDICATES WITNESS

GRID BEARINGS ARE DERIVED FROM OBSERVATIONS BETWEEN GEODETIC CONTROL MONUMENTS PP AND GSD12484

THE UTM COORDINATES AND ESTIMATED HORIZONTAL POSITIONAL ACCURACY ARE DERIVED FROM THE MASCOT PUBLISHED COORDINATES AND STANDARD DEVIATIONS FOR GEODETIC CONTROL MONUMENTS PP AND GSD12484

THIS PLAN SHOWS HORIZONTAL GROUND-LEVEL DISTANCES UNLESS OTHERWISE SPECIFIED. TO COMPUTE GRID DISTANCES, MULTIPLY GROUND-LEVEL DISTANCES BY THE AVERAGE COMBINED FACTOR OF 0.9995836 WHICH HAS BEEN DERIVED FROM CONTROL MONUMENTS PP AND GSD12484

THIS PLAN SHOWS ONE OR MORE WITNESS POSTS WHICH ARE NOT SET ON THE TRUE CORNER(S)

BOOK OF REFERENCE	
LEGAL DESCRIPTION	AREA
REMAINDER DISTRICT LOT 6494 GROUP 1 NEW WESTMINSTER DISTRICT (BOLD OUTLINED)	5.30 ha
REMAINDER DISTRICT LOT 6494 GROUP 1 NEW WESTMINSTER DISTRICT (BOLD OUTLINED AND HATCHED)	0.818 ha

MURRAY & ASSOCIATES
PROFESSIONAL LAND SURVEYORS
201-12448 82nd AVENUE
SURREY, BC V3W 3E9
(604) 597-9189

THIS PLAN LIES WITHIN THE METRO VANCOUVER REGIONAL DISTRICT
(UNIVERSITY OF BRITISH COLUMBIA)

THIS PLAN LIES WITHIN THE JURISDICTION OF THE APPROVING OFFICER FOR THE MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE

ACCESS TO LEASE AREA BY EASEMENT ONLY

THE FIELD SURVEY REPRESENTED BY THIS PLAN WAS COMPLETED ON THE 27th DAY OF MARCH, 2018
GREGORY MARSTON, BCLS 794
FILE 8613EX-07GEO

APPENDIX

F BC ENV AND ASSESSMENT DOCUMENTS

Assessment Roll Report

Disclaimer

This information is obtained from various sources and is determined as of the specific dates set out in the Assessment Act. As a result, BC Assessment cannot warrant that it is current or accurate, and provides it for your convenience only. Use of this information without verification from original sources is at your own risk.

Report Date:	Aug 21, 2018	**Report Time:**	12:31:34 PM
Folio:	189-00175-02	**For:**	PQ63056
Roll Year:	2018	**Roll Number:**	00817.080
Area:	09	**Jurisdiction:**	739
School District:	39		
Neighbourhood:	100 - BOOMING GROUNDS		
Property Address:	UNIVERSITY CAMPUS VANCOUVER BC		
Owner Name:	UNIVERSITY OF BC	**# of Owners:**	1
Owner Address:	C/O THE TREASURER 224-6328 MEMORIAL RD VANCOUVER BC V6T 1Z2		
Document No:	D0000KXTF3		
PID:	012-132-896		
Legal Description:	District Lot 6494, Group 1, New Westminster Land District, Except Plan 11345, & EXC PARTS IN PLANS 18645, 20570, 21966, BCP5864, BCP23588, BCP26848, BCP30252 & BCP45808		

2018 Value

Property Class	Land	Improvement
Residential	$185197000	$964268000
Business And Other	$1443479000	$2826319000
Rec/Non Profit	$337748000	N/A
Farm	$114250	N/A

Total Actual Value: $5757125250

2017 Value

Property Class	Land	Improvement
Residential	$176439000	$841300000
Business And Other	$1375215000	$2777446000
Rec/Non Profit	$321776000	N/A
Farm	$114250	N/A

Total Actual Value: $5492290250

2016 Value

Property Class	Land	Improvement
Residential	$153480000	$692515000
Business And Other	$1196272000	$2806606000
Rec/Non Profit	$279906000	N/A
Farm	$114250	N/A

Total Actual Value: $5128893250

Manual Class: 8000 - Non-Manualized Structures
Actual Use: 650 - Schools & Universities, College Or Technical Schools
Tenure: 01 - Crown-Granted
ALR:
Land Dimension: 927.902 **Land Dimension Type:** Acres

Sales:	Number	Description
	#1	A NON-SALE occurred on 30 Apr 2012. The document # was BB4044423.
	#2	A SINGLE PROPERTY, IMPROVED SALE occurred on 30 Apr 2012. This was a CASH sale and the price was 30,000. The document # was BB4044422.
	#3	A NON-SALE occurred on 30 Apr 2012. The document # was BB4044421.
	#4	A NON-SALE occurred on 06 Oct 2010. The document # was BB1280350.
	#5	A NON-SALE occurred on 07 Jun 2007. The document # was BB405686.
	#6	A NON-SALE occurred on 07 Jun 2007. The document # was BB405685.

Additional Owners:

No Additional Owners

Associated PIDs:

009-693-530
009-693-556
010-814-523
010-814-540
015-767-990
015-891-895
015-891-909
015-940-357
015-940-543
017-903-149
009-693-513
028-826-884

Site Registry

Nil Search

For: [PQ63056] [WSP CANADA INC.]

Aug 20, 2018

As Of: AUG 19, 2018

04:36:07 PM

Folio: 189-00175-02

Area Nil Search

As of AUG 19, 2018, no records from Site Registry
fall within 0.5 kilometers of coordinates
Latitude 49 degrees, 14 minutes, 48.6 seconds, and
Longitude 123 degrees, 13 minutes, 43 seconds.

You have been charged for this information.

Sites may be revealed by searching with alternate search methods. For example, a site not revealed in an Area search may be revealed by searching with another piece of information such as PID, PIN, Address or Crown Lands File Number.

APPENDIX

G SITE VISIT CHECKLIST

PHASE I ESA PROCESS CHECKLIST

PROJECT DETAILS

ITEMS	INFORMATION
WSP Project No.:	189-00175-02
Client:	Architecture 49 Inc.
Project Field Staff:	Jenny Liu
Date of Site Reconnaissance:	23 August 2018
Site Address or Legal Description:	4004 Wesbrook Mall and 6075 Nurseries Road, Vancouver, BC

SITE REVIEW OR RECONNAISSANCE

ITEMS	INFORMATION
Latitude and Longitude coordinates of the centroid (if possible) of the Site using a GPS	N 49°14'48.59" W123°13'42.98"
Building Services (water, sewer, gas and electricity)	Electricity and storm sewer
Topography (slope at and near the Site)	South/southeast
Heating Type and Fuel Source Notes: Electrical baseboard heating, natural gas, heating oil, wood, etc.	NA
Vegetated and paved areas	Asphalt-paved - 4004 Wesbrook Mall portion Vegetated - 6075 Nurseries Road portion
Accessibility for a Stage 2 Investigation	Yes
Current businesses operating at the Site (attach separate pages with details if required)	Temporary Storage Yard
Interviews with tenant, representative (make multiple copies of interview forms if required)	Mr. Ken Buckley, Deputy Associate Laboratory Director - IAMI
Transformers at and near the Site Notes: Check to see if there are any stickers on the transformers (usually for BC Hydro transformers stickers are green or yellow)	South Campus Substation located immediately to the southwest of the Site

100-20339 96th Avenue
Langley, BC, V1M 0E4

Tel.: 604-533-2992

www.wsp.com

AIR AND WATER DISCHARGES

WATER/WASTE WATER MANAGEMENT	YES/NO	DETAILS / COMMENTS
Potable water-site (describe source)	**No**	
Potable water- adjacent properties (describe source)	**Yes**	**UBC**
Neighboring waterways, stream waterways, stream or creek (within 200m)	**No**	
Apparent shallow ground water flow direction		**South/southeast**
Sanitary discharge (describe)	**No**	
Storm water discharge(s) (describe)	**Yes**	
Waste water discharge(s):	**No**	
i) to sanitary sewer		
ii) to storm sewer		
Oil Water Separator(s)	**No**	

AIR EMISSIONS	YES/NO	DETAILS / COMMENTS
Roof access	**No**	
Process stacks/vents	**No**	
Unidentified stacks/vents	**No**	
Apparent contamination issues (e.g. visible or odourous emissions)	**No**	

WATER WELLS AND SEPTIC TANKS

WATER WELLS & SEPTIC TANKS	YES/NO	DETAILS/COMMENTS
Any water well on the Site?	**No**	
If yes, is it currently in use?		
Any septic tanks on the Site?	**No**	

ABOVE-GROUND STORAGE TANKS AND UNDERGROUND STORAGE TANKS

STORAGE TANKS (AGE, QUALITY, INTEGRITY, CONTENTS & SIZE)	YES/NO	DETAILS/COMMENTS
Above-ground tanks	**No**	
Tanks in use?	**-**	
Any indications of tank(s) previously onsite and removed/abandoned	**-**	
Evidence or records of spills, leaks (check below surface of soil and gravel, if possible)	**-**	
Tank testing records (include details)	**-**	
Description of tanks **1. Age** **2. Visible condition** **3. Type** **4. Capacity (Volume of cylinder)** **5. Contents; etc.**	**-**	
Underground tanks	**No**	
Tanks in use?	**-**	
Any indication of tank(s) previously onsite and removed/abandoned (e.g. fill pipes, vent pipes, concrete pads)	**-**	
Evidence of records of spills, leaks, overfilling	**-**	
Tank testing (what, when)	**-**	
Description of tanks **6. Age** **7. Visible condition** **8. Type** **9. Capacity (Volume of cylinder)** **10. Contents; etc.**	**-**	

ASBESTOS-CONTAINING BUILDING MATERIALS / OTHER MATERIALS WITHIN BUILDINGS

BUILDING MATERIALS	YES/NO	DETAILS/COMMENTS
Suspect Asbestos		**Low Potential**
Sprayed on fire proofing, fire-stop plaster/filler		
Pipe wrap, elbow / fittings insulation		
Drywall joint compound		
Ceiling materials (tiles, plaster)		
Apparent friable fibres		
Asphalt-roofing materials		
Other potential sources (e.g. mastic, caulking)		
Reason to suspect asbestos (building age _____)		
Urea Formaldehyde Foam Insulation (UFFI)		**Low Potential**
Any insulation retrofits		
Reason to suspect UFFI (date of renovation _____)		
Lead Based Paints		**Low Potential**
Evidence of peeling, cracking or flaking paint		
Any reason to suspect		
Mercury vapour and fluorescent lamps		
Mercury switches and lead sheeting		

CHEMICAL STORAGE AND HANDLING

MATERIAL HANDLING	YES/NO	DETAILS/COMMENTS
Describe nature and quantities of materials handled (including process details)	**No**	
Shop area (hoists, separators)	**No**	
Floor drains, sumps (indicate whether full)	**No**	
Containment areas (liquid storage, transfer)	**No**	
Petroleum liquids (fuels, oils, lubricants)	**No**	
Liquid Chemicals	**No**	
Pesticides / herbicides (evidence of use or storage)	**No**	
WHMIS controlled substances	**No**	
MSDSs available / reviewed	**No**	
Solids handling	**No**	
Evidence or records of leaks, spills	**No**	
Unidentified drums, containers	**No**	
Other	**No**	
Further Comments	**No**	

SPILLS AND STAINS

EXTERIOR INDICATIONS (SIGNS OF CONTAMINATION)	YES/NO	DETAILS/COMMENTS
Recently replaced / removed gravel or concrete	**No**	
Degraded concrete or asphalt	**No**	
Truck or rail loading / unloading areas	**No**	
Stained or discoloured ground surface (soil, asphalt, etc.)	**No**	
Stressed vegetation	**No**	
Evidence of soil deposit / removal	**No**	
Odours	**No**	
Former buildings (e.g. footings)	**No**	
Surface water – discoloration	**No**	
Contamination evident in catch basins / drains	**No**	
Pits, ponds or lagoons (any contamination?)	**No**	
Other debris, piles (describe)	**No**	

HAZARDOUS WASTE

HAZARDOUS WASTE MANAGEMENT: ACCUMULATION, STORAGE, DISPOSAL	YES/NO	DETAILS/COMMENTS
Waste-handling / storage / disposal areas	**No**	
Secondary containment	**-**	
Waste disposal records	**-**	
Description, source, quality of waste	**-**	
Solid	**-**	
Liquid (chemical)	**-**	
Unidentified / unlabelled waste	**-**	
Permits / approvals (municipal, provincial, federal)	**-**	

NON-HAZARDOUS WASTE

NON-HAZARDOUS WASTE GENERATION, STORAGE, DISPOSAL	YES/NO	DETAILS/COMMENTS
Waste-handling / storage / disposal areas	**Yes**	**Bins**
Containment	**No**	
Waste disposal methods		**Third party**
Recyclable wastes		**Third party**
Non-recyclable wastes		**Third party**
Any wastes landfilled at any location onsite?	**No**	

OZONE DEPLETING SUBSTANCE

OZONE DEPLETING SUBSTANCE	YES/NO	DETAILS/COMMENTS
Source of ozone depleting substance		**Low potential**
Reason to suspect ozone depleting substance		

POLYCHLORINATED BIPHENYLS

PCB'S	YES/NO	DETAILS/COMMENTS
Any containers or equipment (capacitors, transformers) containing PCBs now onsite (pole-mounted or over concrete pad)	**No**	
Evidence of leakage	**-**	
PCB containing fluorescent light ballasts	**-**	
Hydraulic hoists, elevators, lifts installed prior to 1978	**No**	
Any PCBs containing equipment or material previously onsite and removed	**-**	
Any reason to suspect PCBs contamination	**-**	

RADON AND METHANE GAS

RADON AND METHANE GAS	YES/NO	DETAILS/COMMENTS
Reason to suspect Radon	**No**	
Reason to suspect Methane Gas	**No**	

SOILS AND FILLS

ITEMS	INFORMATION
Any cuts or fill areas onsite (Y/N):	**Possibly fill placed at the northern portion of the Site**
If Yes	
Reason	
What type of material was filled?	
Area of fill	
Volume of fill	
Any stockpiles (Y/N):	**No**
If yes	
Reason for the presence of stockpiles	
Type of material in the stockpile / stockpiles	
Approximate volume of stockpile / stockpiles	

MISCELLANEOUS ISSUES

MISCELLANEOUS ISSUES	YES/NO	DETAILS/COMMENTS
Housekeeping (Poor / Moderate / Good)	**-**	**Moderate**
Emergency procedures (Lacking / Sufficient)	**-**	
Fire systems (Lacking / Sufficient)	**-**	
Site security (Lacking / Sufficient)	**-**	
Environmentally sensitive areas in proximity (e.g. wetlands, habitat)	**No**	

ADJACENT PROPERTIES

DIRECTION	USE
Site current use	Temporary storage yard
North	Triumf Facility
South	South Campus Materials Recycling Facility, Staging Research Centre
East	Pacific Spirit Regional Park
West	Triumf Facility, South Campus Substation
Apparent environmental issues associated with current use of land at adjacent properties	
Triumf Facility Hazardous Material Storage Building to the west of the Site and South Campus Substation to the southwest of the Site	

IDENTIFICATION OF POTENTIAL CONCERNS

DESCRIBE ANY KNOWN OR SUSPECTED POTENTIAL ENVIRONMENTAL CONCERNS (RISKS) RELATING TO THE SITE OR ADJACENT PROPERTIES BASED ON ABOVE
Onsite - Fill placed on-site
Offsite - Triumf Facility Hazardous Material Storage Building to the west of the Site and South Campus Substation to the southwest of the Site

SITE ACTIVITIES

CSR SCHEDULE 2 ACTIVITY	COMMENTS
No	

ANNEXURE 1

(Attach separate sheets, if required)

INTERVIEWS

NAME: Ken Buckley
JOB TITLE: Deputy Associate Laboratory Director - IAMI
NO OF YEARS FAMILIAR WITH HISTORICAL ACTIVITIES AT THE SITE: 31

QUESTION	YES / NO	COMMENTS
1. Do you know how long Triumf has occupied this property? And when the Site has been developed? Who was the former occupancy?		TRIUMF has occupied the site since 1970 when it first started developing it. It was previously unoccupied.
2. What is the main usage of the Site? What activities have been conducted at the Site?		Main usage is research. Activities are the production of ion beams for use in nuclear & particle physics, materials characterisation, and radioisotope production.
3. What is the main activities conducted at the building to the north of the Site (the Meson Hall)?		houses the main proton cyclotron, the electron linac, beamlines and support services, as well as laboratories
4. Are you aware of any historical environmental issues at the Site?	No	
5. Are you aware of any historical environmental issues at properties surrounding the Site? (i.e., any spill at the Hazmat storage area, any spill at the BC Hydro Substation and any spill at the Meson Hall)	No	
6. Are you aware of the presence of any historical or current above ground or underground tanks at the Site?		There are above ground tanks for the storage of gases (primarily helium) and liquid nitrogen.
7. Were any chemicals and hazardous waste stored, handled or disposed onsite in the past?	Yes	There is a "hazmat" building west of the IAMI location where hazardous chemicals & oil are stored.
8. Are you aware of the presence of any fill material brought onto the Site? If yes, what was the source and when the fill was brought onto the Site? Where was the fill placed? Do you have any document regarding the fill quality?	No	
9. Are you aware of any third party notification letters issued by owners of any surrounding properties?	No	
10. Are you aware of any spill or stain area on the Site which need to be brought to our attention?	No	
11. Are you aware of any historical landfilling activities onsite?	No	
12. Are you aware of any waste disposal areas onsite?	No	
13. Any other environmentally sensitive issues which you would like to bring to our attention?	No	
14. Is there any water well present onsite?	No	
15. Is there any septic system present onsite?	No	

APPENDIX

H

BACKGROUND INFORMATION OF EMA, CSR AND HAZARDOUS BUILDING MATERIALS

BACKGROUND INFORMATION OF EMA AND CSR

The Waste Management Act (WMA) addressed contaminated sites in British Columbia since 1988. The Waste Management Amendment Act, 1993 (WMAA, also known as Bill 26) was passed in June 1993. The BC Ministry of Environment and Climate Change Strategy (ENV) added provisions, which specifically addressed contaminated sites, and promulgated the Contaminated Sites Regulation[7] (CSR), which came into effect on 1 April 1997. The first, second and third stage amendments to the CSR were made on 19 July 1999, 4 February 2002 and 20 November 2003, respectively. In July 2004, the WMA was repealed and replaced by the Environmental Management Act (EMA), and the CSR was amended. A revised CSR with 10 Schedules was promulgated at that time. The fifth, sixth, seventh, eighth and ninth, stage amendments were made to the CSR in 2007, 2008, 2011, 2013, and 2014, respectively. Omnibus Stage tenth and eleventh amendments were made to the CSR in 2016 and 2017, respectively. Omnibus Stage tenth and eleventh amendments have made the following major changes, which are effective from November 1, 2017.

- Updated all existing soil, water and vapour standards to reflect contemporary science;
- Simplified the formats and consolidated existing schedules into four new schedules organized by environmental media – i.e. Schedules 3.1 (soil), 3.2 (water), 3.3 (vapour) and 3.4 (sediment);
- Added new toxicology-based soil/water standards for some emerging contaminants;
- Eliminated Schedule 7 unique soil standards to trigger Contaminated Soil Relocation Agreements and replaced that schedule by reference to all the applicable new Schedule 3.1 soil standards;
- Added a new category of vapour standards for parkades for use in at-surface or below-surface parking facilities;
- Provided soil standards for two new and different types of residential land uses - high density and low density;
- Set two tiers of soil standards for Wildlands.

The CSR has staged investigations as follows:

— Stage 1 PSI comprises of a historical search and records review, and a walk-through site visit.

— Stage 2 PSI comprises of selective sampling and analyses of environmental media at identified APECs to determine the presence or absence of potential contaminants of concern (PCOCs) exceeding the applicable standards.

— Detailed Site Investigation (DSI) comprises of evaluation of the lateral and vertical extents of contaminants of environmental concern (COCs) in different media at areas of environmental concern (AECs) identified during the Stage 2 PSI.

---

[7] Contaminated Sites Regulation (CSR, BC Reg. 375/96 including amendments up to BC Reg. 253/2016, November 1, 2017); Effective 1 April 1997; Ministry of Environment and Climate Change Strategy; Victoria, British Columbia.

Canadian Standards Association[8] (CSA) refers to Stage 1 and Stage 2 PSIs as Phase I and Phase II Environmental Site Assessments (ESAs), respectively. The DSI is considered a part of the Phase II ESA if contamination is identified. A Phase III ESA consists of remediation or risk assessment.

[8] Canadian Standards Association (CSA); Phase I Environmental Site Assessment (CSAZ768-01 (R2012)); Rexdale, Ontario.

BACKGROUND INFORMATION OF HAZARDOUS BUILDING MATERIALS

Asbestos Containing Materials (ACMs):

Asbestos is a naturally occurring fibrous material that has been commonly used in construction from the early 1900s until the 1990s. It was used extensively because it is an insulator, has good fire protection properties, has tensile strength, and is resistant to chemical erosion. Some of the common uses of asbestos in buildings include spray applied fireproofing, mechanical insulation, linoleum, floor tiles, dry wall taping compound, vermiculite, asbestos cement board and tiles, asbestos cement pipes, and textured decorative coating.

The use of friable asbestos containing materials (ACMs) in buildings was gradually reduced in Canada through the 1970s and 1980s. WorkSafe BC requires that all buildings constructed before 1990 should be tested for asbestos before any demolition or renovation work. Any building which is a workplace must have an inventory prepared of all asbestos containing materials and an Asbestos Management Plan must be developed and maintained until all ACMs have been removed from the building.

Ozone Depleting Substances:

An ozone-depleting substance ("ODS") refers to any substance containing chlorofluorocarbon ("CFC"), hydrochlorofluorocarbon ("HCFC"), halon or any other material capable of destroying ozone in the atmosphere. ODSs have been used in rigid polyurethane foam and insulation, laminates, aerosols, air conditioners, fire extinguishers, cleaning solvents and the sterilization of medical equipment.

Federal regulations introduced in 1995 required the elimination of production and import of CFCs by 1 January 1996 (subject to certain essential uses) and a freeze on the production and import of HCFC-22 by 1 January 1996. These regulations also require the complete elimination of HCFC-22 by the year 2020. The provincial/territorial governments manage the use and handling of ODS. The B.C. Government passed the Ozone Depleting Substances Regulation in 1993 to control ODS stored in products and equipment, and encourage consumers and industry to use more environmentally safe alternatives.

WSP expects a low potential for environmental concern with respect to ODSs at the Site as long as any ODS containing items are maintained properly. Prior to demolition or disposal, equipment which contains ozone depleting substances should be degassed by a certified / licensed contractor as required by British Columbia's Ozone Depleting Substances Regulation.

Polychlorinated Biphenyls:

In Canada, polychlorinated biphenyls ("PCBs") were prohibited from being used in products, fluorescent light ballasts, equipment, machinery, electrical transformers and capacitors, which were manufactured or imported into the country after July 1, 1980. However, older equipment in use after this date may still contain PCBs if the equipment's fluid has not been changed, or if there was sufficient inventory of such equipment.

If a building is to be demolished all light ballasts and dielectric fluid containing equipment should be checked for PCB content prior to disposal. PCB ballasts should be recycled when removed from service. The Light Recycle website provides a list of recycling facilities which accept PCB ballasts at http://www.lightrecycle.ca/.

Lead-Based Paints:

Many older properties in Canada may have surfaces that are painted with lead-based paint. Removing or disturbing this paint when you are renovating could expose people within the building to serious health risks. Buildings built and painted before 1960 probably contain lead-based paint. Buildings built and painted between 1960 and 1990 may have small amounts of lead in some of the painted indoor surfaces. Highest amounts of lead were used in exterior paints. There is little concern about lead-based paint in buildings built and painted in 1991 or later, because most consumer paints produced in Canada and the U.S. since that time contain no more than background levels of lead. However, some specialty coatings (such as artists' paints and metal touch-up coatings) can contain higher levels of lead.

The lead content of consumer paints sold, imported or advertised in Canada is regulated under the Surface Coating Materials Regulations. In October 2010, the Government amended the *Surface Coating Materials Regulations* to significantly lower the level of total lead allowed in paints and other surface coating materials from 600mg/kg to 90 mg/kg - which is equivalent to a lead concentration of 0.009%.

Lead-based paint in good condition presents a relatively low risk if left undisturbed. If paint is in a flaking condition, it is advisable to have the paint chips tested for lead content. Any lead abatement should only be conducted by a qualified contractor following WorkSafe BC guidelines. Lead painted surfaces must be tested for leachability before disposal at a landfill site.

Mercury:

Mercury switches were commonly used in thermostats both in residential and commercial/industrial buildings. Mercury is a poisonous heavy metal and devices containing mercury once out of use are to be treated as hazardous waste. These switches therefore have to be disposed appropriately. Mercury is also present in fluorescent light tubes, compact fluorescent lamps and halide lamps.

Mercury thermostats can be disposed of under the “Switch the 'Stat” program which is a thermostat replacement and collection program delivered in partnership with the Heating Refrigeration and Air Conditioning Institute of Canada (HRAI) in British Columbia. Drop of locations can be found at http://switchthestat.ca/eng/index.php. Fluorescent light tubes and compact fluorescent lamps can be disposed of under the Light Recycle program http://www.lightrecycle.ca/.

Radon Gas:

Radon is a colourless, odourless radioactive gas that occurs naturally from the breakdown of uranium. Radon can be found where soils and rocks contain uranium mineral. It is a radioactive gas that is produced by the decay of uranium. Radon is naturally occurring, and emanates from soil and rocks. It percolates up through soil into buildings, and if it is not evacuated there can be much higher exposure levels indoors than outdoors. In open air or in areas with high air circulation, radon is not considered a health problem. Fortunately, high radon levels can be easily tested for, allowing for mitigation. Health Canada’s guideline for the acceptable level of indoor radon in a normal living area is 200 Bq/m^3. Radon is a known carcinogen, and is estimated to cause up to 10% of all lung cancers in Canada.

In March 2012, Health Canada undertook a large scale study of radon levels in homes across Canada and the results of the study were published in a document entitled Cross-Canada Survey of Radon Concentrations in Homes - Final Report. According to the report, the average percentage of homes with elevated radon levels in Canada was near 7%. In BC, the proportion of homes with elevated radon levels in the Lower Mainland and Vancouver Island were significantly below the national average while the interior of BC had some of the highest elevated radon levels in Canada. For example, the East Kootenay region had 19% of homes with elevated radon levels while Kootenay Boundary had 19.3% and the Okanagan had 17.4% of homes with elevated radon levels.

However, according to Health Canada’s *Reducing Radon Levels in Existing Homes: A Canadian Guide for Professional Contractors*, there is such a high variability in housing construction that even adjacent homes can have significantly different concentrations of radon. Only through radon testing can the radon levels in a home be determined with certainty.

Foundations, Excavation & Shoring Specialists

September 6, 2018
Reference: 16-6691

Via email: avargis@triumf.ca

TRIUMF
4004 Wesbrook Mall
Vancouver, BC V8T 2A3

Attn: Anil Vargis

Re: Geotechnical Exploration Report
Proposed TR24 Cyclotron and IAMI
4004 Westbrook Mall, Vancouver, BC

Braun Geotechnical
102 – 19094 95A Ave
Surrey, BC V4N 4P3
Tel: 604-513-4190
Fax: 604-513-4195
info@braungeo.com

www.braungeo.com

Foundations

Excavation & Shoring

Slope Stability

Natural Hazards

Pavement Design and Management

Reinforced Soil Walls and Slopes

1.0 INTRODUCTION

As requested, Braun Geotechnical Ltd. (Braun) has completed a geotechnical exploration for the proposed TRIUMF TR24 Cyclotron and Institute for Accelerator-based Medical Isotopes (IAMI) Building at the above referenced location. The geotechnical work has been performed in general accordance with the Braun Geotechnical proposal dated July 23, 2018 (Our reference no. 16-6691). The scope of work included subsurface exploration and preparation of this geotechnical report. The scope of services was limited to the evaluation of geotechnical characteristics of the site and environmental considerations have not been reviewed.

Should any changes be made to the proposed layout or general nature of the project, Braun Geotechnical should be notified to review and modify the recommendations to reflect those changes, as appropriate. In addition, final structural and architectural drawings should be provided to Braun Geotechnical for review of geotechnical aspects.

2.0 SITE DESCRIPTION AND PROPOSED DEVELOPMENT

It is understood that construction of the above noted building is proposed on the south side of the existing TRIUMF Meson Hall Building. It is understood that the proposed building would extend about 6m below existing grades, similar to the existing building to the north.

The area of the proposed building slopes down gently to the southeast and has been filled to raise site grades. The areas south and east of the proposed building slope down to approximate natural grades. At the time of the field exploration, a majority of the site was paved, and some areas were landscaped with trees and other vegetation.

3.0 GEOTECHNICAL EXPLORATION

Five test holes (TH18-01 to TH18-05) were drilled on August 15, 2018 using a truck mounted, solid stem auger drill. The auger holes were drilled to depths ranging from approximately 5.5 to 10.7m.

Dynamic Cone Penetration Tests (DCPTs) were also advanced at the locations of select test holes to practical refusal at depths of 4.3 to 7.5m. Local experience indicates that the DCPT results can be approximately correlated with Standard Penetration Test (SPT) N-values to provide an estimate of relative in situ density of granular soils and strength of cohesive soils.

The test holes were logged in the field by Braun Geotechnical and representative disturbed samples were collected from the augers for further visual classification purposes and routine laboratory moisture content testing. The approximate test hole locations are shown on the attached plan (Dwg. 16-6691-2018-01).

4.0 SOIL AND GROUNDWATER CONDITIONS

A review of available published and in-house geological information indicated that the study site area is underlain by Vashon Drift and Capilano Sediments which typically comprise very dense sand and gravel with variable silt content. The results of the geotechnical exploration were considered to be generally consistent with the published information, with the exception of the near surface fill zone. Please refer to the test hole logs for detailed subsurface conditions encountered.

A generalized subsoil profile based on the test holes is provided below.

FILL:

A variable thickness of fill was encountered in all test holes. The fill typically comprised brown to grey-brown, damp, loose to compact SAND and GRAVEL to silty SAND or sandy SILT to SILT with trace gravel and trace organics/wood pieces and extended to depths ranging from 2.0 to 3.6m

ORGANICS:

Dark brown, organic-rich soils was encountered in TH18-01 and TH18-03 below the fill layer. The thickness of the organic containing soil was approximately 0.5m and 0.9m in the respective test holes.

SILT:

Grey, damp, stiff SILT with trace sand and trace gravel was encountered below to depths of 4.6 to 7.0m at all test holes.

Silty SAND:

Grey, dense to very dense, damp to moist silty SAND was encountered below to the depths of exploration.

GROUNDWATER:

Slight seepage was encountered at the time of drilling at TH18-05 at 5.2m depth.

A standpipe piezometer was installed at TH18-03 to a depth of 8.8m to monitor groundwater levels. Groundwater was measured at a depth of 6.7m below existing grades on August 28, 2018. In general, semi-static water levels are expected to fluctuate seasonally, and with drainage conditions, including influence of near-surface seepage.

The subsurface conditions described above were encountered at the test hole locations only. Subsurface conditions at other locations could vary.

5.0 DISCUSSION AND RECOMMENDATIONS

5.1 General

It is understood that the underside of foundations would extend approximately 6m below existing grades, approximately matching the slab elevation of the existing building to the north. It is expected that dense to very dense silty SAND would be encountered at footing subgrade level below a majority of the building. The sand is considered suitable for direct support of conventional spread and strip footings. However, stiff silt may be encountered at the southeast corner of the building, requiring the footings to be lowered to a depth of approximately 7.0m below existing grades. Alternatively, the silt could be sub-excavated and replaced with lean mix concrete or controlled density fill (CDF) where encountered below the building footprint.

The following sections provide our geotechnical recommendations for site preparation and foundation design.

5.2 Site Preparation

Subgrade preparation below the proposed building should include removal of existing fill, organic soils, and any soft or otherwise disturbed soils down to the underlying undisturbed dense to very dense silty sand. Exposed subgrade soils should be reviewed by Braun Geotechnical.

A nominally thick (less than 100mm) protective layer of 20mm clear crushed gravel should be placed over the prepared subgrade. Drainage measures should be implemented to reduce the potential for ponding of water in the excavation.

Note that the underlying natural soils may contain large to very large boulders which may be encountered during site preparation activities. Large boulders could require additional excavation measures such as splitting or blasting.

5.3 Structural Fill

Subgrade restoration fills & general backfills should consist of structural fill comprised of 75mm minus gravel and sand with less than 5% fines (percent passing the #200 sieve). Structural fill should be placed and compacted in maximum 300mm loose lifts with each lift compacted to at least 95% Modified Proctor Density (MPD). For confined areas, structural fill placed under building, sidewalk and roadway pavements should extend horizontally beyond by a distance equal to at least the thickness of structural fill. Unconfined fills should typically extend horizontally by a distance equal to 2 times the thickness of structural fill.

Fine-grained or high fines site soils (silt or silty sand) are generally not considered suitable for reuse as structural fill.

Density testing should be carried out during fill placement on a regular basis to confirm adequacy of compaction, and the results forwarded to Braun Geotechnical for review. Braun Geotechnical should also be contacted to review fill quality, and placement and compaction procedures.

5.4 Excavation Slopes

It is anticipated that unsupported excavation cuts could be sloped at 1H:1V (Horizontal to Vertical) in fill and the underlying firm to stiff silt, and 1H:2V in the dense to very dense silty sand. Flatter slopes may be required if poor soil conditions or seepage is encountered. All cut slopes should be covered with poly plastic sheeting held securely in place at the crest and toe of slopes for moisture control and erosion protection.

Where the use of temporary unsupported excavation slope cuts is not feasible due to site constraints, suitable support systems such as conventional shotcrete and anchor shoring may be required.

Details of proposed excavation and shoring would be provided on excavation and shoring drawings under separate cover after the building design and exterior sump layout is finalized.

Based on subsurface conditions encountered at test hole locations, it is anticipated that the excavation could be kept free of any standing water using conventional pumping sumps. However, dewatering requirements should be reviewed at the time of excavation.

5.5 Proposed On-Site Asphalt Pavements

With subgrade preparation completed in the manner recommended above, the minimum recommended pavement structure is outlined below.

Parking Areas	*Travel + Fire Access Pavements (Truck traffic)*	*Material*
65mm	75mm	Hot Mix Asphalt Surface (MMCD Hot Mix Asphalt, LC#2 and UC#2)
100mm	100mm	19mm minus Granular Base (MMCD Sec. 2226 & 2223)
300mm	300mm	Granular Subbase (SGSB) (MMCD Sec. 2226 & 2234)

The gradation of the above materials should comply with the appropriate Master Municipal Specifications outlined above. The road construction materials should be placed and compacted in compliance with the current MMCD specifications. Adequate drainage and/or cross falls should be provided to ensure that the base and subbase materials will not become saturated.

5.6 Foundation Design

It is recommended that foundations for the proposed building be supported on the natural dense to very dense silty sand, or lean mix concrete or controlled density fill (CDF) placed thereon. The following soil resistance (bearing) values may be adopted for foundation design. Recommended soil resistance values for structural fill are also provided for any other structures that may be supported on structural fill.

Foundation Subgrade	Limit States Design		Working Stress Design
	Factored Ultimate Bearing Resistance (ULS)	Serviceability Limit State (SLS)	Allowable Bearing Pressure DL + LL
Dense to very Dense Silty SAND	600 kPa (12500 psf)	400 kPa (8300 psf)	400 kPa (8300 psf)
Structural Fill (other structures)	225 kPa (4700 psf)	120 kPa (2500 psf)	120 kPa (2500 psf)

The design pressures assume the following:

- Strip and pad footings have minimum widths of 460 mm (18”) and 600 mm (24”), respectively.
- Footings are founded at least 460 mm (18”) below final finished adjacent grade for frost protection and confinement.
- Foundation subgrade is prepared as described in Section 5.2 “Site Preparation”.
- All load-bearing surfaces are reviewed by the Geotechnical Engineer.
- Foundation bearing surfaces are no higher than 2H:1V (horizontal to vertical) from the base or toe of adjacent foundation elements and no higher than 1H:1V from the base or toe of sumps, utility structures, or other buried structures.
- Silty subgrade areas are protected immediately after exposure.

Foundations for any ancillary structures founded at shallow depth should be reviewed on a case by case basis. Potential for total and differential settlements between these structures and the main building should be considered in design due to the potential for settlement resulting from the near surface zone of fill and organic containing soils.

Subgrade for a raft type foundation should be prepared as described in subsection 5.2 above. A subgrade reaction modulus (ks) of 50,000kN/m^3 is considered appropriate for the prepared subgrade consisting of dense to very dense silty sand. It should be noted that the modulus of subgrade reaction is typically estimated in the field using a 300mm x 300mm plate (k_{v1}). However the subgrade reaction modulus parameter is dependant on a wide variety of conditions including the size and shape of design footings, type of soil, relative stiffness of footings and soil, location below foundation, duration of load relative to hydraulic conductivity of the loaded soils, and other parameters (CFEM 2006). Generally, the modulus of subgrade reaction decreases as foundation size increases, all other factors held constant.

Total settlements for foundations designed as recommended above are expected to be less than 12mm, with differential settlements less than half of the total over a horizontal distance of 5m.

5.7 Seismic Considerations

The 2018 BC Building Code classifies a site as Site Class C where the subgrade soils in the upper 30m consist of "very dense soil and soft rock" with average SPT N values greater than 50 and average undrained shear strength (su) greater than 100 kPa. As indicated above, available subsurface information indicates that dense to very dense soils are present at footing level, corresponding to Site Class C.

The subgrade soil conditions are not considered susceptible to seismically induced liquefaction.

5.8 Machine Vibrations

It is understood that the proposed Cyclotron equipment is sensitive to vibration from natural (i.e. earthquake) and anthropogenic sources (i.e. construction equipment, installed reciprocating and rotary machinery, etc).

Detailed machine vibration analysis is beyond the scope of this geotechnical report, and if required should be carried out by a vibration specialist with expertise in machine foundations and vibration mitigation measures.

5.9 Slab on Grade

Any areas with a conventional slab on grade should be underlain by a drainage layer comprising a minimum 150mm (6") thick layer of well-compacted 19mm clear crushed gravel. Polyethylene sheeting should be provided beneath the slab to reduce potential slab dampness.

Compaction testing should be carried out on underslab fills to confirm that all fill placed below the building has been compacted to at least 95% MPD. Prior to placement of any grade restoration fills, the subgrade should be reviewed by the geotechnical consultant.

5.10 Groundwater

It is considered that drainage (perimeter drains) around the existing structure to the north may have resulted in lowering of the groundwater level in the vicinity of the proposed building. However, seepage and/or groundwater levels above the base of the proposed structure could be encountered at the time of excavation. Braun Geotechnical should be contacted to review actual groundwater and seepage conditions at the time of excavation to assess if additional temporary dewatering measures or permanent drainage measures around the proposed building are required.

5.11 Perimeter Drainage and Backfill

Perimeter drainage should consist of perforated 150mm (6") PVC pipe, placed around the building perimeter, with the invert elevation at footing level. The perimeter drains should be surrounded by at least 150mm (6") of 19mm (¾") clear crushed gravel. A 150mm (6") thick layer of birdseye gravel should be placed over the clear crushed gravel to act as a filter layer.

Backfill placed around perimeter foundation walls should typically consist of free-draining granular material such as sand or sand and gravel with less than 5% fines. The material should be compacted to at

least 95% of MPD for its full depth. Where space is limited adjacent to the foundation walls, birdseye gravel placed in maximum 900mm (3') thick lifts, with each lift compacted using a concrete vibrator while flushing with water may be used as backfill material.

5.12 Horizontal Wall Pressures

The building walls should be designed for lateral pressures which would be applied by the backfill bearing against the outside of the walls and possible surcharge pressures.

For design purposes building walls may be designed for the loads indicated on the Horizontal Wall Pressure Diagrams attached (Dwg. 16-6691-02) for horizontal ground surface. Actual earth pressures on foundation walls will be a function of backfill material, compaction procedure and equipment, surcharge loads, wall rigidity, and backfill slope.

5.13 Permanent Slopes

The recommended maximum permanent cut slope angle within any soft/loose to compact soils is 3H:1V. The recommended maximum permanent cut slope within dense/stiff soils is 2H:1V.

Any deterioration of the cut slopes should be immediately reported to the geotechnical engineer. Based on the engineers review, recommendations for stabilization will be provided which may include subsequent flattening of the slopes in addition to other possible mitigative measures.

Permanent fill slopes consisting of suitably compacted mineral soils may be constructed at gradients no steeper than 2.5H:1V.

6.0 GEOTECHNICAL FIELD REVIEW

Geotechnical field reviews are required by the Geotechnical Engineer of Record and to satisfy the requirements of the Letters of Professional Assurance required for the Building Permit. Field reviews are essential to confirm that the recommendations of the geotechnical report are understood and followed.

Geotechnical field reviews should be arranged by the Contractor to address the following:

- Removal of unsuitable materials below the building footprint and asphalt pavement areas;
- Review of temporary slope cuts and shoring installation;
- Suitability of exposed footing subgrade;
- Review and density testing of structural fill placed below building footings and slab;
- Review and density testing of perimeter backfill.

7.0 CLOSURE

This report is prepared for the exclusive use of TRIUMF and their designated representatives and may not be used by other parties without the written permission of Braun Geotechnical Ltd.

If the development plans change, or if during construction soil conditions are noted to be different from those described in this report, Braun should be notified immediately in order that the geotechnical recommendations can be confirmed or modified, if required. Further, this report assumes that field reviews will be completed by Braun Geotechnical during construction.

The site Contractor should make their own assessment of subsurface conditions and select the construction means and methods most appropriate to the site conditions. This report should not be included in the specifications without suitable qualifications approved by the geotechnical engineer. The report should be considered preliminary and subject to review and revision as required for final project design and construction.

The use of this assessment report is subject to the conditions on the attached Report Interpretation and Limitations sheet. The reader's attention is drawn specifically to those conditions, as it is considered essential that they be followed for proper use and interpretation of this report.

We hope the above meets with your requirements. Should any questions arise, please do not hesitate to contact the undersigned.

Yours truly,

Braun Geotechnical Ltd.

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA S.S. SINGHA #25924

Sep 6, 2018

Sonny Singha, P.Eng.
Geotechnical Engineer

Braun Geotechnical Ltd.

James Wetherill, P.Eng.
Geotechnical Engineer

Encl: Report Interpretation and Limitations
Test Hole Location Plan
Test Hole Logs
Horizontal Wall Pressure Diagram

BRAUN GEOTECHNICAL LTD.

REPORT INTERPRETATION AND LIMITATIONS

1. STANDARD OF CARE

Braun Geotechnical Ltd. (Braun) has prepared this report in a manner consistent with generally accepted engineering consulting practices in this area, subject to the time and physical constraints applicable. No other warranty, expressed or implied, is made.

2. COMPLETENESS OF THIS REPORT

This Report represents a summary of paper, electronic and other documents, records, data and files and is not intended to stand alone without reference to the instructions given to Braun by the Client, communications between Braun and the Client, and/or to any other reports, writings, proposals or documents prepared by Braun for the Client relating to the specific site described herein.

This report is intended to be used and quoted in its entirety. Any references to this report must include the whole of the report and any appendices or supporting material. Braun cannot be responsible for use by any party of portions of this report without reference to the entire report.

3. BASIS OF THIS REPORT

This report has been prepared for the specific site, development, design objective, and purpose described to Braun by the Client or the Client's Representatives or Consultants. The applicability and reliability of any of the factual data, findings, recommendations or opinions expressed in this document pertain to a specific project at described in this report and are not applicable to any other project or site, and are valid only to the extent that there has been no material alteration to or variation from any of the descriptions provided to Braun. Braun cannot be responsible for use of this report, or portions thereof, unless we were specifically requested by the Client to review and revise the Report in light of any alterations or variations to the project description provided by the Client.

If the project does not commence within 18 months of the report date, the report may become invalid and further review may be required.

The recommendations of this report should only be used for design. The extent of exploration including number of test pits or test holes necessary to thoroughly investigate the site for conditions that may affect construction costs will generally be greater than that required for design purposes. Contractors should rely upon their own explorations and interpretation of the factual data provided for costing purposes, equipment requirements, construction techniques, or to establish project schedule.

The information provided in this report is based on limited exploration, for a specific project scope. Braun cannot accept responsibility for independent conclusions, interpretations, interpolations or decisions by the Client or others based on information contained in this Report. This restriction of liability includes decisions made to purchase or sell land.

4. USE OF THIS REPORT

The contents of this report, including plans, data, drawings and all other documents including electronic and hard copies remain the copyright property of Braun Geotechnical Ltd. However, we will consider any reasonable request by the Client to approve the use of this report by other parties as "Approved Users." With regard to the duplication and distribution of this Report or its contents, we authorize only the Client and Approved Users to make copies of the Report only in such quantities as are reasonably necessary for the use of this Report by those parties. The Client and "Approved Users" may not give, lend, sell or otherwise make this Report or any portion thereof available to any other party without express written permission from Braun. Any use which a third party makes of this Report – in its entirety or portions thereof – is the sole responsibility of such third parties. BRAUN GEOTECHNICAL LTD. ACCEPTS NO RESPONSIBILITY FOR DAMAGES SUFFERED BY ANY PARTY RESULTING FROM THE UNAUTHORIZED USE OF THIS REPORT.

Electronic media is susceptible to unauthorized modification or unintended alteration, and the Client should not rely on electronic versions of reports or other documents. All documents should be obtained directly from Braun.

5. INTERPRETATION OF THIS REPORT

Classification and identification of soils and rock and other geological units, including groundwater conditions have been based on exploration(s) performed in accordance with the standards set out in Paragraph 1. These tasks are judgemental in nature; despite comprehensive sampling and testing programs properly performed by experienced personnel with the appropriate equipment, some conditions may elude detection. As such, all explorations involve an inherent risk that some conditions will not be detected.

Further, all documents or records summarizing such exploration will be based on assumptions of what exists between the actual points sampled at the time of the site exploration. Actual conditions may vary

significantly between the points investigated and all persons making use of such documents or records should be aware of and accept this risk.
The Client and "Approved Users" accept that subsurface conditions may change with time and this report only represents the soil conditions encountered at the time of exploration and/or review. Soil and ground water conditions may change due to construction activity on the site or on adjacent sites, and also from other causes, including climactic conditions.
The exploration and review provided in this report were for geotechnical purposes only. Environmental aspects of soil and groundwater have not been included in the exploration or review, or addressed in any other way.
The exploration and Report is based on information provided by the Client or the Client's Consultants, and conditions observed at the time of our site reconnaissance or exploration. Braun has relied in good faith upon all information provided. Accordingly, Braun cannot accept responsibility for inaccuracies, misstatements, omissions, or deficiencies in this Report resulting from misstatements, omissions, misrepresentations or fraudulent acts of persons or sources providing this information.

6. DESIGN AND CONSTRUCTION REVIEW

This report assumes that Braun will be retained to work and coordinate design and construction with other Design Professionals and the Contractor. Further, it is assumed that Braun will be retained to provide field reviews during construction to confirm adherence to building code guidelines and generally accepted engineering practices, and the recommendations provided in this report. Field services recommended for the project represent the minimum necessary to confirm that the work is being carried out in general conformance with Braun's recommendations and generally accepted engineering standards. It is the Client's or the Client's Contractor's responsibility to provide timely notice to Braun to carry out site reviews. The Client acknowledges that unsatisfactory or unsafe conditions may be missed by intermittent site reviews by Braun. Accordingly, it is the Client's or Client's Contractor's responsibility to inform Braun of any such conditions.
Work that is covered prior to review by Braun may have to be re-exposed at considerable cost to the Client. Review of all Geotechnical aspects of the project are required for submittal of unconditional Letters of Assurance to regulatory authorities. The site reviews are not carried out for the benefit of the Contractor(s) and therefore do not in any way effect the Contractor(s) obligations to perform under the terms of his/her Contract.

7. SAMPLE DISPOSAL

Braun will dispose of all samples 3 months after issuance of this report, or after a longer period of time at the Client's expense if requested by the Client. All contaminated samples remain the property of the Client and it will be the Client's responsibility to dispose of them properly.

8. SUBCONSULTANTS AND CONTRACTORS

Engineering studies frequently requires hiring the services of individuals and companies with special expertise and/or services which Braun Geotechnical Ltd. does not provide. These services are arranged as a convenience to our Clients, for the Client's benefit. Accordingly, the Client agrees to hold the Company harmless and to indemnify and defend Braun Geotechnical Ltd. from and against all claims arising through such Subconsultants or Contractors as though the Client had retained those services directly. This includes responsibility for payment of services rendered and the pursuit of damages for errors, omissions or negligence by those parties in carrying out their work. These conditions apply to specialized subconsultants and the use of drilling, excavation and laboratory testing services, and any other Subconsultant or Contractor.

9. SITE SAFETY

Braun Geotechnical Ltd. assumes responsibility for site safety solely for the activities of our employees on the jobsite. The Client or any Contractors on the site will be responsible for their own personnel. The Client or his representatives, Contractors or others retain control of the site. It is the Client's or the Client's Contractors responsibility to inform Braun of conditions pertaining to the safety and security of the site – hazardous or otherwise – of which the Client or Contractor is aware.
Exploration or construction activities could uncover previously unknown hazardous conditions, materials, or substances that may result in the necessity to undertake emergency procedures to protect workers, the public or the environment. Additional work may be required that is outside of any previously established budget(s). The Client agrees to reimburse Braun for fees and expenses resulting from such discoveries. The Client acknowledges that some discoveries require that certain regulatory bodies be informed. The Client agrees that notification to such bodies by Braun Geotechnical Ltd. will not be a cause for either action or dispute.

BRAUN GEOTECHNICAL LTD.

Rev.	Description	Date

Client: Triumf

Project: Proposed TR24 Cyclotron and IAMI
4004 Westbrook Mall, Vancouver, BC

Title: LOCATION PLAN

Project no.	Drawn	Design	Checked	Date	Scale	Drawing no.
16-6691	GA	SS	JW	August 09, 2018	1:250	16-6691-2018-01

Test Hole Log: TH18-01

File: 16–6691
Project: Proposed TR24 Cyclotron and IAMI
Client: TRIUMF
Location: 4004 Wesbrook Mall, Vancouver, BC

BRAUN GEOTECHNICAL LTD.

Depth (ft / m)	Thickness (mm)	Sample	Soil Description	Sample #	Water cont.	DCPT (Blows per ft)	Remarks
0 / 0			50mm ASPHALT over				
			grey-brown, crushed SAND & GRAVEL, trace silt (BASE)				
1		○	brown, damp, compact SAND, some silt, some gravel (FILL)	S1	14%		
5 / 2		○	grey, damp, compact, silty SAND, trace gravel, trace organics (FILL)	S2	14%		
		○	dark-brown, damp, loose, silty SAND, some organics, trace gravel (FILL)	S3	31%		
		○	- wood debris from 2.4 to 2.7m	S4	38%		
10 / 3		○	dark-brown, damp, soft, organic-rich SILT	S5	144%		
4			grey, occasionally brown-mottled, firm to stiff SILT, trace sand, trace gravel				
15 / 5		○		S6	21%		
			grey, damp, dense to very dense, silty SAND, some gravel				120 blows / 6"
20 / 6		○		S7	11%	End of DCPT, Refusal @ 5.7m	
7			End of Test Hole, Refusal @ 6.7m				
25 / 8							
9							
30 / 10							
35 / 11							

DCPT (Blows per ft): 0 10 20 30 40 50 60

Equipment: Truck Mounted Auger Rig
Sampling method: Grab Off Auger Flight

Datum: Ground Surface
Water Depth: Not encountered
(at time of drilling)

Logged By: DC
Exploration Date: August 15, 2018
Dwg No.: 16-6691-TH01
Page: 1 of 1

Test Hole Log: TH18-02

File: 16–6691
Project: Proposed TR24 Cyclotron and IAMI
Client: TRIUMF
Location: 4004 Wesbrook Mall, Vancouver, BC

BRAUN GEOTECHNICAL LTD.

Depth (ft)	Depth (m)	Thickness (mm)	Sample	Soil Description	Sample #	Water cont.	DCPT (Blows per ft) 0 10 20 30 40 50 60	Remarks
0	0		○	tan-brown, damp, compact SAND & GRAVEL, some silt (FILL)	S1			
	1		○	grey, damp, compact, silty SAND, trace gravel, trace organics (FILL)	S2	11%		
5			○	grey, damp, firm, sandy SILT, trace gravel (FILL)	S3	11%		
	2		○	grey, compact to dense, silty SAND, trace gravel (FILL)	S4	9%		64
10	3		○	grey, damp, stiff SILT, trace sand, trace organics (FILL)	S5	22%		
			○	brown, moist, compact SAND (FILL)	S6	18%		
	4		○	grey, occasionally brown-mottled, damp, stiff SILT, trace sand, trace gravel	S7	19%		
15			○	grey, damp, dense, silty SAND, trace to some gravel	S8	10%		
	5			End of Test Hole, Refusal @ 5.5m			End of DCPT, Refusal @ 5.7m	102 blows / 2"
20	6							
	7							
25								
	8							
30	9							
	10							
35	11							

Equipment: Truck Mounted Auger Rig
Sampling method: Grab Off Auger Flight

Datum: Ground Surface
Water Depth: Not encountered
(at time of drilling)

Logged By: DC
Exploration Date: August 15, 2018
Dwg No.: 16-6691-TH02
Page: 1 of 1

Test Hole Log: TH18-03

File: 16–6691
Project: Proposed TR24 Cyclotron and IAMI
Client: TRIUMF
Location: 4004 Wesbrook Mall, Vancouver, BC

BRAUN GEOTECHNICAL LTD.

Depth (ft / m)	Thickness (mm)	Sample	Soil Description	Sample #	Water cont.	Remarks
0 / 0		○	brown, damp, compact SAND, some silt, trace to some gravel (FILL)	S1	9%	
		○	grey, damp, compact to dense, silty SAND, trace gravel (FILL)	S2	10%	
5 / 1						
		○		S3	8%	
2			- trace organics below 2.1m			
		○		S4	17%	
		○	brown, damp, firm, organic-rich SILT	S5	125%	
10 / 3						
			grey, occasionally brown-mottled, firm to stiff SILT, trace sand			
4		○		S6	23%	2" PVC Standpipe Piezometer, Top 18' soil cuttings
15 / 5			grey, moist, dense, silty SAND to sandy SILT, trace gravel			
		○		S7	15%	
		○	grey, damp, dense, silty SAND, trace gravel	S8	11%	
20 / 6						
7		○		S9	10%	
25 / 8						Bottom 10' slotted pipe with Filter SAND
		○		S10	11%	
30 / 9						Piezometer Readings: August 28, 2018: 6.7m
10		○		S11	10%	
35 / 11			End of Test Hole @ 10.7m			

Equipment: Truck Mounted Auger Rig
Sampling method: Grab Off Auger Flight

Datum: Ground Surface
Water Depth: Not encountered
(at time of drilling)

Logged By: DC
Exploration Date: August 15, 2018
Dwg No.: 16-6691-TH03
Page: 1 of 1

Test Hole Log: TH18-04

File: 16–6691
Project: Proposed TR24 Cyclotron and IAMI
Client: TRIUMF
Location: 4004 Wesbrook Mall, Vancouver, BC

BRAUN GEOTECHNICAL LTD.

Depth (ft)	Depth (m)	Thickness (mm)	Sample	Soil Description	Sample #	Water cont.	DCPT (Blows per ft)	Remarks
0	0		○	tan-brown, compact, SAND & GRAVEL, trace silt (FILL)	S1			
				grey, damp, compact, silty SAND, trace organics (FILL)				
5	1		○		S2	13%		
	2			brown, damp, firm SILT, some organics				
			○		S3	29%		
10	3		○	grey, occasionally brown-mottled, damp, stiff SILT	S4	26%		
	4		○		S5	19%		
15				grey, moist, stiff SILT, trace sand				
	5		○		S6	22%		
				grey, moist, stiff SILT, trace clay				
20	6		○		S7	24%		
	7		○		S8	18%		
25				grey, damp, dense, silty SAND, trace gravel				
	8							
			○		S9	11%		
30	9							
	10		○		S10	11%		
35								
	11			End of Test Hole @ 10.7m				

DCPT (Blows per ft): 0 10 20 30 40 50 60

105 blows / 9"

End of DCPT, Refusal @ 7.5m

Equipment: Truck Mounted Auger Rig
Sampling method: Grab Off Auger Flight

Datum: Ground Surface
Water Depth: Not encountered
(at time of drilling)

Logged By: DC
Exploration Date: August 15, 2018
Dwg No.: 16-6691-TH04
Page: 1 of 1

Test Hole Log: TH18-05

File: 16–6691
Project: Proposed TR24 Cyclotron and IAMI
Client: TRIUMF
Location: 4004 Wesbrook Mall, Vancouver, BC

BRAUN GEOTECHNICAL LTD.

Depth (ft / m)	Thickness (mm)	Sample	Soil Description	Sample #	Water cont.	DCPT (Blows per ft)	Remarks
0 ft / 0 m		○	grey, damp, dense, silty SAND, some gravel (FILL)	S1	10%		
			- compact, trace organics below 0.9m				
5 / 1		○		S2	19%		
			- loose below 2.4m				
10 / 3		○	brown, damp, firm SILT, some organics	S3	66%		
			grey-brown, damp, stiff SILT				
		○		S4	22%		
15 / 4							101 blows / 12"
						End of DCPT, Refusal @ 4.3m	
			grey, damp, dense, silty SAND, trace gravel				
		○		S5	18%		- seepage at 5.2m
20 / 6			- wet below 6.1m				
		○		S6	17%		
25 / 7		○		S7	12%		
		○		S8	11%		
30 / 9			End of Test Hole @ 9.1m				
35 / 10 / 11							

DCPT (Blows per ft): 0 10 20 30 40 50 60

Equipment: Truck Mounted Auger Rig
Sampling method: Grab Off Auger Flight

Datum: Ground Surface
Water Depth: Seepage at 5.2m
(at time of drilling)

Logged By: DC
Exploration Date: August 15, 2018
Dwg No.: 16-6691-TH05
Page: 1 of 1

NOTES:

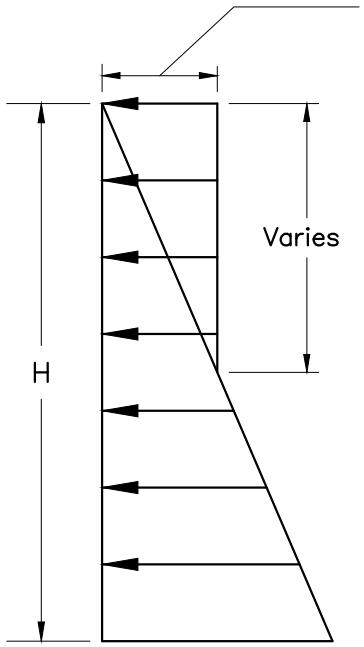
- Granular backfill adjacent to foundation walls as per city requirements and/or the Geotechnical Report.
- Lateral loads indicated are subject to review of actual soil conditions exposed at time of excavation.
- Wall pressures are approximate, actual pressures will depend on wall stiffness, groundwater conditions, backfill slope, type of backfill, compaction equipment, and surcharge pressures.

ASSUMPTIONS:

- Horizontal ground surface.
- Active loading conditions (i.e. top of wall is free to rotate 0.1% of wall height). Other conditions subject to review by Braun Geotechnical.
- Fully drained backfill.
- Seismic peak ground acceleration of 0.381g.
- All surcharge loads to be reviewed by Braun Geotechnical.

ALL LOADS ARE UNFACTORED

Metric Units m & kPa Imperial Units ft & psf

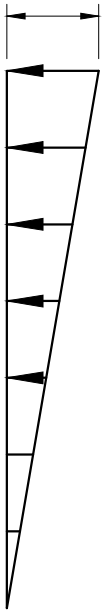


- Compaction Induced Pressure of 20kPa (400psf).
- A lower value may be feasible based on review of compaction equipment and procedure
- Compaction pressure need only be used for structural design not overall stability

5.2H kPa
(33.1H psf)

STATIC

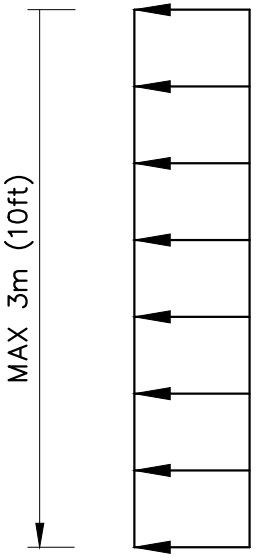
See Table for Wall Pressure Based on Tolerable Displacement of Wall away from Soil Backfill



Tolerable Displacement	Wall Pressure
0	4.8H kPa (30H psf)
13mm (0.5")	3.0H kPa (19H psf)
25mm (1")	2.4H kPa (16H psf)
50mm (2")	2.0H kPa (13H psf)

(Based on Richard & Elms Procedure)

SEISMIC



0.3 x Surcharge Press.

SURCHARGE

BRAUN GEOTECHNICAL LTD.

Client: Triumf				Title: Horizontal Wall Loading Diagram			
Project: Proposed TR24 Cyclotron and IAMI, 4004 Wesbrook Mall, Vancouver, BC							
Project no. 16-6691	Drawn DC	Design DC	Approved SS	Date September 5, 2018	Scale NTS	Drawing no. 16-6691-02	

UBC Energy & Water Services 6130
Agronomy Road, Vancouver, BC V6T 1Z3
Tel: (604) 822-9445 Fax: (604) 822-8833

PRELIMINARY UTILITY SERVICE CONNECTION APPLICATION

Part 1. INSTRUCTIONS

- Application is required for any new or substantially modified connection to UBC's utility systems. There is no fee for this application.
- Fill in Part 2 for all requests. **INCLUDE PROJECT NAME**. Fill in Parts 3 and/or 4 as applicable.
- **This *Service Connection Application* shall be considered approved when an authorized UBC *Development permit* is obtained**.

Part 2. REQUESTOR INFORMATION

UBC Contract Administrator or UBC Project Manager

Project Manager name & Dept. (e.g. C&CP DM, UBCPT Manager, UBC Plant Ops, Housing)		Telephone	
		Fax	
		Email	
Project Name/Title/Description		Project No.	
Gross Building Area (m2)		Date BOG Approval Obtained (month, year)	
Total Impervious Area (m2)			
Date Requested		Highest UBC Board of Governors Approval (Pre-board,1,2,3 or 4)	

Part 3. MECHANICAL SERVICES: WATER, SANITARY, STORM, GAS, and DISTRICT HEATING

Part 3 (a). Water Distribution. Water service to meet requirements of UBC Technical Guidelines Division 2, Section 02660.

Design by (Company)	AME Consulting Group LTD.			Telephone	604-684-5995
Primary Contact	ZLATKO PULJIC P.ENG.			Fax	604-684-5993
				Email	ZLATKOPULJIC@AMEGROUP.CA
Drawings Attached? (Yes / No / Later)	No	Peak Domestic Water Consumption (L/S)	12.5 l/s (200 gpm)	Sprinkler & Hose Fire Flow Demand (L/s)	47-63 l/s (750-1000 gpm)

Part 3 (b). Storm Sewer and Sanitary Sewer: Consultant & Design Data

Service to meet requirements of UBC Technical Guidelines Division 2: Section 02720 for Storm, and Section 02730 for Sanitary.

Design by (Company)	AME Consulting Group LTD.				Telephone	604-684-5995	
Primary Contact	ZLATKO PULJIC P.ENG.				Fax	604-684-5993	
					Email	ZLATKOPULJIC@AMEGROUP.CA	
Storm Drawings Attached? (Yes / No / Later)	No			Stormwater Control Plan Attached? (Yes / No / Later / Not Required)	No		
Lot Area (m^2)		Total of roof horizontal projection area, 50% of largest vertical area adjacent to roof and paved area	10,270m2	Run-off coefficients	Predeveloped		
					Postdeveloped		
Time of concentration T_c (min)	15	10 year rainfall (mm/h)	10mm/15min	Peak storm load (L/s)	9.5 L/s	Pumped storm load (L/s) ***Note 1***	
Sanitary Drawings Attached? (Yes / No / Later)	No			Peak sanitary load (L/s)	16.1 L/s	Pumped sanitary load (L/s) ***Note 1***	
Any new or modified food preparation facilities?(Yes / No). If yes, then describe.	No			Any Biological, Chemical or Radioactive Wastes to be discharged to sanitary? (Yes / No). If yes, then describe.	TBD		

***Note 1*:** Only under unique circumstances pumping into UBC network will be considered. A prior request for permission to pump into UBC network shall be submitted to UBC Energy & Water Services (see UBC Technical Guidelines, Section 02720, Clause 2.5.7 and Section 02730, Clause 2.5.6).

Part 3 (c). Gas and District Heating Distribution

- Service to meet requirements of UBC Technical Guidelines Div. 2, Section 02685 (gas) and Div. 15, Section 15004 (District Heating).
- Fax or mail request to UBC EWS (address & telephone above) to attention of Manager, Mechanical Distribution Services.

Gas Distribution

Design by (Company)	AME Consulting Group LTD.	Telephone	604-684-5995
		Fax	604-684-5993
Designer Primary Contact	ZLATKO PULJIC P.ENG.	Email	ZLATKOPULJIC@AMEGROUP.CA
Required overpressure to building downstream of meter (kPa)	13.8 (2PSI) downstream of meter and PRVs	Peak Gas Load based on all gas equipment in building (m^3/hour)	297.4 m3/hour (10,500 mbh or scfh)

District Heating Distribution

- Summer supply temperature: 70° C, winter peak supply temperature: 115° C.

Design by (Company)		Telephone	
		Fax	
Designer Primary Contact		Email	
Peak Design District Heating Load (building heating) based on all equipment in building (kW)			
Peak Design District Heating Load (domestic hot water) based on all equipment in building (kW)			

- **Fax or mail request to UBC EWS (address & telephone at top of 1st pg) to attention of Mgr, Mechanical Dist. Services.**
- Campus Planning & Development additionally requires a Plumbing Permit for any modification or connection to water distribution, sanitary sewer, or storm sewer as per B.C. Building Code (Plumbing). Contact C&CP Regulatory Services at (604) 822-8228.
- B.C Gas/Boiler Safety Branch (Act) required permits and inspections are the responsibility of the project team.

Part 4. ELECTRICAL SERVICE

Electrical Design by (Company)				Telephone	
				Fax	
Designer Primary Contact				Email	
Connected Load		**Demand Load**			
	kVA		kVA		
	kW				
	Phase				
	Wire				
	Voltage				

- B.C Electrical Safety Branch (Act) required permits and inspections are the responsibility of the project team.
- Electrical service to meet requirements of UBC Technical Guidelines Division 2, Section 02800.
- **Fax or mail request to UBC Energy & Water Services (address & telephone above)**.