DIALOG®

# Canada Centre for Inland Waters

**2016-03-28**

PWGSC Project R.072688.001
Environment Canada
Burlington, Ontario

RS 2.1.2
**New Laboratory Building Analysis at CCIW**

Public Works and Government Services Canada | Travaux publics et Services gouvernementaux Canada

Environment Canada | Environnement Canada

Canada

# 1. Executive Summary

The Canada Centre for Inland Waters, as one of the National Water Research Institute (NWRI) two main centres is located at 867 Lakeshore Road in Burlington Ontario and is considered one of the world's leading water research centres. The CCIW complex consists of six inter-connected buildings, most built in the early 1970s in 4 phases, with a total of almost 50,000 square metres of floor space. It is owned and operated by Environment Canada who are the 'Custodial Department' of the CCIW and self-manages the facility. In addition to Environment Canada, the facility also houses Department of Fisheries & Oceans (DFO), Canadian Coast Guard (CCG) and members of the RCMP. The buildings have undergone some upgrades in the past as Environment Canada continues to improve the facilities.

The CCIW houses the central facilities of the (NWRI) and other Environment Canada programs, including the Ecosystem Monitoring and Assessment Network (EMAN) coordinating office; Ontario regional offices of Environment Canada, including those related to Great Lakes and meteorological programs; and the Wastewater Technology Centre (WTC), specializing in the advancement of environmentally friendly chemistry technologies as well as technologies for the treatment of municipal and industrial wastewater.

Research staff working at the CCIW includes aquatic ecologists, hydrologists, toxicologists, physical geographers, modellers, limnologists, environmental chemists and research technicians. The National Laboratory for Environmental Testing (NLET) at the CCIW has fully accredited environmental analysis capability for a wide range of organic and inorganic chemicals, including a specialization in low level metals and the analysis of organic contaminants. In addition to laboratory research, work carried out at the NLET involves engineering and technical operations, such as the planning and management of field sampling programs. Some of the highlights of the Canada Centre for Inland Waters include:

- A world-class ecotoxicological wetlab.
- The world's largest circulated flume, which is used in sediment transport studies.
- Specialized water quality and aquatic ecosystem laboratories.
- Great Lakes research vessels, operated in partnership with the Department of Fisheries and Oceans.
- World-class equipment calibration facilities, essentially to conducting excellent research.

The CCIW main buildings are all located within the building compound and are identified as follows:

1. Administration & Laboratory (A&L) – A seven storey building housing the main facility entrance, administrative offices, cafeteria, kitchen, auditorium, library, offices, laboratories. The majority of the laboratories are located on floors 4 to 7 with approximately 3,000 m² on each floor (Labs at 1,400m² and Office and Common Areas at 1,600m²). The Mechanical Room serving the A&L is located on the 3rd floor and the fume hood exhaust fans and stacks are housed in the Penthouse located above Floor 7.
2. Research & Development (R&D) – A two storey building housing offices, laboratories and workshops.
3. Hydraulics Lab – A two storey building housing laboratories and offices.
4. Warehouse – A two storey building housing workshops, storage areas, shipping/receiving areas, offices, and laboratories.
5. Boiler Plant – A one storey building with 2 mezzanine areas housing the main heating equipment for the entire facility.
6. WTC Building – A two storey, heated building, originally constructed in 1971 with an addition on the east side in 1995, currently housing offices and laboratories, workshops. This building is not part of the current investigation.

The four floors of the A&L Building which house the majority of the laboratory and office support space for the CCIW which comprise the focus of the Laboratory Modernization Plan Design Concept in this report.

### PROJECT OVERVIEW

The Canada Centre for Inland Waters is an advanced world-class facility at the leading edge of science and technology related to aquatic research. In order to meet its mandate it should provide an environmentally sustainable facility platform which encourages and supports the creativity and efforts of the professional, technical and administrative staff and visitors working at the facility. In a statement from Environment Canada's Science Strategy 2014-2019 for improving science infrastructure:

"Environment Canada maintains important infrastructure and resources to carry out and support its science activities, from its world-class scientific and technical workforce to its wealth of scientific data to the specialized laboratories, facilities and instruments that monitor environmental conditions across the country. This Strategy will help strengthen these resources by improving data management, facilitating greater external access to Departmental science and developing tools and policies to support leadership development and quality management across the Department. Environment Canada is committed to maintaining cutting-edge infrastructure to support its world-class science. In addition, an important part of performing science efficiently and in a responsive manner is working with partners, be it other federal departments, provinces or universities, to maximize world-class infrastructure and resources."

The CCIW has continued to operate since the 1970's as originally designed but as Environment Canada's science mandate has evolved, the facilities are at risk of becoming redundant. Various renovations have taken place or are on-going and the laboratories and offices are a patchwork of existing conditions and state of repair. There are a number of areas within the facility that do not meet current standards for life safety and accessibility and the energy and operating costs of running the facilities are quite high due to the age of the infrastructure with frequent breakdowns of equipment. Environment Canada as part of their mandate to provide facilities for world class research has undertaken a Laboratory Modernization Plan to provide a better process for managing capital projects for the long term recapitalization of the CCIW facility. The intent of the LMP is to function as a roadmap on how to provide the best value for the investment and to help determine the most beneficial way to develop the facility in both the short and long term. This LMP has been completed and a process and cost estimate has been prepared for review as Environment Canada considers options for maintaining the facilities into the 21st Century.

As part of the strategic review of the LMP, Environment Canada has also considered alternatives to the modernization of the existing Administration and Laboratory building which was the focus of the LMP with this study for a free-standing laboratory building on the CCIW campus. The implementation strategy for the LMP would require a complete redevelopment of the Floors 4 to 7 of the A&L Building with all new laboratories and work spaces being constructed during the projected six year timeline of the project. Undertaking such an endeavour would inevitably have an impact on Environment Canada and other user laboratories research as well as an impact on staffing. The results of this alternative study are synthesized in the report which follows.

### PROCUREMENT AND CAPITAL COSTS FOR A NEW LABORATORY BUILDING

It is expected that a new Laboratory Building for the CCIW would be a multi-year project which is contingent on long term capital funding. The timing of the program will be determined based on a commitment from the responsible agencies as well as how the project is ultimately funded. It is expected that the design of a new facility would occur over a two to three year period and the procurement model has been predicated on a start of construction in the first quarter of 2019 with a completion of the facility by the end 2021. It is expected that the commonly employed procurement strategies would be followed although there may be other strategic partnerships with institutional and private investors that could be considered.

The Project Cost Estimate for the New Laboratory Building of the CCIW has been developed to provide an assessment of the total project costs associated with the NLB of the Canada Centre for Inland Waters in Burlington, Ontario as illustrated in this report. Accordingly, these costs should only be considered within the full context of the above noted documentation. The estimates are based on the total work required to undertake the construction of a free standing facility as well as required infrastructure upgrades to accommodate the building. The cost estimate also includes the overall project costs normally associated with this type of development including project soft costs such as Furniture, Fixtures and Equipment (FFE), Information Technology (IT) and design costs. The cost estimate is not intended to accommodate other work which is beyond the scope indicated in the plans, other than costs to demobilize and renovate some limited areas of the existing Administration & Laboratory Building.

The project has been budgeted based on January 2016 costs with an assumed start of construction in January 2019. The construction cost of the building has been estimated at $49.5M in 2016 with a Project Cost of $66.5M and an escalated cost of $71.6M in 2019 dollars. The costs assume that the building will be designed to a minimum of LEED Silver or Green Globe standard in accordance with Federal Government policy. Furniture, Fixtures and Equipment and Information Technology have been included as a percentage of construction costs and allowances have been used to cover Post Contract Costs unknowns, and an allowance for project Ancillaries (Soft Costs) such as Consultant Design Fees and Construction or Project Management. The Cost Estimate does not include for Owner staff and management expenses, financing, land acquisition or legal settlements, or major scientific equipment costs.

# 2. Introduction and Project Overview

## 2.1 INTRODUCTION

DIALOG was engaged by Public Works and Government Services Canada (PWGSC) on behalf of Environment Canada (EC), to undertake a site analysis and costing report for the construction of a proposed 10,000m$^2$ laboratory building, as part of the Laboratory Modernization Plan (LMP) for the Canada Centre for Inland Waters (CCIW).

The prospective new laboratory building is an alternative approach to the Laboratory Modernization Plan, which established a phased renovation to the laboratory and offices spaces of the A&L Building's 4th to 7th floors. This new building is intended to accommodate the programming established in the LMP, with the addition of circulation, support, and service spaces necessary for a stand-alone building.

## 2.2 OVERVIEW OF CANADA CENTRE FOR INLAND WATERS

The Canada Centre for Inland Waters (CCIW), located at 867 Lakeshore Road in Burlington, Ontario, it considered one of the world's leading water research centres. The complex consists of six inter-connected buildings built in the early 1970s in 4 phases, with a total of almost 50,000 square metres of floor space. It is owned and operated by Environment Canada who are the Custodial Department of the CCIW and self-manages the facility.

The CCIW houses the central facilities of the (NWRI) and other EC programs, including the Ecosystem Monitoring and Assessment Network (EMAN) coordinating office; Ontario regional offices of EC, including those related to Great Lakes and meteorological programs; and the Wastewater Technology Centre (WTC), specializing in the advancement of environmentally friendly chemistry technologies as well as technologies for the treatment of municipal and industrial wastewater.

The CCIW main buildings are all located within the building compound and are identified as follows:

NWRI Building – multi-storey, heated building, constructed in stages throughout the early 1970's and comprised of the following 5 separate buildings:

1. Administration & Laboratory (A&L) – A seven storey building housing the main facility entrance, administrative offices, cafeteria, kitchen, auditorium, library, offices, laboratories. The majority of the laboratories are located on floors 4 to 7 with approximately 3,000 m$^2$ on each floor (Labs at 1,400m$^2$ and Office and Common Areas at 1,600m$^2$). These floors are generally arranged with the laboratories backing on a central service core with staff offices located on the building exterior. The Service Core which contains the plumbing, piping, drainage, and fume hood exhaust risers to the penthouse are centrally located on each floor and back on to the laboratories. The Mechanical Room serving the A&L is located on the 3rd floor and the fume hood exhaust fans and stacks are housed in the Penthouse located above Floor 7.
2. Research & Development (R&D) – A two storey building housing offices, labs and workshops.
3. Hydraulics Lab – A two storey building housing laboratories and offices.
4. Ship's Wing/Warehouse – A two storey building housing workshops, storage areas, shipping/receiving areas, offices, and laboratories.
5. Boiler Plant – A one storey building with 2 mezzanine areas housing the main heating equipment for the entire facility.

WTC Building – A two storey, heated building, originally constructed in 1971 with an addition on the east side in 1995, currently housing offices and laboratories, workshops.

Annex Building – A two storey, partially heated building, originally constructed in 1988 with a partial 2nd storey added in 1991, currently housing offices and storage areas.

Figure 2.1 - Canada Centre for Inland Waters - Burlington, ON

# 3. Site Analysis

### 3.1 BUILDING SITING

The CCIW is located on a glacial sand bar that separates Lake Ontario from Hamilton Harbour, adjacent to the Queen Elizabeth Way's James N. Allan Skyway Bridge that connects Burlington and Hamilton. The site is accessed from Burlington to the site's north by Lakeshore Road and the QEW, and from Hamilton to the site's south by Eastport.

The facility is constructed on an artificial tract of land measuring approximately 30 acres (121,400 m$^2$) which extends westward into Hamilton Harbour. The land was engineered for the construction of the facility in 1966. With a soil composition that is primarily sand with a high organic matter content, the site's land suffers from a low soil bearing resistance pressure, which complicates the design of the prospective building's foundations. Also of note is the site's high water table, which has an elevation of just 3.7m below grade.

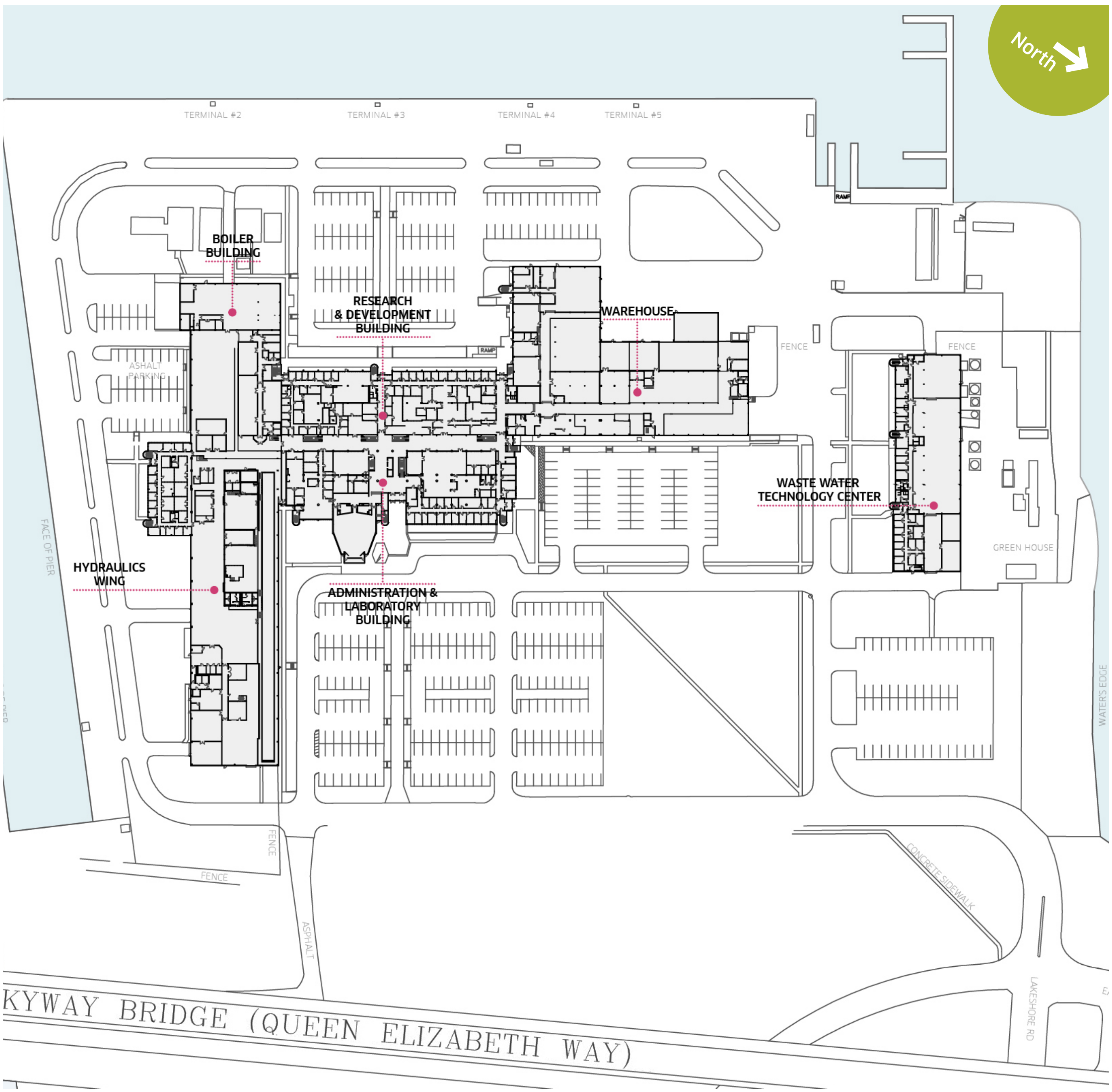



Figure 3.1 - Canada Centre for Inland Waters Site Plan

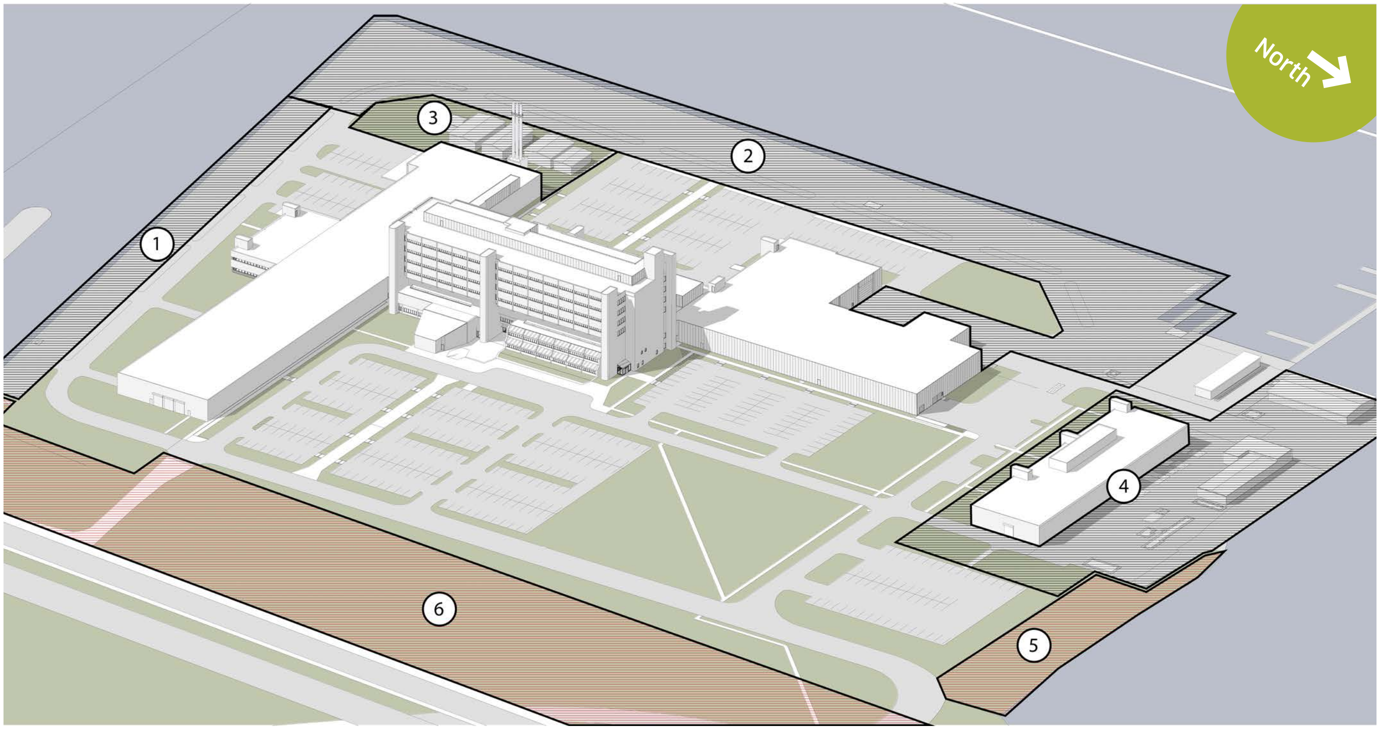



Figure 3.1 - Canada Centre for Inland Waters Axonometric – Building Siting Constraints

### 3.2 ASSUMPTIONS & CONSTRAINTS

In the analysis of the CCIW site for prospective locations for a new laboratory building, a few assumptions that constrain the number of viable siting options must be identified. Firstly, with the understanding that the facility makes full use of the parking spaces currently available, we have proceeded with the constraint that the facility must not have a reduction in the number surface parking spaces available on-site. Rather, since it is assumed that the old A&L Building's floors 4-7 will be repurposed for another use with a similar population of staff to the existing condition (refer to Section 5.3 Re-Purposing A&L Building), the facility must gain a commensurate number of new surface parking spaces based on the size of the proposed new building. Refer to Section 4.2 Parking.

In addition, there are also a number of vital facility operations that further reduce options for siting a new building. To establish our understanding of these operations we have consulted with Environment Canada staff familiar with long-term workflows on-site.

#### AREA 1

The protected pier on the facility's south end is used for the deployment of research equipment during the warm months of the year. To accommodate this research, access and equipment staging along the pier wall have been identified as necessary.

#### AREA 2

The western and south-western sea walls are the primary docking area for ships at CCIW. There are four terminals along the western dock, and one on the west side of the southern dock, which provide power to docked ships. The docks and adjacent pavement must remain clear to allow access for service vehicles. Additionally, the CCIW's boat launch and roadway providing access to the Warehouse area are one of the busiest areas of the CCIW grounds. The boat launch is used regularly in the warm months, and Warehouse access vital for repair and refurbishment of the site's vessels and vehicles.

#### AREA 3

The area just west of the Boiler Plant and Hydraulics Wing is currently occupied by 5 small buildings and a vent stack for the Boiler Plant. Three of the buildings are used as offices, one as a meeting room, and the remaining is a cold storage freezer. Though these building uses could be incorporated into the new laboratory building's program, the loss of their use during the construction would be a logistical challenge.

### AREA 4
Despite the presence of small buildings and equipment that are underused, the area surrounding the Wastewater Technology Centre is considered to be inappropriate for a new building of similar area to the A&L Building's 4th to 7th floors. The main impediments to building in this area include a new storage building and new parking lot to the west and east of the WTC, respectively.

### AREA 5
The shoreline to the north-east of the WTC has been identified as outside the facility property lines.

### AREA 6
Most of the land to the east of the main entrance road is outside the facility property lines. It is currently occupied by soccer fields formerly operated by the City of Burlington, but for the past many years has been left derelict.

## 3.3 SERVICES AND UTILITIES
The Canada Centre for Inland Waters site is traversed by major utility services, including high voltage electricity lines, 24" water main pipes, storm water lines, sanitary lines, and natural gas mains. Diverting subgrade service main lines is not a preferred option to any project, however it was determined that such an occurrence should be a minor factor in determining the preferred building siting.

The primary detraction of an existing utility line diversion concerns the nature of the work conducted at CCIW. The sensitivity of CCIW to prolonged service disruptions would add a further level of complexity to the project, and would likely require shut-downs of operations at the facility to complete the diverted utility tie-ins.

The costs associated with diverting subgrade utility main lines would also be a consideration, however the value of the work would be a minimal fraction of the large investment required to construct a new 10,000m$^2$ laboratory building. Furthermore, as the building would have no subgrade level, it is likely the design could establish a structural foundation grid that would avoid conflict with these utility lines.

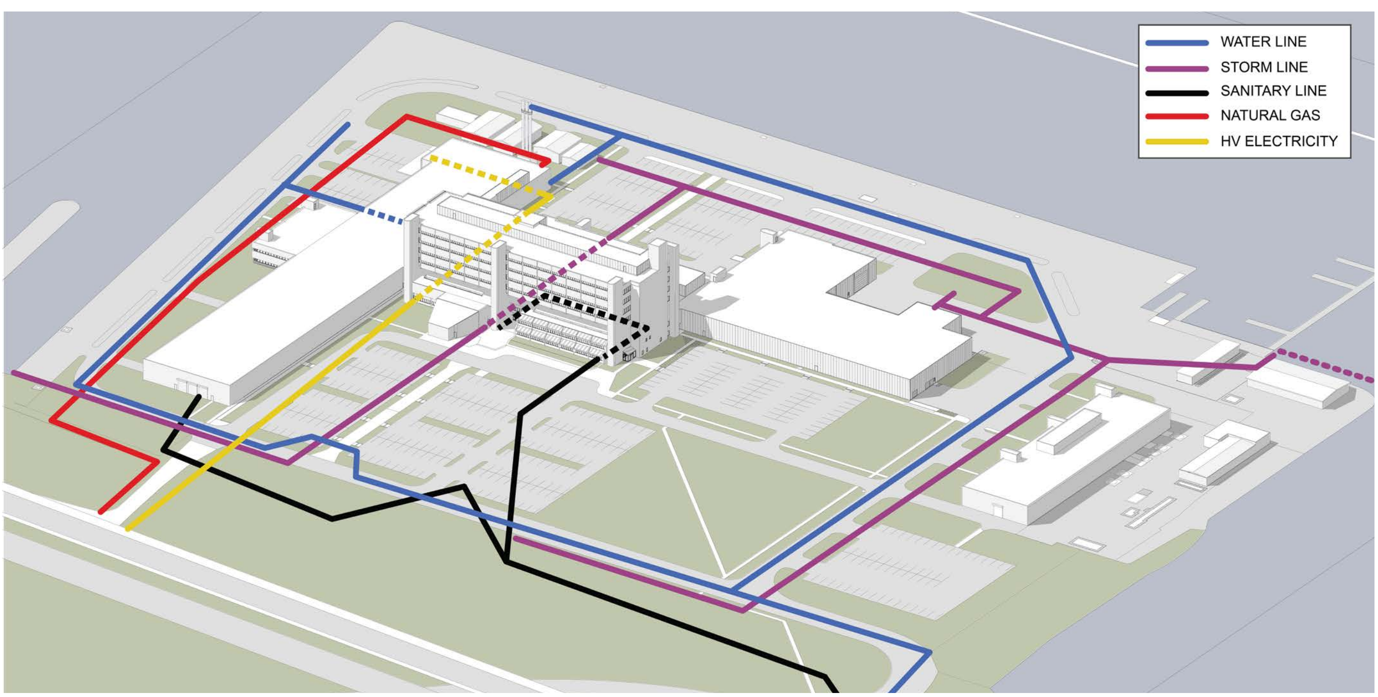



Figure 3.2 - Existing Sub-Grade Main Service Lines At CCIW

Figure 3.3 – University of Calgary Energy Environment Experiential Learning, Calgary, Alberta

Figure 3.4 – Existing Exhaust Vents on A&L Building Penthouse Roof

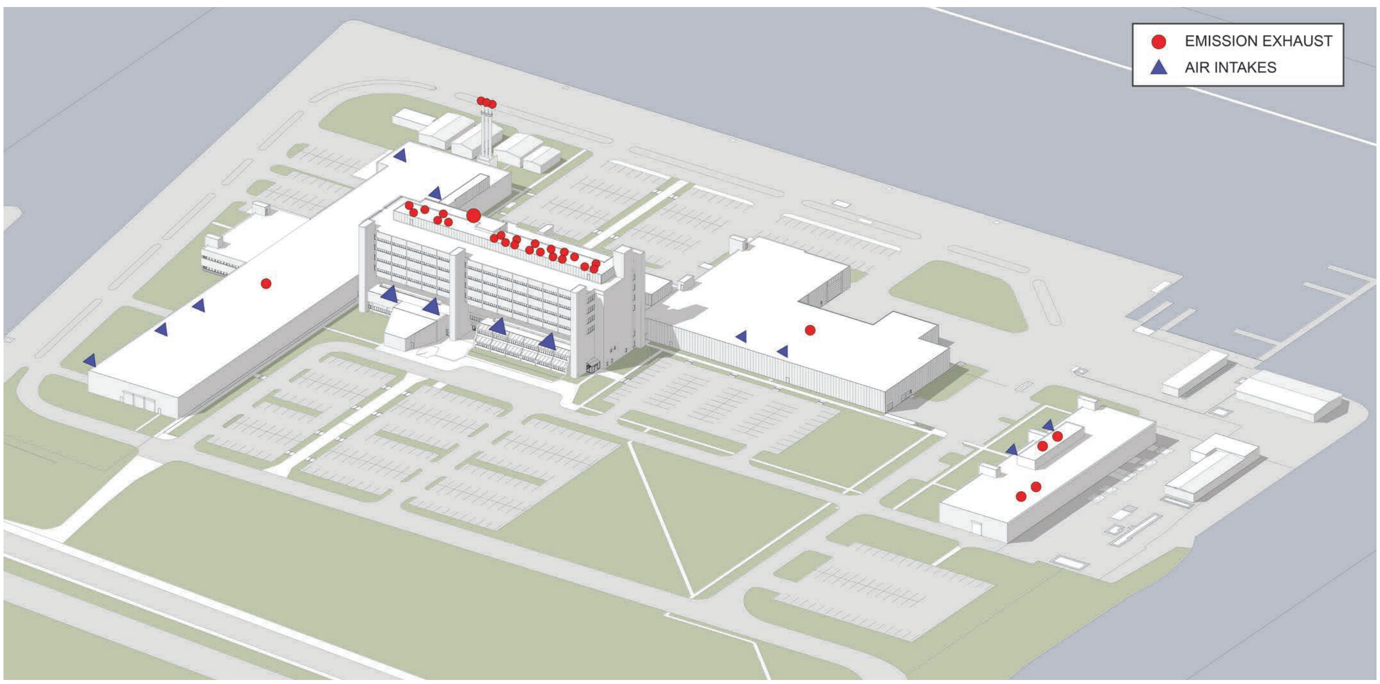



Figure 3.5 – Existing Exhaust Vents and Air Intakes at CCIW

## 3.4 ENVIRONMENTAL CONDITIONS

An analysis of the new building's potential for exhaust emission re-entrainment must examine both the new building's emissions relative to the existing air intakes, and conversely the existing facility's emissions relative to the new building. Currently, the largest concentration of effluent emissions originate from the fume hoods of the laboratories on the A&L Building's 4th to 7th floors. Multiple small exhaust vents are distributed along the roof of the penthouse, while a new Central Exhaust system will be constructed in 2016 for the southern half of the building. The primary air intakes are located on the A&L Building's 3rd level, which feed the facility's central air handling equipment.

The Wastewater Technology Centre has four dedicated exhaust vents that serve that building's fume hoods, and two large intakes on the south face of the penthouse wall. The Hydraulic Wing and Warehouse each have a single effluent exhaust vent and sporadic air intakes, mostly serving packaged rooftop HVAC units. The tall vent stacks of the boiler are also an effluent consideration for the CCIW facility.

The wind rose depicted in Figure 3.6 below illustrates the predominant wind directions at the CCIW site. The wind directions in the figure refer to the direction from which the wind blows, while the annual frequency of a given wind direction is shown as a distance radially from the centre. The most frequent winds originate from the west and south-west directions, while winds from the south and south-east are less frequent. The highest frequency of high-wind conditions occurs from a north-easterly direction.

With the prevailing west-south-westerly wind, it would be optimal to site the new building to the east of the NWRI complex to limit emissions from the new building affecting the existing buildings. Conversely, the new building's intake and exhaust system could be designed to reduce the potential for emission re-entrainment specific to the effluent signature of the existing buildings. It is recommended that a full re-entrainment analysis be conducted during the building schematic design phase by qualified fluid dynamic engineers to assist in the design of the new building's HVAC and exhaust system.

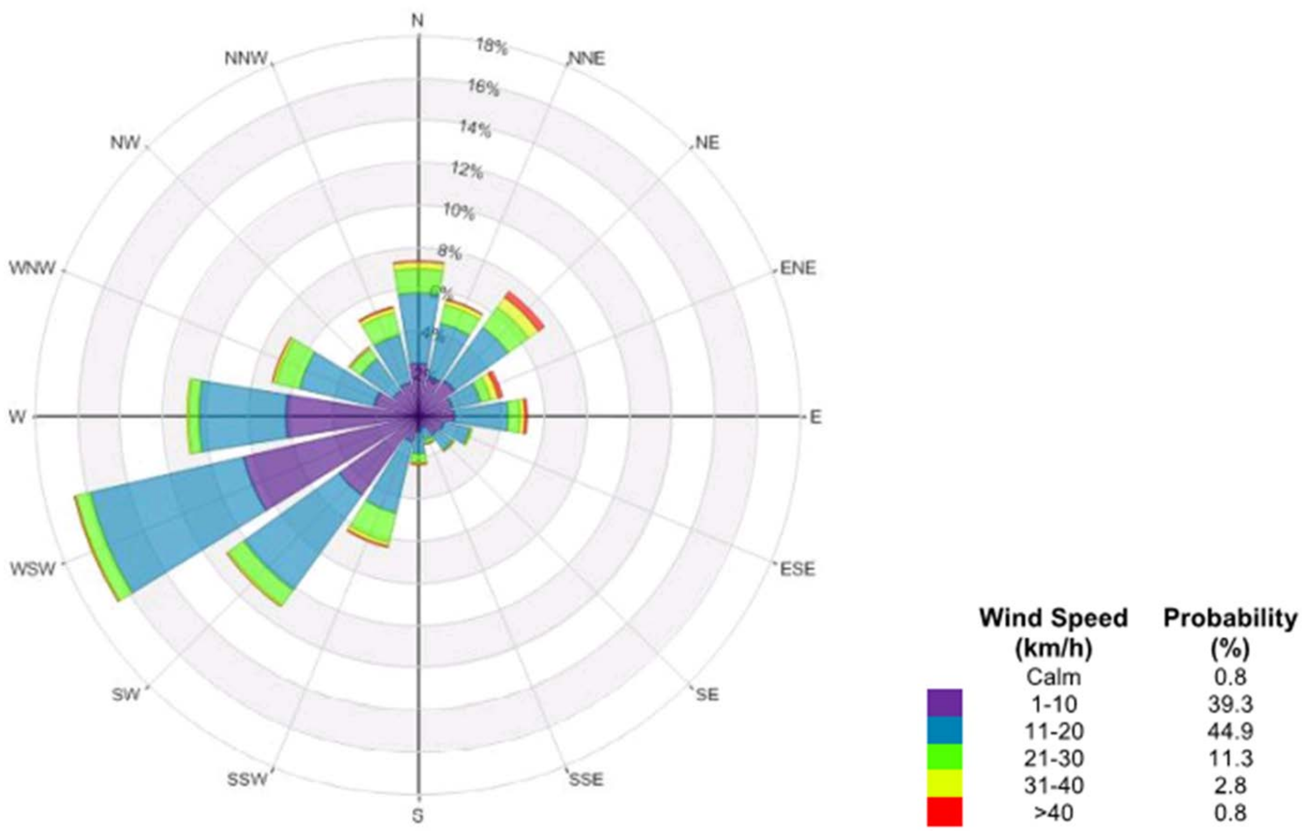



Figure 3.6 – Directional Distribution of Winds (Blowing From), Burlington Piers Station 2008-2019 (Source: RWDI)

### 3.5 PROSPECTIVE AREAS FOR DEVELOPMENT

With a number of the least viable siting options for the new laboratory building identified and excluded, the site analysis process evaluated the most feasible siting options through the use of a design objective matrix. The matrix identifies many siting characteristics that impact the building design's ability to achieve particular project objectives. A summary of the site analysis criteria matrix is provided below.

| | |
|---|---|
| **Philosophical & Mission Issues** | • Does site allows for unique character for labs?<br>• Does site have positive impact on science?<br>• Does site create a new focal point to the CCIW campus?<br>• Does site contributes to the EC/CCIW message<br>• Does site provide desirable location for EC (i.e. 'Sense of Place')?<br>• Does site provides an opportunity for external or civic activities?<br>• Is the site visible external to CCIW grounds? |
| **Access Issues** | • Would public accessibility be a challenge at the site?<br>• Does site have access to existing pedestrian links? |
| **Site Envelope Issues** | • Is there potential to disrupt existing M/E and civil services<br>• Requires additional mechanical or electrical services to be provided?<br>• Allows height or footprint options?<br>• Allows security and access controls? |
| **Environmental Issues** | • Can site minimize risk of re-entrainment from other buildings?<br>• What is the potential of re-entrainment to existing operations?<br>• Geotechnical risks with site<br>• Allows for sustainable design activities to be employed |
| **Future Expansion** | • Is future expansion possible? |
| **Utilization of Existing Services & Space** | • Could siting enable new building to utilize existing building space?<br>• Could siting enable new building to utilize existing building services? |
| **Disruption Of Existing Operations** | • Could siting cause disruption to existing operations?<br>• Does site requires removal of existing buildings or amenities?<br>• Requires removal of existing tress or natural amenities? |
| P**arking** | • Is site in close proximity to existing parking areas?<br>• Displacement of existing parking areas? |
| **Costs** | • Does the site allow ease of construction? |

Figure 3.7 identifies the six (6) areas of the CCIW grounds that are viable candidates for the siting of a new building, each with a variety of positives and negatives which are summarized below.

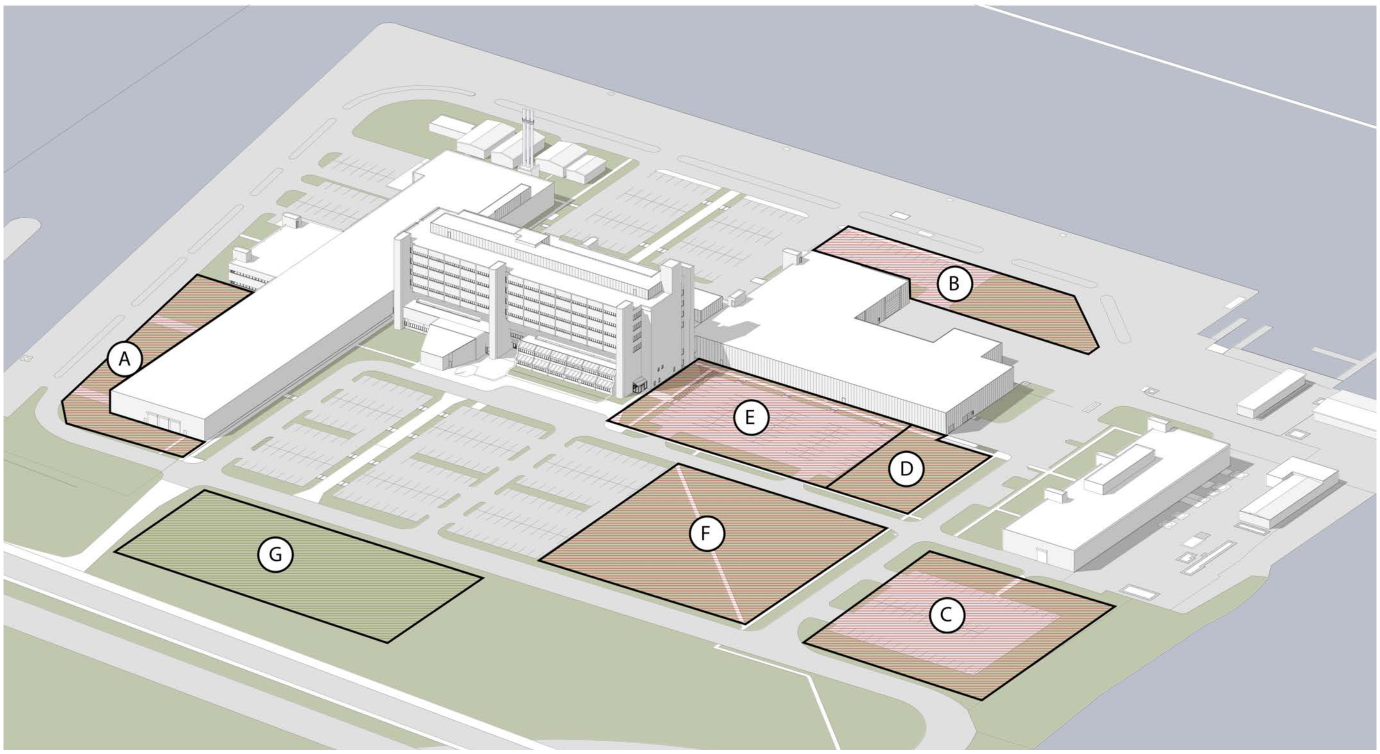



Figure 3.7 - Canada Centre for Inland Waters Axonometric – Potential Building Sites

### AREA A

Area A is located to the south and east of the Hydraulic Wing. This area is currently underutilized, with primary activities involving periodic experiment and equipment staging. It is understood these activities could be readily located elsewhere if the site were utilized for a new building. This area also includes the secondary gate entrance to CCIW's secure docks, as well as an overhead door on the south wall of the Hydraulics Wing, which is used by medium sized vehicles to gain access to the Hydraulics Wing storage area. A new building will need to maintain these access points

Figure 3.8 – Hydraulics Wing looking east to Skyway Bridge.

### AREA B

Area B is located to the west of the Warehouse and North of the Ship's Wing, encompassing the small parking lot serving the warehouse and a vacant island of paving. At just 26 stalls, it is expected this parking area could be amalgamated with the larger new parking area to serve the new building. The island is currently used as the staging area for snow accumulation on-site. If the building were situated here, a new location for snow dumping would be required.

Figure 3.9 – Parking area looking west to docks and Hamilton Harbour.

### AREA C

Area C is located to the east of the Wastewater Technology Centre (WTC), and is presently occupied by a parking lot with capacity for 56 cars. Though these parking spaces would need to be relocated elsewhere, situating the new building here would allow for a significant change in the arrival procession to CCIW. Detractions of this site are its distance from the NWRI complex.

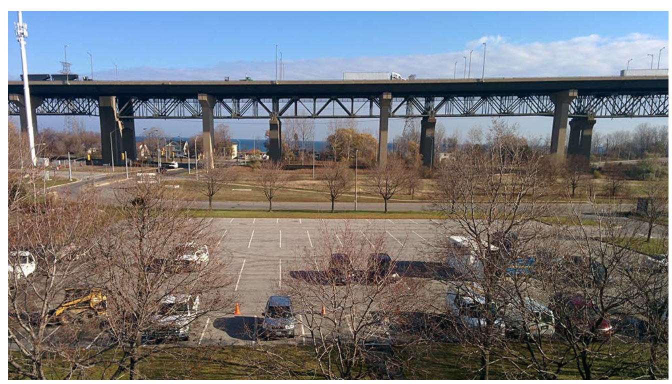


Figure 3.10 – Parking area east of WTC towards skyway bridge.

### AREA D & E

The areas identified as D & E are located to the east of the Warehouse, immediately north of the A&L Building. The area is ideally located for integration with the NWRI complex, however it would consume 64 parking spaces that would need to be relocated. It has been noted that a project to introduce a radar system on this land has been initiated, which will require an alternative location if chosen as the preferred building site. Area D & E are approximately 5,500m$^2$ in area.

Figure 3.11 – Parking areas looking south towards A&L Building and Warehouse.

### AREA F

The area identified as Area F is the largest greenspace presently available for the construction of a new building. It is currently occupied by trees and park benches for exterior recreation for CCIW employees. This site is approximately 7,000m$^2$, and there are no notable constraints to building in this area.

Figure 3.12 – Parking area looking north.

### AREA G

The area identified as Area G is currently not a viable building site, as it is located outside of the designated properly line. Currently this area is occupied by two soccer fields belonging to the City of Burlington, however, the fields have been abandoned for many years, and from discussion between the city staff and CCIW, it is believe the city has no long-term interest in the property. With this in mind, it may be possible for Environment Canada to obtain this land for surface parking. Area G has an area of approximately 15,000m$^2$.

Figure 3.13 – Parking area looking east towards Skyway Bridge.

| | *FACILITATE PHILOSO. GOALS* | *READILY ACCESSIBLE* | *MINIMIZES IMPACT ON EXIST. BLDGs* | *MINIMIZES ENVIRON. INFILTR.* | *FUTURE EXPANSION POSSIBLE* | *AVOID DISRUPTING EXIST. BLDGs* | *COST EFFECTIVE SITING* | *PROXIMITY TO EXISTING BLDGs* |
|---|---|---|---|---|---|---|---|---|
| **AREA A** | ✓ | ✓ | Construction would add snow loading to Hydraulic W. | ✓ | ✓ | Construction would disrupt the Hydraulic Wing | Building on existing structure is more costly | ✓ |
| **AREA B** | Site hidden from main site viewpoint (QEW) | Site is in 'secure zone' of CCIW, complicating visitor access | ✓ | Site is down-wind of NWRI building | Site is too small to enable future expansion | Construction would disrupt the CCG marine workshops | ✓ | Site is too far from NWRI buildings |
| **AREA C** | ✓ | ✓ | ✓ | ✓ | Site is too small to enable future expansion | Construction would remove WTC parking lot | ✓ | Site is too far from NWRI buildings |
| **AREA D & E** | ✓ | ✓ | Construction would add snow loading to Warehouse | ✓ | ✓ | Construction would remove south-east parking lot | ✓ | ✓ |
| **AREA F** | ✓ | ✓ | Construction would consume CCIW's primary green space | ✓ | ✓ | ✓ | ✓ | Site is detached from NWRI buildings |
| **AREA G** | Site hidden from main site viewpoint (QEW) | ✓ | ✓ | ✓ | ✓ | ✓ | Site requires the purchase of additional land | Site is too far from NWRI buildings |

The above table illustrates how the site analysis matrix (pg.13) applies to the 6 identified potential sites for the new laboratory building. Check marks indicate the site satisfactorily meets the requirements to achieve the identified design goal, and a text description indicates how the site was considered deficient. Area F and Area D & E achieved the most check marks with 6, while Area A, Area C, and Area G were tied at 5. As Area A provides the unique opportunity to locate the building above a portion of the existing NWRI building, that site will be carried forward (with Area F and Area D & E) for further study.

## 4. Building Programming

As noted, this study for the addition of a new laboratory building at CCIW has been conducted as an alternative approach to the Laboratory Modernization Plan (LMP) for the A&L Building. The LMP outlined a phased renovation to the laboratory and offices spaces on the 4th to 7th floors. Alternatively, this report examines the feasibility of relocating approximately 10,000m² of the program of the A&L Building 4th to 7th floors into a new laboratory building.

Figure 4.1 indicates the defined program of the A&L Building's Lab Modernization Plan (LMP), which totaled 10,464m². Since the LMP is a renovation plan for a larger building, the areas listed does not include some program space vital for the lab floors to function. This includes the mechanical and electrical rooms that house the HVAC equipment and transformers that provide conditioned air and power, as well as the ground floor entrance lobby for public access.

Determining the required program for the new laboratory building involved reducing the program of the LMP such that it would fit within the required 10,000m² footprint, along with the aforementioned additional program required for a new stand-alone building.

The first step in reducing the laboratory program of the LMP design involved removing all 'undetermined' or fallow lab space. Requiring further space reduction it was decided that only Environment Canada laboratories would be accommodated in the new building, while all tenant laboratories (DFO's labs in the LMP scope) would remain in the A&L Building. This reduction provides a total lab program requirement of 3,400m², and an estimated 240 FTEs for the new building. In making this decision to split EC and tenant labs we have proposed a modified renovation strategy for the A&L Building which involves converting the 4th floor to storage and office use, and selectively renovating floors 5 to 7 for tenant-held laboratories. Refer to section 5.3 A&L Building Re-Purposing for more information.

With the lab area and FTE count established, the shared lab storage and service core program of the LMP was reduced linearly with the reduction in lab space to arrive at the new buildings program needs. Workplace 2.0 was used to determine the appropriate gross-up factor for the office, office support, and office circulation space, with office space requirements benchmarked at 4.5m²/FTE, office support at 3.75m²/FTE, and circulation at 4.75m²/FTE. The mechanical & electrical space requirements were estimated relative to the remaining established program.

**CCIW A&L Building Floors 4 to 7 - Proposed LMP Programming**

| DIVISION OR USE | | Floor 4 | Floor 5 | Floor 6 | Floor 7 | TOTAL |
|---|---|---|---|---|---|---|
| Aquatic Contaminants Research Division | ACRD | 0 m² | 466 m² | 1,079 m² | 98 m² | 1,643 m² |
| Water Quality Monitoring and Surveillance | WQMS | 172 m² | 0 m² | 0 m² | 0 m² | 172 m² |
| Watershed Hydrology and Ecology Research Division | WHERD | 0 m² | 613 m² | 0 m² | 0 m² | 613 m² |
| Ecotoxicology and Wildlife Health | EWHD | 0 m² | 0 m² | 0 m² | 25 m² | 25 m² |
| Emerg., Operational Analyt. Labs & Research Support | EOALRD | 0 m² | 0 m² | 0 m² | 956 m² | 956 m² |
| Department of Fisheries and Oceans | DFO | 319 m² | 0 m² | 0 m² | 0 m² | 319 m² |
| Monitoring and Data Services Directorate | MDSD | 0 m² | 17 m² | 0 m² | 0 m² | 17 m² |
| Undetermined | | 589 m² | 0 m² | 0 m² | 0 m² | 589 m² |
| All Laboratories | | 1,079 m² | 1,096 m² | 1,079 m² | 1,079 m² | 4,333 m² |
| | | | | | | |
| Shared Cold Storage & Store Rooms | | 152 m² | 148 m² | 142 m² | 130 m² | 572 m² |
| Research Offices | | 404 m² | 404 m² | 404 m² | 561 m² | 1,773 m² |
| Office Support | | 135 m² | 135 m² | 135 m² | 135 m² | 540 m² |
| Washrooms | | 37 m² | 37 m² | 37 m² | 37 m² | 149 m² |
| Corridors & Lobbies | | 573 m² | 573 m² | 573 m² | 573 m² | 2,293 m² |
| Service Core (North & South) | | 201 m² | 201 m² | 201 m² | 201 m² | 805 m² |
| | | 3660 m² | 3690 m² | 3650 m² | 3796 m² | 10,464 m² |

Figure 4.1 – Space Programming Proposed for A&L Building Floors 4 to 7 LMP.

## 4.1 BUILDING FOOTPRINT

The determination of the ideal building footprint and floor count involves three primary considerations. The first is the amount of unobstructed ground space available for the new building's siting, noted as a factor in the site analysis section. As shown in Figure 1.2, the Canada Centre for Inland Waters is occupied by many buildings and parking surfaces, with minimal space free for the proposed building.

The second involves the economics of vertical construction. As the CCIW site is composed of infill soil with a very high water table, all substantial buildings must employ costly foundations consisting of structural piles, which will likely be required to reach bedrock. Minimizing the area of the building footprint reduces the number of piles required, but in doing so each pile would be supporting an order of magnitude more load with the higher building height. For a laboratory building this effect is compounded due to the larger equipment loads and required floor structural load ratings as compared to other building types. Reducing the building height minimizes the cost of the columns, wind loading, and foundations.

A minor factor to consider when determining ideal building height involves the diminishing returns in the ratio of usable floor area to circulation space. Simply stated, the more floors a building has, the more times required circulation shafts and service chases, which have a fixed footprint, will be factored into a building's GFA. For example, a 10m$^2$ elevator shaft will occupy 20m$^2$ in a two storey building, and 60m$^2$ for a six storey office building – while the overall program area remains fixed.

The third factor in determining the best footprint involves the space usage requirements of laboratory buildings. The space planning of laboratory buildings centres on the laboratory module, and the provision of services to each module - often through the use of a service corridor.

All considered, it is understood that the most cost efficient shape for a new laboratory building at CCIW would be one that establishes a balance between footprint area and building height. Specifically, the 10,000m$^2$ of floor space would be most efficiently distributed in a building of 3 to 5 stories that incorporates rectilinearity in its floor plate to enable efficient service distribution.

## 4.2 PARKING

The Canada Centre for Inland Waters currently has a full-time staff population of approximately 600 individuals. This does not include the many part-time staff and visiting researchers that regularly use the facility. Many research teams periodically work off-site gathering samples or data in the field, making it difficult to determine the population of CCIW at any one time.

The facility has 693 surface parking spaces, including 28 spaces added to the north-east of the Wastewater Technology Centre in 2015. The facility's parking spaces are heavily utilized, with typical days experiencing full-use of the visitor-accessible lots east of the NWRI buildings. Occasionally, on days with a particularly high volume of users of the CCIW complex, cars will park alongside the entrance roadway.

**CCIW - New Laboratory Building Proposed Program (m$^2$)**

| | FTE | Labs | Shared Stor. | Offices | Office Sup. | Circulation | Service Core | W/C | M/E | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| EXISING A&L 4-7 FLOOR | 288 | 4,047 | 161 | 2,709 | 170 | 2,868 | 805 | 172 | N/A | 10,932 |
| **PROPOSED NEW BUILDING** | **240** | **3,400** | **447** | **1,200** | **900** | **1,920** | **680** | **200** | **1,400** | **10,147** |

Figure 4.2 – Space Programming Proposed for A&L Building Floors 4 to 7 LMP.

CCIW's remote siting is not overly conducive to cycling or walking as a method of commuting to work, particularly in the winter months. While Burlington City buses do have a stop at the facility's Eastport Drive entrance, it is understood public transit is not a commonly used method of commuting to CCIW.

Assuming the A&L Building's 4th to 7th floors are re-purposed (see section 5.3 A&L Building Re-Purposing), the near-capacity use of parking spaces will require the new building to provide additional parking capacity. As the expected population of the new building is approximately 240 full time staff, and assuming the A&L Building's population will remain approximately the same, the facility is expected to require a minimum 240 spaces. This would account for 0.85 spaces per FTE, and 0.15 for visitors per FTE. As a comparison, all the parking to the east of NWRI building totals 260 spaces.

The open green space noted as Area F in section 3.4 Prospective Areas for Development would be an obvious choice for an expansion to the surface parking. The detraction from this strategy is that, during the warm months of the year, this open green space is frequently used throughout the day by staff for lunch and breaks. Another factor is that even if this space were fully utilized it is too small to accommodate the 240 parking spaces required by the new building.

The proposed strategy involves acquiring rights to the land between the main entrance roadway and the Skyway Bridge, currently left vacant be the City of Burlington. There is ample space for the acquired parking capacity, and the open space can be preserved.

An alternate strategy would involve building a new parking structure. This option would be much more costly and have a more direct impact on CCIW's aesthetics, and if the noted land acquisition could not be accomplished a parking garage would be necessary with a new building. Though estimating the cost of the parking garage is difficult without a design, using a rule of thumb per parking space a new garage could be upwards of $3,500,000.


Figure 4.3 – Prospective New Surface Parking Lot

## 4.3 STRUCTURAL CONSIDERATIONS

The structural systems will be developed to satisfy the functional (experimental laboratories) and architectural requirements of the building, and to accommodate mechanical and electrical systems. The final selection of structural systems will consider, at minimum, the cost of construction, the cost of maintenance to the Facilities Managers, impact on the architectural, mechanical and electrical systems, vibration and noise control, floor-to-floor heights and fire protection requirements.

The building will be designed and constructed to sustain all live, dead, seismic and wind loads and other environmental effects in accordance with the accepted engineering practices and standards as prescribed by the local jurisdiction, the Ontario Building Code (OBC) and the National Building Code (NBC).

### 4.3.1 FOUNDATIONS

Information on the existing soil conditions and existing foundation systems were reviewed from two previous studies: (i) Structural Evaluation report of the WTC, dated November 2000; and (ii) Geotechnical Investigation for Elevator Alterations at the WTC, dated March 2007.

The geotechnical report identified the presence of a buried organic layer within the native sand that is not considered suitable to support building loads. The building columns can thus be supported on spread footings founded within the compact sand and gravel below the organic layer at an approximate founding depth of 5.2m below existing grade. The design soil bearing resistance pressures are low (100 kPa at SLS and 200 kPa at ULS), which would require large pad footings depending on building height and bay spans. Also note that excavation costs would be large due to the depth of excavation required.

Based on that increased excavation depth, a consideration for a basement level can be an option. However, it should be noted that ground water levels are approximately at 3.7 metres depth. Therefore, to accommodate a basement level, a permanent drainage system should be installed, especially to eliminate hydrostatic uplift forces that would develop should water level rise above the 3.7 metre level.

A more viable alternate design option would be to found the new building on pile foundations. The existing WTC building is supported on a series of steel pipe piles that were driven into the subgrade approximately 15 metres. Similar pile foundation system can be used, which can include steel piles or helical piles.

### 4.3.2 FLEXIBILITY / ADAPTABILITY

To account for the ever evolving and changing dynamic of a laboratory / research facility, the building structure should accommodate future growth and re-use of space. To do so, the building design and layout of vertical support elements, such as columns and walls, shall not be located within labs. In addition, the lateral load resisting system should consist of reinforced masonry or cast-in place concrete shear walls surrounding vertical transportation circulation elements such as elevator shafts and stairwells. Reinforced masonry, cast-in place concrete shear walls, or structural steel braced members may also be used along the exterior walls to supplement the interior core walls so long as the system does not interfere with the architecture or restrict any window and door openings. Vertical bracing elements or shear walls shall not be located within program spaces in order to minimize conflict with future expansion and / or renovation. Vertical braced members shall not be exposed except for back of house spaces, and shall never be positioned to impede circulation.

The elevated floor framing should be designed to allow for future floor penetrations for mechanical and electrical demands, to accommodate re-use of space and changes in lab equipment and demands.

#### 4.3.3 FLOOR SLAB AND ELEVATED FRAMING

Assuming there is no basement level, the ground floor slab-on-grade will consist typically of a 125mm thick slab, but will be increased to 200mm thick slab at areas where heavier lab equipment is to be installed. The slab on grade will require that the existing undocumented fill be replaced with suitable structural fill regardless of the foundation option eventually chosen.

The elevated floor structure of the new building can be constructed of structural steel, cast-in-place concrete and/or engineered wood products especially at entry or atrium locations. To reduce the building overall weight, steel framing would be preferred. Large spans can be accommodated with open-web steel joist and/or steel beam girders. The joists/beams would support a composite concrete slab on metal deck. Fire protection would be required for the structural steel framing as well as the metal deck. Alternatively, the concrete topping on the metal deck could be thickened and reinforced to avoid the need for fire protection on the underside of the steel decking.

The composite floor slab will act as the floor diaphragm for the distribution of the lateral wind and seismic forces.

The steel framed system could be modified in the future to accommodate additional openings for services or heavier loads in localized areas from new equipment.

Roof framing for areas that are not designed for future vertical construction or are portions of the mechanical penthouse, will consist of steel deck on joists / beams. Roof framing for penthouse would be similar to typical elevated floor construction.

All elevated floor framing will be designed for lab loading and an allowance for suspended mechanical and electrical services. Control of vibration will be considered to accommodate areas where sensitive lab equipment is to be installed.

## 4.4 MECHANICAL CONSIDERATIONS

### 4.4.1 PLUMBING

#### SANITARY

The sanitary drainage for the new building will be split into two sub-systems; one for laboratory drainage and one for general sanitary service.

The lab drainage service will collect to as few central points as practical, where it will be neutralized to pH level suitable for discharge to the municipal sewer system. The acid neutralizer will be sized based on present demand with some allowance for future expansion. Acid resistant drainage piping throughout the building will be thermoplastic PVDF piping.

Sanitary drainage will be provided as required for washrooms, lunch rooms, floor drains, and janitor's rooms.

#### STORM WATER

Storm drains will be provided on the roof of the new building. Storm piping in the facility will route the water to the municipal storm sewer.

#### DOMESTIC WATER

Domestic water will enter the facility from a connection to the incoming municipal water service. Premises isolation will be provided by a new backflow preventer and an independent water meter will be provided for the new building. Water to laboratory sinks will be provided with backflow preventers to reduce the risk of contamination in the potable water supply. Laboratory (non-potable water) will be distributed throughout the building by a second set of piping.

Reverse osmosis (RO) water will be provided throughout the facility for use in laboratories. A central RO system will be located on the top floor of the facility and piping will be distributed throughout the building.

Domestic hot water will be provided from new high efficiency gas fired water heaters. Recirculation piping and pumps will be provided to reduce wait time for hot water.

#### PLUMBING FIXTURES

New plumbing fixtures will be provided throughout the facility. Washrooms and lunchrooms will be provided with new high efficiency fixtures.

Lab fixtures will be stainless steel. Double and single basin sinks will be provided in consultation with user groups of the building, as well as quantity of faucet necks available. Emergency safety showers and eyewash stations will be provided to comply with applicable health and safety guidelines.

### 4.4.2 LABORATORY PIPING

Piping for natural gas in laboratories will be provided in accordance with the requirements of the facility user groups.

### 4.4.3 FIRE PROTECTION

It is proposed that the new building be complete with a wet sprinkler system, fully compliant with NFPA 13. Further investigation is required on site water pressure to determine if a booster pump is required to deliver water at a suitable pressure and flow rate to satisfy the sprinkler demand.

### 4.4.4 HEATING, VENTILATION, AND AIR CONDITIONING SYSTEM

#### HEATING SYSTEMS

Heating for this facility will be provided by two systems; heating from the air handling unit and hot water radiant panels located at ceiling level along the perimeter. New gas fired condensing boilers will be installed in the mechanical room to provide hot water to the air handling unit heating coils and perimeter radiant panels.  For sustainability considerations, refer to section 5.2.3 – Sustainable Design Opportunities.

#### AIR CONDITIONING

Air conditioning for the new building will be provided via new air handling units. The new unit will connect to a new chiller system, located in the mechanical space. It is expected that the new chilled water plant will be sized at approximately 600 tons capacity.

#### AIR CONDITIONING SYSTEMS

As noted above, supply air will be delivered to the building via large central air handling units located in an indoor mechanical room. The airflow rate to the laboratories will be based on 10 air changes per hour (ACH). Air will be supplied to the office spaces in accordance with ASHRAE 62.1. It is expected that a number of units will be required to deliver a total airflow rate of approximately 210,000 CFM.

The units will provide heating, cooling, dehumidification and humidification to the building. They will utilize a pre-heat coil connected to the exhaust air heat recovery coil in a centralized exhaust fan. Fans in the air handling units will operate with variable frequency drives (VFD's) to increase and decrease air flow in accordance with the demand of the space.

Zone level control of the system will be provided by fast acting venturi valves, in response to changes in the exhaust air flow rate as determined by the laboratory fume hoods. Venturi valves will be provided for control of the general exhaust, fume exhaust, and supply air.

#### HUMIDIFICATION SYSTEM

Humidification for the building will be delivered at the central air handling units. Domestic water will be softened locally and heated into steam by a gas-fired boiler in the mechanical room.

### 4.4.5 SPECIAL VENTILATION SYSTEMS

A centralized fume exhaust system is proposed to serve as a means of removing fume hood exhaust and capturing exhaust air heat at one central location. The fume exhaust system will be constructed of stainless steel ductwork and connect to a roof mounted exhaust fan with a heat recovery coil. The central exhaust fan will be complete with VFD's to increase or decrease the flow of air in accordance with demand from the fume hoods. The flow rate of the new central exhaust fan is expected to be approximately 140,000 CFM.

### 4.4.6 HVAC CONTROLS

The new building will be equipped with a new DDC control system. The new control system can interface with the existing BMS in the main A&L/R&D building.

## 4.5 ELECTRICAL CONSIDERATIONS

### EMERGENCY POWER SYSTEM

As with the A&L LMP option, the New Building option will require a new generator. An estimated 200kW outdoor unit would be sufficient to supply new emergency loads, including life safety and lab exhaust. This generator could be connected to the existing CCIW emergency distribution system located within the Boiler Building. Emergency power will be brought to the New Building via underground duct bank.

Two (2) new 200A, 600V, 3Ph distribution panels will be needed in the New Building; one for Life Safety Power and one for Critical Power. Similarly, two new 225kVA transformers will be required to provide power to branch circuits.

### 4.5.1 LABORATORY POWER SYSTEM

A new 100A, 120/208V, 3Ph panel board should be installed for each laboratory.

### 4.5.2 LIGHTING & RECEPTACLES

All new lighting should be LED type for the efficiency and control options that it offers. In the labs, lighting should be via a combination of overhead fixtures and task lighting. Refer to section 5.2.3 – Sustainable Design Opportunities for a breakdown of lighting level targets by room type.

Outlets and wiring should be installed in a lab-safe raceway with multiple channels for data, normal power, and emergency power where needed. Where required for island furniture, vertical raceway should be used to provide services to the work area.

### 4.5.3 FIRE ALARM, TELECOMMUNICATIONS, AND SECURITY SYSTEMS

A new addressable single stage fire alarm system will be required within the new building with devices to suit latest Ontario Building Code requirements.

Telecom service should be connected to the overall facility service via underground duct bank. New communications rooms will be provided to suit telecom standards. Cable tray infrastructure should be provided within the New Building for horizontal distribution.

All lab doors will be provided with card access as per PWGSC Lab Standards.

Figure 4.4 – University of Alberta, National Research Council National Institute for Nanotechnology, Edmonton, Alberta

# 5. Building Design

## 5.1 LABORATORY BUILDING DESIGN CONCEPTS

When the identified programming and building form requirements are applied to the siting analysis, a number of feasible building design concepts emerge which meet the project's objectives. From this extensive site selection matrix and building footprint analysis we have selected three options as the most exemplary of the divergent opportunities available for a new building at CCIW.

Three building concepts have been delineated to help envision how they may look and function relative to the existing CCIW buildings. It is important to note, however, that there are multiple variant design options that would equally satisfy the project objectives. Arriving at the ultimate building concept design would occur after a full schematic design phase can be completed.


Figure 5.0 – University of Alberta/National Research Council National Institute for Nanotechnology, Edmonton, Alberta

### 5.1.1 OPTION 1 – HYDRAULICS WING ADDITION

The first option presented involves transposing the new laboratory building over the existing Hydraulics Wing. With an elevated design that exhibits the north-south orientation of the A&L Building, it attempts to maximize accessibility to the desirable east and west views currently experienced in the upper floors of the A&L Building. Additionally, the building siting establishes a desirable shoreline presence with a front entrance adjacent to that of the A&L building.

The form is four and a half storeys high, and rectilinear in shape to a central service corridor to service the laboratories, similar to the existing A&L floors. Interior access to the building would occur by way of a vertical circulation shaft in the Hydraulic Wing spacious loading dock area. Exterior access to the building is available from both the public and secure sides of the CCIW facility, where visitors and most staff would arrive by the front entrance and samples have equipment from the separated southern entrance.

#### ADVANTAGES

A major benefit with siting the new laboratory building atop the Hydraulics Wing is its proximity to the NWRI complex, and subsequent ease at which the new building could be integrated into the existing infrastructure of the NWRI complex. Most of the existing laboratories that would be relocated to a new building depend on interaction with areas of the NWRI complex that lie outside the A&L building's 4th to 7th floors. Many of the NWRI Directorates represented in the pool of laboratories that would populate the new building have infrastructure and staff in other areas of the building, leading to regular internal travel between these areas.

Other notable universally utilized infrastructure of the NWRI complex, such as the incoming mail and sample transmittal from the A&L Building's 2nd Floor, the cafeteria, lecture hall, and main security desk place further benefit on an internal "all weather" connection.

#### DISADVANTAGES

The building would require a supplementary structural system be added to the Hydraulics Wing, which would cause disruptions to the occupants of the Hydraulics Wing. The Hydraulics Wing would also require significant modification, possibly including the addition of new roof drains. The expected these disruptions would likely be intermittent and confined to the early phases of construction. The consumption of the southern section of the main parking lot would require an additional 60 spaces be added to the new parking lot.

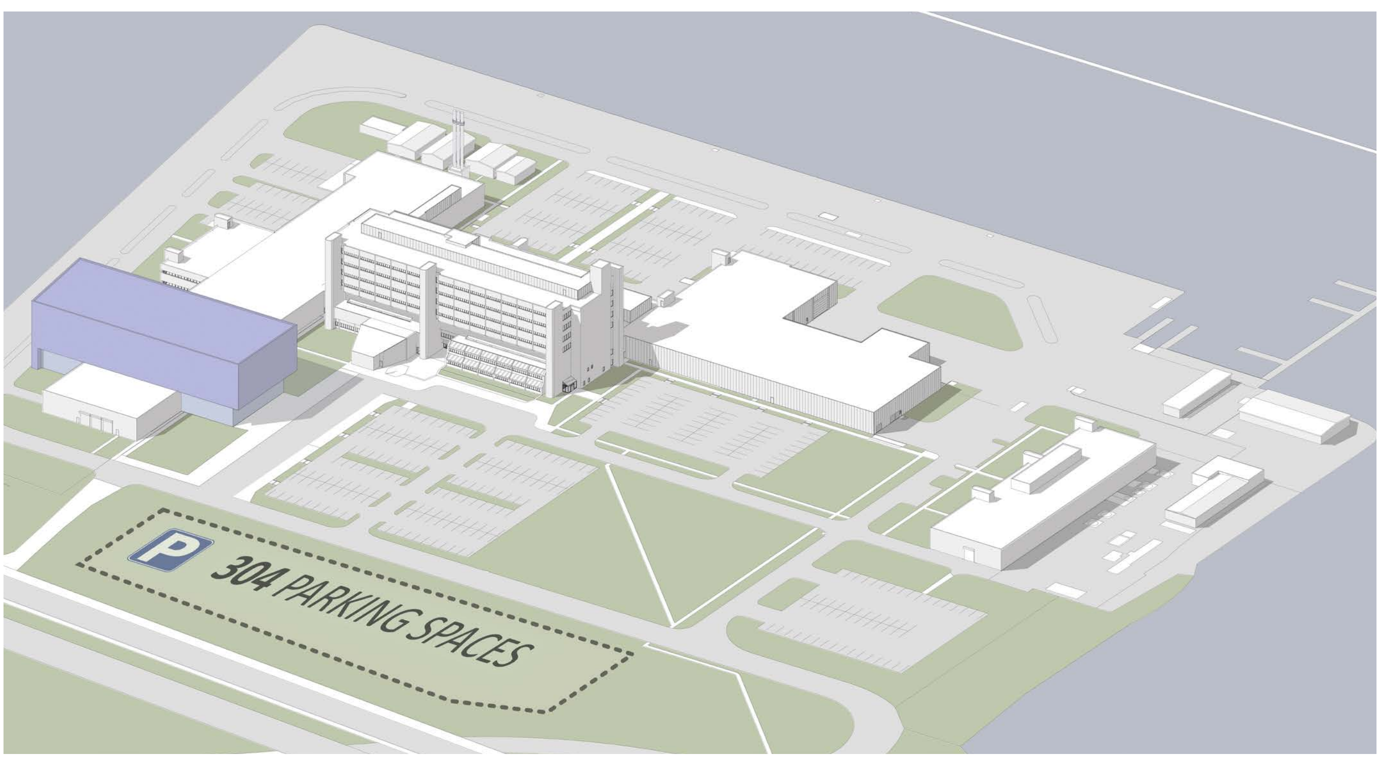



Figure 5.1 – Design Option 1 – Hydraulics Wing Addition

### 5.1.2 OPTION 2 – FREESTANDING MODERN "CAMPUS" BUILDING

The building concept illustrated in the second option aims to achieve three objectives: i) establish a new entrance procession to the CCIW campus, ii) develop the open green space it occupies to become more vibrant and actively used, and iii) introduce a building that creates the spatial relationships common to other institution campuses.

The building form explored here is in an 'L' shape, whereby the laboratories would occupy the four storey east-west wing, while the office and support spaces the sloping three storey north-south wing. The sloping roof is intended to provide the building with a distinctive form, and also to provide either better visibility of an extensive green roof system, or better solar orientation for generating thermal energy or electricity.

The courtyard formed and sheltered by the new building's shape would establish an attractive visual and physical link to the NWRI buildings. This space is intended to be actively landscaped with urban furniture and plantings conducive to accommodating socializing and occasional light work.

#### ADVANTAGES

The design offers the opportunity to introduce a new modern building that could re-brand the aesthetics of the CCIW grounds. Any addition of the NWRI building will be unable to compete with its physical size and overwhelming uniformity of the concrete brutalism it expresses. A 'separate' modern building like Option 2, positioned in the foreground of the vintage existing buildings to most passers-by, could help rebrand the aesthetics of CCIW to reflect the 21st century relevance of the institution.

Like Option 1, this design would also have unobstructed access to daylight, and the sustainable and quality of interior environment opportunities it presents.

#### DISADVANTAGES

Unlike Option 1, this design is not directly connected to the NWRI complex. As a result it would expectedly require regular external travel by staff. Another concern of this siting would be maintaining separate private and public access to the building, as it cited entirely in the unsecured public zone. Lastly, though the new building would make use of the preferred east and north views, the south and western views would be obstructed by the NWRI building.

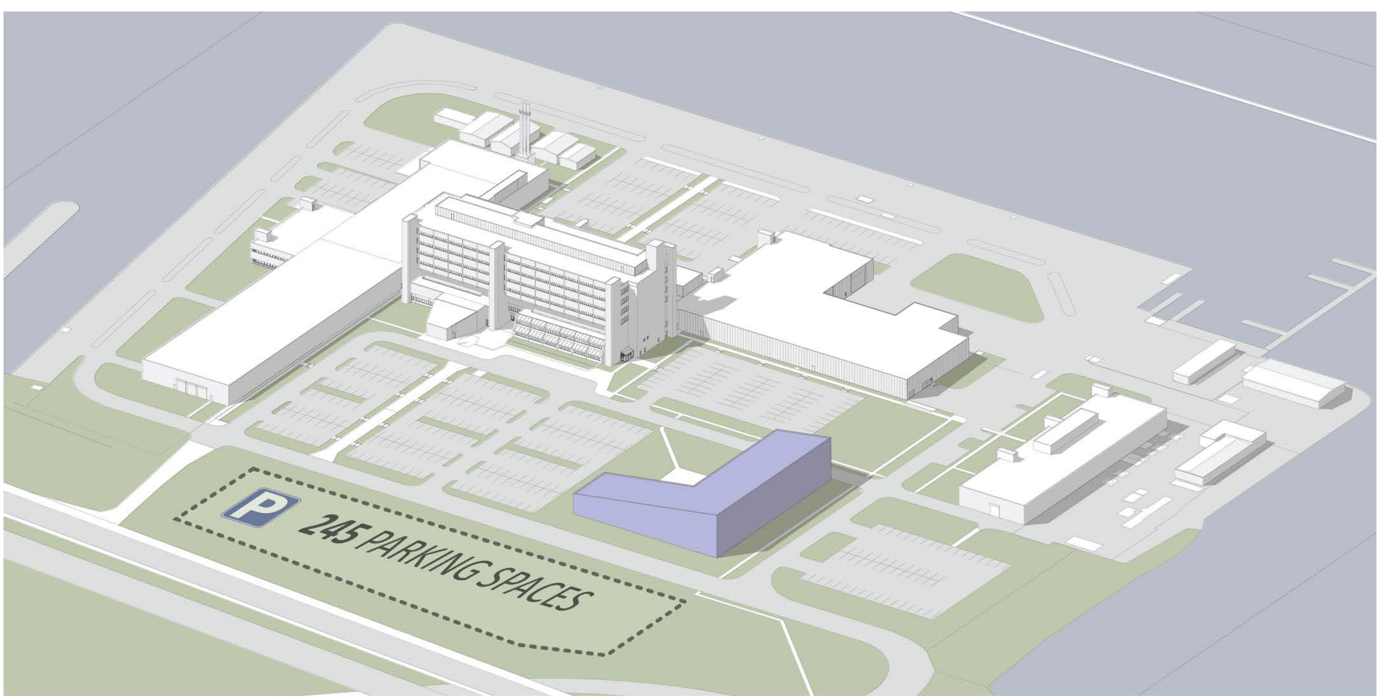



Figure 5.2 – Design Option 2 – Freestanding Modern "Campus" Building

### 5.1.3 OPTION 3 – NWRI COMPLEX ADDITION

The third design option seeks to establish a close integration with the NWRI Complex. The building form is a relatively simple four storey rectilinear block. The building's position would form a narrow corridor between its western wall and the Warehouse, which could be easily converted into a double-height atrium space in continuation of the NWRI Building's most distinct architectural space.

### ADVANTAGES

This design fits snugly into the NWRI complex, providing opportunities for direct connections between both the Warehouse ground level, as well as each of the first four floors of the A&L Building. Multi-level connections would readily enable collaboration and resource sharing between the Environment Canada labs of the new building and the future lab tenants of the A&L Building (see section 5.3 A&L Building Re-Purposing. As requirements for lab space change over time, physically integrating multiple floors of the A&L Building and new laboratory building would easy allow EC directorates or tenants to occupy labs in both buildings.

In addition to the noted potential of continuing the A&L Building's central atrium, the new building's siting would also obscure the unappealing façade of the Warehouse with a new modern laboratory building.

### DISADVANTAGES

Access to daylight for design Option 3's siting is obstructed by the A&L Building and Warehouse, limiting sustainable initiatives that could be targeted. Similarly, views from the west and south facades would largely be obscured by the adjacent existing buildings.

Also, the planned weather station for this site would need to be relocated in order to proceed with this siting for the new building. Relocating the weather station may be complicated, as the project is understood to be nearing completion of the schematic design phase.

The consumption of the parking lot north of the A&L Building would also require an additional 64 spaces be added to the new parking lot.

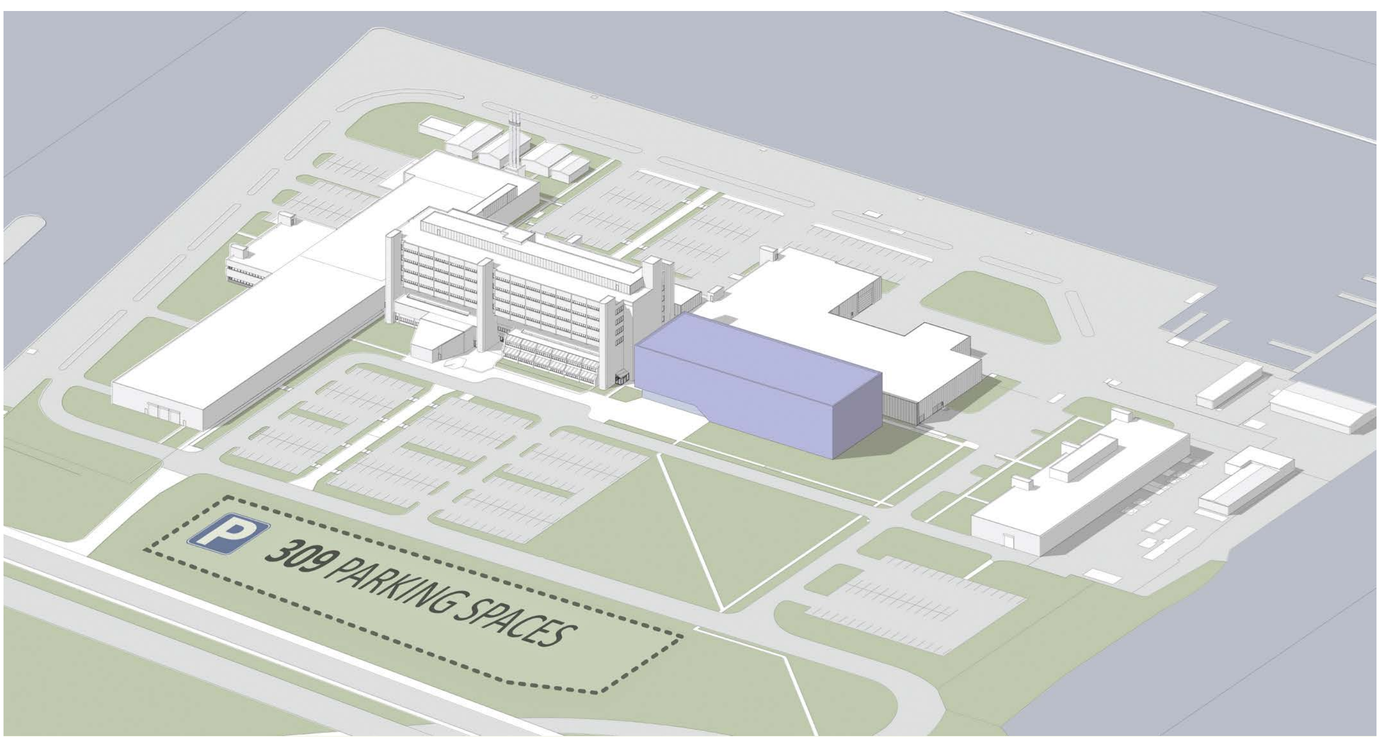



Figure 5.3 – Design Option 3 – Hydraulics Wing Addition

## 5.2 DETAILED PROGRAMMING ANALYSIS

From the three preferred options identified, it was determined that one would be selected for a further detailed analysis of the building program and costing. Option 3 NWRI complex addition was selected for this analysis as its design is the most easily accommodated elsewhere on the CCIW grounds, thus affording the analysis protection from redundancy due to design or siting alterations in future detailed design phases.

## 5.3 A&L BUILDING RE-PURPOSING

Mentioned previously, the new laboratory building would be an alternative the phased renovation of the A&L Building's 4th to 7th floors, referred to as the Laboratory Modernization Plan (LMP). Should this alternative new building be pursued, Environment Canada will need to consider the future implications this would have on the A&L Building's operations.

The prospect of retaining all the A&L Building laboratory space was considered However, programming studies from the LMP revealed that the existing A&L Building labs could be accommodated in roughly the same footprint as they presently occupy, just under 4,100m$^2$, with minimal pressure for future lab expansion. If all the A&L Building's lab space were maintained, it would be largely left unassigned after the New Building's completion. This would create two problems for Environment Canada, as much of the existing lab space would require renovations that could greatly increase the required project budget, and subsequently new tenants would need to be secured to occupy the unassigned lab space.

Alternatively, the prospect of converting the 4th to 7th floors to non-laboratory uses was also considered an option, particularly to office and storage space which are lacking at CCIW. However, as the A&L Building's laboratory specific base building infrastructure is in good condition and in keeping with modern laboratory design practices, a wholesale conversion of all floors from laboratory use ultimately reduce the inherent value of the building asset.

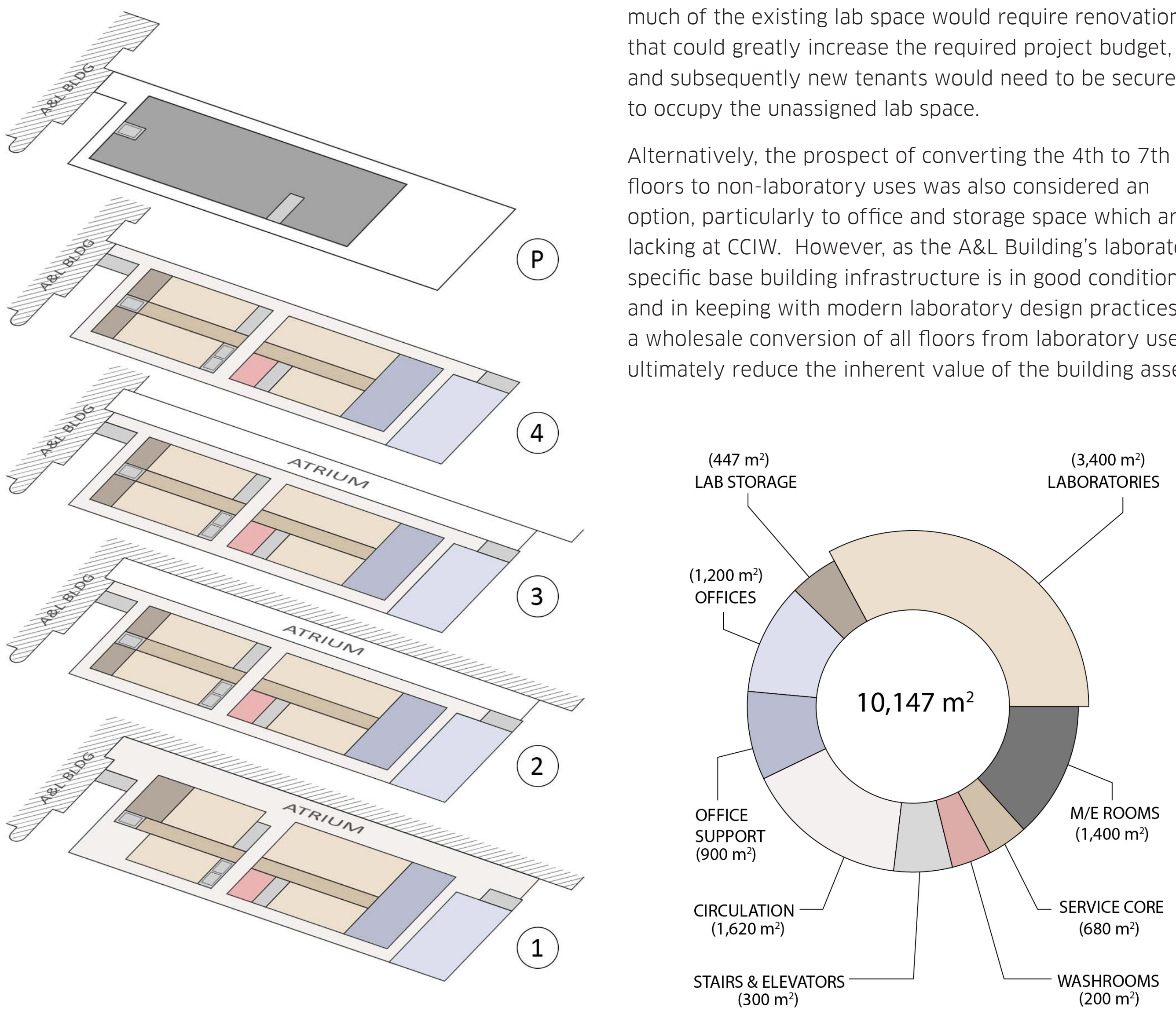


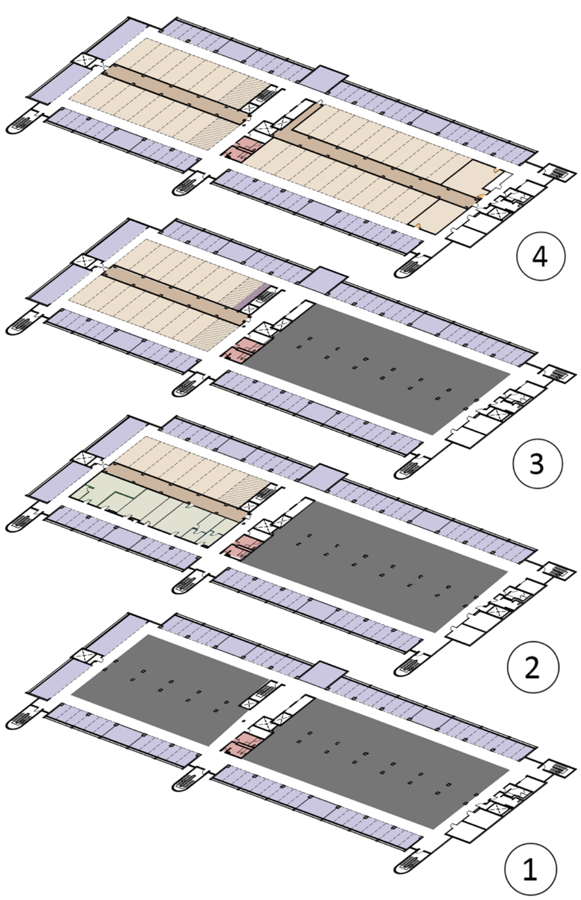

Figure 5.4 – Feasible Program Distribution for New Building

Due to the shortcomings of both noted plans, a hybrid option emerged as the preferred recommendation for the A&L Building repurposing. The design would maintain approximately half the existing laboratory space in the A&L Building, with the remaining half (complete with associated service corridors) to be demolished and converted to office and storage uses. The lab areas to be demolished includes the entire seventh floor, as well as the southern end of floors five and six. These areas were selected to include the most recently renovated lab space and infrastructure, including the recently completed Trace Metal labs on the seventh floor (L750 & L752), the upcoming lab renovations on the on the fifth floor (L527 & L530), and associated central exhaust upgrades from floors 5 to 7.

This proposed design also recommends renovating the labs to remain on an as-needed basis, and preserving laboratories that have been renovated recently and are in good condition. This recommendation is largely driven from the goal of reducing the cost of the project to include only functionally required lab upgrades, rather than the uniform upgrades proposed in the LMP. This divergent rationalisation from the LMP design is based on the reduction of benefits for a wholesale and uniform design for the A&L Building. As the New Laboratory Building would serve the function of Environment Canada's signature lab space at CCIW, the A&L Building could serve a more functional support role to the New Laboratory Building, whereby it would be occupied by tenants from external departments or institutions and overflow for EC's primary laboratory programs.

By converting one floor of the A&L Building to an alternative program, some of the expected program shortcomings (office, office support, workshop, dry lab, and storage) of the NWRI complex could be resolved. The 4th floor is the most suitable to be converted from laboratory use. It is the lowest level dedicated to laboratories in the A&L Building, meaning its central service corridor can be largely removed without impacting the remaining building. Furthermore, unlike floors 5 through 7 in the A&L Building, the 4th Floor has been known to experience vibrational disturbance due to the operation of mechanical equipment on the 3rd floor below.

With just 10,000$m^2$ of total program area set for the new laboratory building, not all laboratory space currently housed in the A&L Building's 4th to 7th floors can be accommodated. The decision was made to exclude all tenant laboratories from the new building's program, making the new building dedicated solely to Environment Canada. As a result, the A&L Building's 5th to 7th floors would be dedicated to 'tenant' laboratories, including the 319$m^2$ presently occupied by the Department of Fisheries and Oceans (DFO).



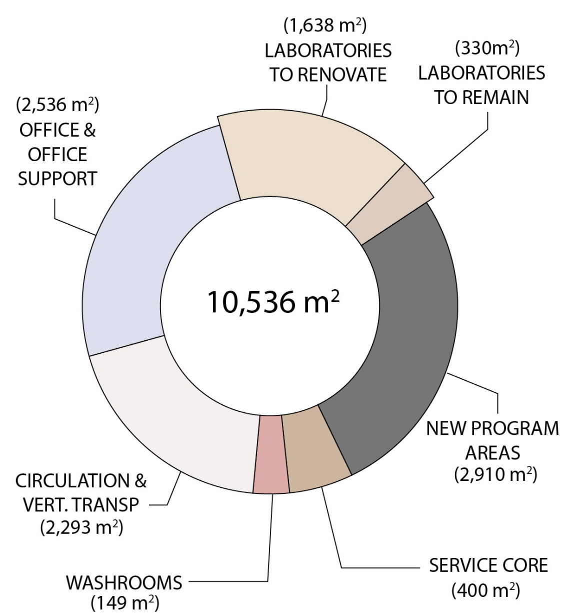




Figure 5.5 – Proposed A&L Building Program

## 5.4 SUSTAINABILITY

### 5.4.1 SCOPE AND OBJECTIVES

This capital project will be aligned with the Federal Sustainable Development Strategy (FSDS) and the federal government's framework for sustainable planning. Goals, targets and priorities are organized under four priority themes: addressing climate change and clean air, maintaining water quality and availability, protecting nature, and shrinking the environmental footprint.

Applying these overarching themes to a laboratory modernization project highlights four key areas of focus:

I. Energy efficiency and greenhouse gas (GHG) reduction
II. Materials impact and life-cycle analysis
III. Enhanced workplace environmental quality
IV. Potable water conservation

Benchmarking sustainability for the modernization means documenting performance and making meaningful contributions in each of these areas; the goal is to create a great place for research, a great place to work and to achieve a quantifiable reduction in the environmental footprint.

The CCIW is home to a successful Federal Buildings Initiative energy efficiency improvement project which is targeting reduction and tracking of the facility's GHG footprint. The lab modernization will aim to contribute to building wide GHG reductions by implementing energy efficiency initiatives and complementing existing projects at the systems and plant levels.

In stakeholder visioning sessions clear themes around sustainability, including: flexibility, efficiency, thermal comfort & control, waste conservation, air quality, lighting control, and carbon footprint. Clearly these topics need to be addressed to create a space that is attractive to occupants now and through decades to come.

Setting benchmarks and targets for success ensures that the finished space reflects these environmental values. The output should be quantifiable reductions in impact (achieved by measures like energy metering and contractor waste tracking) and improvements that can be experienced in the space (like interior glazing providing natural light into office and labs).

Green building certifications like LEED for Commercial Interiors (LEED CI) can be used to communicate success and these will be investigated for cost-benefit analysis.

### 5.4.2 REFERENCES, BENCHMARKS AND STANDARDS

The following references will be used, either as a minimum standard or as a target for higher levels of performance:

- ANSI/AIHA Z9.5-2012, Laboratory Ventilation
- ASHRAE Guideline 0 – 2013 The Commissioning Process
- ASHRAE Guideline 1.1 – 2007 The HVAC Commissioning Process
- ASHRAE Standard 55-2004, Thermal Comfort Conditions for Human Occupancy
- ASHRAE Standard 62.1 – 2010 Ventilation for Acceptable Indoor Air Quality
- ASHRAE Standard 90.1-2010 Energy Standard for Buildings Except Low-Rise Residential Buildings
- ASHRAE Standard 110-1995 Method of Testing Performance of Laboratory Fume Hoods
- Federal Sustainable Development Strategy for Canada; Environment Canada Sustainable Development Office
- International Institute for Sustainable Laboratories Labs 21 Toolkit
  - Design Guide for Energy Efficient Research Laboratories
  - Best Practice Guides: Ventilation, Commissioning, Water Efficiency, HVAC
  - Environmental Performance Criteria
- International Performance Measurement and Verification Protocol Volume III: Concepts and Options for Determining Energy Savings in New Construction, April, 2003
- ISO 14040:2006 Environmental management - Life cycle assessment - Principles and framework
- LEED Canada for Commercial Interiors, 2007
- LEED Canada for Existing Buildings: Operations and Maintenance, 2009
- NRC National Energy Code for Buildings 2011
- Public Works and Government Services Mechanical Design Guidelines:
  - MD 15126 Guide for Laboratory Heating, Ventilation and Air Conditioning (HVAC)
  - MD 15128Minimum Guidelines for Laboratory Fume Hoods
  - MD 250005 Energy Monitoring and Control Systems Design Guidelines
- Sheet Metal and Air Conditioning Contractors National Association (SMACNA) IAQ Guidelines For Occupied Buildings Under Construction, 2nd Edition 2007, ANSI/SMACNA 008-2008

### 5.4.3 SUSTAINABLE DESIGN OPPORTUNITIES

The following sections present an overview of best practices, design strategies and measures that are presented to achieve a measurable reduction in the project's environmental footprint.

#### ENERGY USE AND GREENHOUSE GAS REDUCTION

Energy use is a primary driver for climate change and reductions in energy use and GHGs are a key measure for any project targeting sustainability. Lab buildings in particular are high users of energy across the sector; achieving a percentage reduction in energy use has proportionately high impact in total GHG emissions.

#### HEATING, COOLING AND VENTILATION

Exhaust air volumes are a major driver for energy use in labs based on fan energy as well as heating and cooling energy for incoming makeup air. High performance laboratories need to balance safety and adherence with codes and standards with energy conservation to 'right size' exhaust systems to the appropriate number of air changes per hour (ACH).

The ASHRAE lab guide recommends the following:

- Minimum supply air changes
- Minimum exhaust air changes
- Minimum outdoor air changes
- ACH number between 4 and 12

The Health Canada Lab Standards – Space Standards and Design Guidelines recommend air change rates of 10 ACH during occupied periods and 6 ACH during unoccupied periods.

The Labs 21 Best Practice Guide for Ventilation Rates recommends Control banding – classifying and grouping substances used in a process by health risk to determine an appropriate control strategy. It may be possible to classify each laboratory according to toxicity, scale of use and volatility. Under this scheme some zones may be appropriately designed as low as 6 ACH / 4 ACH or even 4 ACH / 2 ACH.

Fume hoods are another major driver of energy use. The quantity and size of fume hoods should be optimized to balance user needs with energy consumption. Lower-energy alternatives such as snorkels, balance hoods and chemical storage cabinets should be considered where appropriate.

Major energy savings will be realized with the conversion of the lab exhaust system to a Variable Air Volume (VAV) fume hood exhaust connected to a manifolded exhaust. Reducing fan power when full airflow is not required will generate large scale electrical savings.

Other energy savings features that are recommended:

- Effective sash management ensures that air flow will decrease when appropriate, either:
- Motorized sash control based on occupancy sensor to ensure hoods decrease to low flow rates when possible OR
- On site sash management training for users
- Glycol heat recovery coil providing energy recovery for the exhaust air stream
- Low pressure drop duct design, complete with premium efficiency fan motors, in accordance with ASHRAE 90.1-2010
- Appropriate zoning of lab spaces requiring tight tolerances for temperature and humidity to minimize reheat energy
- Occupied / unoccupied control mode for offices allowing for temperature setback when possible

#### POWER AND LIGHTING

Lighting systems will be designed to appropriately balance environmental quality, safety and energy consumption. Best practices will be followed to optimize systems and minimize lighting energy use. LED lighting fixtures will be investigated as the best balance between up-front costs, maintenance / replacement costs and energy use / GHG footprint.

The ASHRAE 90.1 – 2010 Standard provides maximum allowable Lighting Power Densities (LPDs) for each building space type, taking into account space environment and required lighting levels. Best practice typically allows for a lower connected wattage by focusing on effective placement of light fixtures and efficacy (lumens per watt). The lighting design for the LMP will target on these lighting levels:

| SPACE TYPE | ASHRAE 90.1 LPD ALLOWANCE (W/M²) | TARGET LPD (W/M²) | % REDUCTION |
|---|---|---|---|
| Research Laboratory | 19.5 | 13.7 | 30% |
| Office – Open Plan | 10.5 | 7.5 | 28% |
| Office – Enclosed | 11.9 | 8.5 | 28% |
| Meeting / Multipurpose | 13.2 | 9.5 | 28% |
| Storage | 6.8 | 5.8 | 15% |
| Restrooms | 10.5 | 8.9 | 15% |

Task lighting may supplement overhead zone lighting to ensure that IESNA recommended illuminance levels are achieved.

Space layouts will be designed with daylighting strategy in mind, ensuring that natural light is accessed in areas of the floor plate where it's available. Daylight and occupancy responsive controls will be used to achieve further energy savings.

### OPERATIONS AND PROCESS

A full commissioning process, according to ASHRAE requirements as dictated in Guidelines 0 and 1.1, should be employed to ensure the proper operation of equipment and systems. Operations and maintenance will be considered in the design of all mechanical & electrical systems to provide for ongoing efficiency.

Benchmarking and metering are a method for laboratory buildings to demonstrate leadership and facilitate ongoing building optimization. Separate metering of energy and water uses (HVAC, lighting, plug loads, equipment) allows potential areas for improvement to be identified and tacked. A 'dashboard' style user interface can be considered to facilitate continuous improvement and benchmarking vs. other lab facilities. Energy use data can be combined with employee engagement – occupant training, user surveys, and communication of energy savings achievements – to achieve deeper energy savings in the operations phase.


Figure 5.6 – University of British Columbia, Centre for Comparative Medicine, Vancouver, British Columbia

## MATERIALS AND LIFECYCLE IMPACT

Construction materials can represent a significant portion of a building's environmental footprint. By adopting a Lifecycle Analysis (LCA) approach we can minimize the impact of construction materials through all phases:

- Extraction
- Manufacturing
- Transportation
- Installation
- Use & Maintenance
- Disposal or reuse

When choosing systems and materials all phases of the materials lifecycle will be considered to ensure that decisions reflect the best possible functionality with lowered lifecycle impacts.

During the demolition and construction phases a Waste Management Plan will be implemented to maximize the diversion of materials from landfill. Wherever possible materials will be identified for reuse on- or off-site through programs like Habitat for Humanity. Recycling facilities will be identified for expected waste materials including wood, metal, gypsum board, cardboard etc. Contractor waste tracking will be required to ensure that a waste diversion rate of over 75% is achieved

The NLP project be designed to maximize flexibility and adaptability in the space, configured with the next 40 years in mind. Material and capital efficiency can be achieved by planning for future expansion and modifications and minimizing the work required to periodically refresh or retrofit the space. As research trends and government requirements change over years to come the space must be ready to accommodate. Durable materials with a long service life are incorporated to minimize maintenance requirements over time and minimize the environmental impact of replacements.

The emergence of Environmental Product Declarations means that new materials can be chosen with the goal of minimizing environmental impact:

- Greenhouse gases
- Ozone depletion
- Acidification of land and water sources
- Eutrophication
- Smog formation

Similarly the emergence of Health Product Declarations (HPDs) and the movement for disclosure and transparency in the construction materials industry is allowing designers and owners to identify and eliminate materials that contain bio-accumulative carcinogens, toxins, mutagens, and endocrine disruptors.

Materials selection will prioritize the use of products with EPDs and HPDs available, minimizing environmental and human impact.

Other materials properties will be evaluated to assist in making sustainable material choices:

- Recycled content
- Regional materials / local manufacture
- FSC certified wood
- Embodied carbon
- Long service life
- Low-emitting materials (VOCs & formaldehyde emissions)

## INDOOR ENVIRONMENTAL QUALITY

Healthy buildings contribute to occupant wellbeing and satisfaction as well as employee comfort, health and productivity. A premium work environment is one that is well ventilated, comfortable, well lit with access to daylight and natural views, and creates a great environment for research and collaboration. Studies have repeatedly demonstrated that healthy workplaces translate to improved worker satisfaction, less sick days, increased productivity and increased ability to attract and retain talented employees.

Ventilation in laboratory spaces will be designed to provide safety, meet thermal loads, provide adequate outdoor air and balance energy costs as outlined in section 10.3.1. Offices and other spaces will be designed according to the latest version of ASHRAE standard 62.1.

During construction the contractor will be required to create and implement an Indoor Air Quality Management Plan, which will encourage clean air at occupancy and employ the SMACNA best practices:

- HVAC protection
- Pollutant source control
- Housekeeping
- Pathway interruption
- Scheduling of construction activities

Prior to occupancy it will be required that the contractor administer a building 'flush-out', using increased outdoor air volumes to remove particulates, CO2 and Volatile Organic Compounds (VOCs) which may be emitted by materials, finishes and furniture. If desired an air quality test can be commissioned to ensure that pollutants are at acceptably low levels prior to occupancy.

In addition to low environmental impact, materials, finishes, and furniture will be selected to best industry standards for low emission of VOCs and other harmful materials:

- South Coast Air Quality Management District Rules # 1113, 1168 (latest versions) for adhesives, sealants and coatings
- Green Seal Standards GS-03, and GS-11, and GS-36 for top coat paints, aerosol adhesives & anti-corrosive coatings
- CRI Green Label program for carpet tile
- FloorScore certification (or equivalent test results per State of California methods) for hard surface flooring including vinyl, linoleum, laminate, rubber flooring, and wall base
- Composite wood materials certified as 'No added urea-formaldehyde' including plywood, MDF, and particle board
- New furniture and seating certified as low-emitting according to GreenGuard, BIFMA Level, or equivalent

Space layout will be designed to give occupants access to natural light and views of the exterior. Window shades will be provided to limit excessive glare and preserve light quality. Lighting quality will be maintained throughout the space, balancing safety, function, environmental quality and energy efficiency.

Natural materials, textures, and patterns will be incorporated where possible to enhance the feeling of connection to nature and wellbeing according to the principles of biophilic design.

HVAC controls for space temperature and humidity will be designed to maintain comfort conditions as per the latest version of ASHRAE Standard 55 for Thermal Comfort.

#### WATER CONSERVATION

Water conservation will be a central feature of the LMP, treating water as a valued resource and limiting consumption of potable water.

Plumbing fixtures in washrooms and break rooms will be selected for low flow rates, suggested as follows:

- 4.8L / 3.0L dual flush water closets
- 0.5 LPF urinals
- 1.9 LPM faucets with automatic sensor control
- 5.7 LPM kitchen sink faucets

Process water savings can be targeted by considering these laboratory water efficiency measures:

- Elimination of single pass cooling for lab equipment
- Rinsing by counter-current method
- Flow control on/off for intermittent process equipment

Water use measurement and reporting can be a useful method of reducing water consumption – similar to an energy reporting and occupant engagement program, communications of water consumption may stimulate savings based on user behaviour.

#### 5.4.4 RATING SYSTEMS AND BENCHMARKS

Green building rating systems are frequently used as a way of communicating sustainable design and construction success to occupants, stakeholders and the public. The LEED certification program (Leadership in Energy and Environmental Design) has gained widespread popularity for its marketing appeal and recognition amongst the general public.

LEED Canada for Commercial Interiors (LEED-CI) is the LEED rating system that is applicable to a modernization project. Based on the sustainable design measures detailed above it is reasonable to expect that LEED Silver or LEED Gold certification could be achieved with the additional investment of LEED consulting services and contractor tracking & documentation. LEED Platinum is possibly achievable however additional measures and/or additional costs may be required.

Registration is open for LEED-CI v1.0 until October 31st; after this date LEED v4 for Interior Design will be the applicable rating system. LEED registration should be conducted before that date if certification under the original LEED CI v1.0 is desired.

The Labs 21 Environmental Performance Criteria (EPC) provide a path for laboratory projects to supplement LEED and achieve measures that are more specific to the complexity, health and safety requirements, flexibility and adaptability needs and energy use of lab facilities. The EPC was designed to be used in conjunction with the LEED rating system. EPC criteria can be used as best practices, or used to contribute to LEED certification by including as 'Innovation in Design' credits.


Figure 5.7 – University of Calgary, Clara Christie Centre for Mouse Genomics, Calgary Alberta

### 5.4.5 RECOMMENDATIONS, NEXT STEPS AND DECISIONS REQUIRED

It is recommended that DIALOG and PWGSC, Environment Canada and project users review and confirm the sustainable design vision and priorities:

I. Energy efficiency and greenhouse gas (GHG) reduction
II. Materials impact and lifecycle analysis
III. Enhanced workplace environmental quality
IV. Potable water conservation

The integrated design process requires a clear understanding of Owner Project Requirements; it is possible to deliver higher levels of performance with minimal cost increase when values are clearly defined. For example, effective daylighting can improve workplace quality and save lighting energy without added material costs but requires input at the programming and schematic phases.

DIALOG will consult with confirm that the sustainable design strategy matches client goals and ongoing programs for GHG reduction, water conservation etc. The measures proposed are suggested as a best practice approach to sustainable design; further suggestions will refine the strategy to reflect the characteristics of the site and the operations team.

It should be investigated whether there is the possibility for LEED certification on this project; if so then LEED registration should be investigated and a preliminary LEED scorecard can be constructed.

Figure 5.8 – NAIT Spartan Centre for Instrumentation Technology & PetroCanada Centre for Millwright Technology, Edmonton, Alberta

# 6. Project Execution

## 6.1 PROCUREMENT

The purpose of this procurement strategy and cost report is to provide an analysis of the viability of constructing a new laboratory building on the grounds of the Canada Centre for Inland Waters in Burlington, Ontario. It would be expected that a new Laboratory Building for the CCIW would be a multi-year project which is contingent on long term capital funding. The timing of the program will be determined based on a commitment from the responsible agencies as well as how the project is ultimately funded. As this is an analysis with no defined procurement horizon it is unknown how the project would be developed. However, in order to provide project parameters to guide Environment Canada some commonly employed procurement strategies will be considered.

Capital funds approved by the Treasury Board must generally be spent in the fiscal year in which they are allocated. If capital projects are delayed, then approved funds revert to consolidated revenues. For many capital projects, delays can result in a funding shortfall that departments must obtain from other sources. It is understood that many times, planned projects and programs experience delays and therefore deference of expenditures towards the end of a fiscal budget period. Given the nature of fiscal year funding constraints and lack of real-time project intelligence or shelf-ready projects, planned expenditures fall short of available budgets and therefore opportunities to allocate funding to future year projects in current years, is not capitalized upon

Regardless of whether a multi-year or year to year program is established, it would be expected that the design and the construction of the new Laboratory Building would be carried out by organizations or firms from outside the federal government. How these firms are chosen and how the program is developed will be determined by the project's procurement strategy. That procurement strategy should be tailored to the specific needs and drivers of the project.

As part of this analysis several design and costing options have been developed so that Environment Canada would be in a position to determine how to proceed with the NLB and over what timeline based on funding. Based on the Development Schedule prepared as part of this Feasibility Study, a single long term program or a series of smaller programs may be considered.

There are a number of options available for the development of the NLB, many of which are used in the private and public sector, but which may have limited appeal for this project. Nevertheless, the pros and cons of each will be reviewed in the sections to follow. Some of the factors which will have to be considered in order to develop the procurement strategy include:

- Maintenance of on-going operations
- Ability to meet Environment Canada Strategic Plan
- Short and long term funding
- Flexibility to meet current and future needs
- Necessity of providing facilities that promotes collaboration between users and contributes to productivity
- Long-term operations
- Staff and User engagement

### 6.1.1 PROCUREMENT OPTIONS

A range of procurement strategies can be considered for the CCIW NLB. These are listed following and options with a summary of limitations and benefits associated with each.

#### PWGSC MANAGED - DESIGN/BID/BUILD

This is the traditional method used by PWGSC to obtain design and construction services. Under this type of procurement, a design firm, or more than one firm if undertaken as a series of contracts experienced in laboratory projects would be retained through a competitive proposal process to undertake a detailed Design Development and Construction Document Phases for the project. Depending on the schedule developed by Environment Canada, one or a number of tenders would be prepared and bid under the traditional Design/Bid/Build process. It would be expected that bids from pre-qualified General Contractors would be sought through a public tender and competitive bids based on the scope of work outlined in the tender documents. The successful firm would be awarded the contract to undertake the NLB. PWGSC would maintain control throughout the design and construction phase in accordance with current Treasury Board guidelines.

#### PROS

- Environment Canada and PWGSC would have input throughout the design phase
- Design-Bid-Build increases potential for partnership negotiations
- Design would be able to adapt to changes in science and technology programs
- Design and construction firms set up in check and balance for better quality assurance
- Costs are known once bids close

Figure 5.9 – University of Alberta, NINT, Edmonton, Alberta

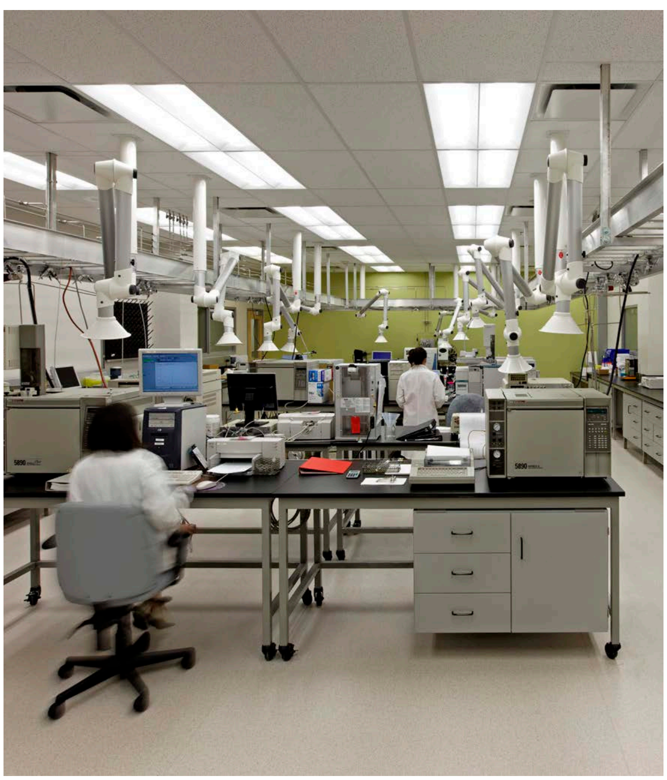


Figure 5.10 – Saskatchewan Disease Control Laboratory, Regina, Sask

### CONS

- Little opportunity to accelerate the NLB program as construction can start only after design is completed
- If undertaken as a series of contacts, each phase would be distinct with little to no interaction between firms
- No opportunity for discussion on optimal and/or innovative approaches
- Little incentive for lifecycle outcomes
- Delivery delays could lead to extra costs & funding approvals
- EC and PWGSC retain significant project risks including interface risks between work of design & construction phases

### PARTNERSHIPS

As public funding for large capital investments in laboratory infrastructure continue to be scarce, increased use of alternate project delivery and funding mechanisms will become increasingly necessary. There may be opportunities for PWGSC to collaborate with strategic partners such as Labs 21 and other Science Based Departments (SBD) to broaden and leverage the best practices, tools, and principles of Labs21 to modernize existing facilities, rationalize inventory, and ensure that the facilities remain world-class, high-performance, energy efficient, environmentally-conscious, safe, and productive assets. Under these programs, innovative service delivery solutions through partnerships with other levels of governments, academic institutions, and the private sector, are seen as becoming increasingly viable, particularly for non-regulatory laboratory infrastructure and scientific programs.

These partnerships is intended to capitalize on a foundation of collaboration between the United States and Canada in laboratory knowledge management, helping to ensure a more sustainable future working with the nations' laboratories. It is further understood that PWGSC is working to facilitate the understanding of and access to the Labs21 principles to all federal laboratory custodial departments in Canada. The design of the NLB is a prime example of how this approach can be utilized to meet this future growth in Canada. Increased use of construction management, design-build, and similar delivery techniques can be considered to provide a different approach to project delivery and therefore economies of scale and total investment costs. Methods that could be considered and the pros and cons include the following.

### PWGSC MANAGED - DESIGN/BUILD

Under this method of procurement, a contract would be developed with one firm which will provide both the design and construction services. It would be expected that PWGSC would utilize the completed Concept Design to provide a baseline design for the NLB. It would be expected that PWGSC would use an Advocate Architect to further refine the design undertaken to date for the NLB and to be PWGSC's advisor throughout the design-build process.

A Request for Proposals would be carried out in which Design-Build firms would present their technical proposals and ideas on how to accomplish these goals. A Contract would be awarded to the firm with the best combination of technical compliance and innovation, work plan, schedule and cost. A procurement strategy such as this would be developed so that work on the NLB could commence upon award of contract.

#### PROS

- Allows for fast-tracking the NLB as the Design-Build contractor would use their expertise and the design & construction phases would overlap
- Strong coordination between design and construction thereby minimizing constructibility risks

#### CONS

- The costs for the LMP would not be fully developed when seeking capital funding
- Lack of control over the design may compromise programming
- Limited incentive for lifecycle outcomes as the Design-Builder is not typically responsible for operations
- Typically favours larger firms which tends to limit competition
- The integration of the designer and builder eliminates many of the traditional checks and balances that PWGSC relies on

#### PWGSC MANAGED - CONSTRUCTION MANAGEMENT

Under this type of procurement, a Construction Management firm would be engaged to provide construction oversight during the design phase and to act as the general contractor during the construction phase. The Construction Management firm would competitively tender construction trade packages, as portions of the design are complete. This type of procurement would allow Environment Canada to commence with some portions of the work which are strategically important such as civil services and the expected piling and required to support the building above the landfill areas.

#### PROS

- NLB project could be fast-tracked
- CM firms provides coordination & flexibility in contracting and procurement
- CM approach allows for overlap between design and construction
- PWGSC/EC would have design input and control
- Process offers opportunity for contractors to provide input into design phase such as fire protection systems or central exhaust options and sustainability measures.

#### CONS

- Overall project costs at start only estimates and would not become fixed until the last work package has been let
- CM firms unless set up as 'CM At Risk' are not accountable for potential cost overruns
- The NLB progress would be dependent on experience and skill of the CM and PWGSC oversight

### 6.1.2 PROCUREMENT ANALYSIS

#### SUPPORT OF ENVIRONMENT VISION

'To provide leadership on environmental science addressing federal priorities'

#### PRIORITIES

- Focus on current and emerging issues of significance to the Government of Canada;
- Build on the Department's existing expertise, knowledge, methods, tools and products;
- Target science that supports effective solutions to pressing environmental problems;
- Direct efforts toward activities and topics in line with the federal role for science and technology

Goals specific to the CCIW NLB would include:

#### SUSTAINABILITY

- Minimize environmental footprint
- Reduces energy use and costs
- Ability to test potential alternative energy sources
- Aesthetic Quality of CCIW Facilities
- Ensures appropriate building image for the facility

#### PROVISION OF A SAFE WORK ENVIRONMENT

- Ensures:
  - Safety of Environment Canada staff and building occupants
  - Safe engineering systems
  - Appropriate types of finishes
  - Durability of materials

### FUTURE FLEXIBILITY

- Ability to accommodate changes in usage and future growth or rationalization
- Allows for flexibility in operations within Environment Canada and other Departments

### PROVIDE VALUE FOR FUNDING AND SCHEDULE

- Ensure that the cost of the NLB will not exceed the approved budget during the construction phase and/or during operations
- Ensure that the NLB meets the schedule established by Environment Canada

### ACHIEVE VALUE FOR MONEY AND STEWARDSHIP OVER THE LMP LIFECYCLE

- Provide the best value for money and the elements of economy, efficiency and effectiveness
- Value to be achieved through the (1) lifecycle management approach and (2) promotion of innovation and (3) optimal allocation of risk over the life of the LMP between the public and private sectors (if considered)

## 6.2 PROJECT COSTING

The Project Cost Estimate for the New Laboratory Building of the CCIW has been developed by Hanscomb Ltd. and is intended to provide an assessment of the total project costs associated with the NLB of the Canada Centre for Inland waters in Burlington, Ontario as illustrated in this report. Accordingly, these costs should only be considered within the full context of the above noted documentation. The construction cost estimate is based on the work required to undertake the construction of a free standing facility as well as required infrastructure upgrades to accommodate the building.

The cost estimate also includes the overall project costs normally associated with this type of development including project soft costs such as Furniture, Fixtures and Equipment (FFE) and Information Technology (IT) and design costs. The cost estimate is not intended to accommodate other work which is beyond the scope indicated in the plans, other than costs to demobilize and renovate some limited areas of the existing Administration & Laboratory Building.

The project has been budgeted based on January 2016 costs with an assumed start of construction in the 1st Quarter of 2019. The construction cost of the building has been estimated at $49.5M in 2016 with a Project Cost of $66.5M and an escalated cost of $71.6M in 2019 dollars. The costs assume that the building will be designed to a minimum of LEED Silver or Green Globe standard in accordance with Federal Government policy.

The costs used in the preparation of this estimate include labour and material, equipment, sub-contractors overheads and profits. Design scope allowance of 10% has been included in the construction costs. This allowance is intended to inform the adequacy of construction costing data through the various stages of the more detailed design process, when all items which may impact cost estimates are identified or known. It must be acknowledged that the existing sub-surface conditions of the CCIW site present a risk in that it is understood that this area has been infilled to accommodate the existing A&L Building as well as other structures on the site.

The capacity to support new structures has not been developed at this time, and there is also a risk that the materials used to infill the site may contain materials or contaminants that would have to be remediated.

Furniture, Fixtures and Equipment (FFE) and Information Technology (IT) have been included as a percentage of construction costs at ten percent. An allowance of 5% has been made to cover construction Post Contract Costs (PCC) unknowns and changes and an allowance of 20% of construction costs has been included for project Ancillaries (Soft Costs) such as Consultant Design Fees and Construction or Project Management. The Cost Estimate does not include for Owner staff and management expenses, financing, land acquisition or legal settlements, or major scientific equipment costs.

A note concerning the differences between the values contained in the following costing tables, and the values shown in Hanscomb's costing report (Appendix A). At the time of commissioning Hanscomb's report the it was understood that the contemplated new laboratory building should accommodate all the lab & office space uses in the A&L Building's 4-7 floors. Subsequently, the size of the new laboratory building was reduced to the 10,000m$^2$ maximum specified by EC. The valves in the succeeding tables use this updated, reduced building sizing, while maintaining the same unit rates established in Hanscomb's costing report. The costing of the A&L Building refurbishment were obtained from the costing values established during the LMP project.

The following is a proposed capital funding expenditure for the new Laboratory Facility.

| | | |
|---|---|---|
| 1. | Total Construction Cost (2016) | $49,468,000 |
| 2. | Post Construction Cost (PCC) | $ 2,473,000 |
| 3. | Ancillaries | $ 9,834,000 |
| 4. | FFE & IT | $ 4,712,000 |
| **5.** | **Current Project Cost** | **$66,547,000** |
| 6. | Escalation (1st Qtr 2019 Start) | $ 5,124,000 |
| 7. | Escalated Project (1st Qtr 2019) | $71,671,000 |

# CCIW - New Laboratory Building Project Development Costs

| | AREA | M² | $/M² | NET CONSTRUCTION COST | DESIGN SCOPE ALLOWANCE @ 10% | LEED ALLOWANCE @ 2.5% | TOTAL CONSTRUCTION COST | CONSTRUCTION CONTINGENCY ALLOWANCE (CCP) @ 5% | ANCILLARY COSTS (DESIGN & MANAGEMENT) @ 20% | FFE & IT ALLOWANCE @ 10% | TOTAL PROJECT COST IN 2016 $ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **NEW CONSTRUCTION** | | | | | | | | | | | |
| Laboratory | 3,400 | m² | $5,200 | $17,680,000 | $1,768,000 | $442,000 | $19,890,000 | $994,500.00 | $3,978,000.00 | $1,989,000.00 | $26,851,500 |
| Shared Storage | 570 | m² | $3,550 | $2,023,500 | $202,350 | $50,588 | $2,276,438 | $113,821.88 | $455,287.50 | $227,643.75 | $3,073,191 |
| Offices | 1,200 | m² | $3,775 | $4,530,000 | $453,000 | $113,250 | $5,096,250 | $254,812.50 | $1,019,250.00 | $509,625.00 | $6,879,938 |
| Office Support | 900 | m² | $3,775 | $3,397,500 | $339,750 | $84,938 | $3,822,188 | $191,109.38 | $764,437.50 | $382,218.75 | $5,159,953 |
| Circulation | 1,200 | m² | $3,350 | $4,020,000 | $402,000 | $100,500 | $4,522,500 | $226,125.00 | $904,500.00 | $452,250.00 | $6,105,375 |
| Service Core | 680 | m² | $3,015 | $2,050,200 | $205,020 | $51,255 | $2,306,475 | $115,323.75 | $461,295.00 | $230,647.50 | $3,113,741 |
| Washrooms | 500 | m² | $4,300 | $2,150,000 | $215,000 | $53,750 | $2,418,750 | $120,937.50 | $483,750.00 | $241,875.00 | $3,265,313 |
| Mechanical & Electrical Space | 2,000 | m² | $3,015 | $6,030,000 | $603,000 | $150,750 | $6,783,750 | $339,187.50 | $1,356,750.00 | $678,375.00 | $9,158,063 |
| Building Construction | 10,450 | m² | $4,008 | **$41,881,200** | **$4,188,120** | **$1,047,030** | **$47,116,350** | **$2,355,817.50** | **$9,423,270.00** | **$4,711,635.00** | **$63,607,073** |
| **SITE DEVELOPMENT COSTS** | | | | | | | | | | | |
| Site Development Costs | 10,130 | m² | | $1,200,000 | $120,000 | $24,000 | $1,344,000 | $67,200.00 | $268,800.00 | $ - | $1,680,000 |
| Mechanical Site Services | 10,130 | m² | | $450,000 | $45,000 | $9,000 | $504,000 | $25,200.00 | $100,800.00 | $ - | $630,000 |
| Electrical Site Services | 10,130 | m² | | $450,000 | $45,000 | $9,000 | $504,000 | $25,200.00 | $100,800.00 | $ - | $630,000 |
| Total Site Development | | | | **$2,100,000** | **$210,000** | **$42,000** | **$2,352,000** | **$117,600.00** | **$470,400.00** | **$ -** | **$2,940,000** |
| **TOTAL PROJECT COSTS** | | | | $43,981,200 | $4,398,120 | $1,089,030 | $49,468,350 | $2,473,418 | $9,893,670 | $4,711,635 | $66,547,073 |

**Escalation Costs to 2019 Construction Start @ 2.5% / Annum**

| | | |
|---|---|---|
| Jan-19 | $5,124,124.58 | $71,671,197 |
| Jan-20 | $7,187,083.83 | $73,734,156 |
| Jan-21 | $8,917,307.72 | $75,464,380 |

## CCIW - Existing A&L Laboratory Project Renovation & Demobilization Costs

| | AREA | M² | $/M² | NET CONSTRUCTION COST | DESIGN SCOPE ALLOWANCE @ 10% | LEED ALLOWANCE @ 2.5% | TOTAL CONSTRUCTION COST | CONSTRUCTION CONTINGENCY ALLOWANCE (CCP) @ 5% | ANCILLARY COSTS (DESIGN & MANAGEMENT) @ 20% | FFE & IT ALLOWANCE @ 10% | TOTAL PROJECT COST IN 2016 $ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **RENOVATED CONSTRUCTION** | | | | | | | | | | | |
| Laboratory | 1,638 | m² | $2,960 | $4,848,603 | $484,860 | $121,215 | $5,454,679 | $272,733.93 | $1,090,935.73 | $545,467.87 | $7,363,816 |
| Offices & Office Support | 2,536 | m² | $1,292 | $3,275,673 | $327,567 | $81,892 | $3,685,132 | $184,256.61 | $737,026.45 | $368,513.22 | $4,974,929 |
| Circulation | 2,293 | m² | $538 | $1,234,082 | $123,408 | $30,852 | $1,388,343 | $69,417.13 | $277,668.51 | $138,834.26 | $1,874,262 |
| Lobby & Washrooms | 149 | m² | $3,250 | $484,250 | $48,425 | $12,106 | $544,781 | $27,239.06 | $108,956.25 | $54,478.13 | $735,455 |
| New Program (Office) | 1,410 | m² | $1,184 | $1,669,482 | $166,948 | $41,737 | $1,878,168 | $93,908.39 | $375,633.55 | $187,816.77 | $2,535,526 |
| New Program (Storage) | 1,500 | m² | $538 | $807,293 | $80,729 | $20,182 | $908,205 | $45,410.25 | $181,640.98 | $90,820.49 | $1,226,077 |
| Building Construction | 9,526 | m² | $1,293 | $12,319,384 | $1,231,938 | $307,985 | $13,859,307 | $692,965.37 | $2,771,861.47 | $1,385,930.74 | $18,710,065 |

**Escalation Costs to 2019 Construction Start @ 2.5%/annum**

| | | |
|---|---|---|
| January 2019 | $1,440,675.00 | $20,150,740 |
| January 2020 | $2,020,687.01 | $20,730,752 |
| January 2021 | $2,507,148.70 | $21,217,214 |


Figure 5.11 – Foothills Medical Centre Seventh Floor CLS Lab, Calgary, AB

DIALOGDESIGN.CA

**TORONTO**
2 Bloor Street E, 1000
Toronto, ON M4W 1A8
T (416) 966-0220
F (416) 966-0223

**EDMONTON**
10154 – 108 Street NW
Edmonton, AB T5J 1L3
T (780) 429-1580
F (780) 429-2848

**CALGARY**
300, 134 – 11 Avenue SE
Calgary, AB T2G 0X5
T (403) 245-5501
F (403) 229-0504

**VANCOUVER**
406 - 611 Alexander Street
Vancouver, BC V6A 1E1
T (604) 255-1169
F (604) 255-1790