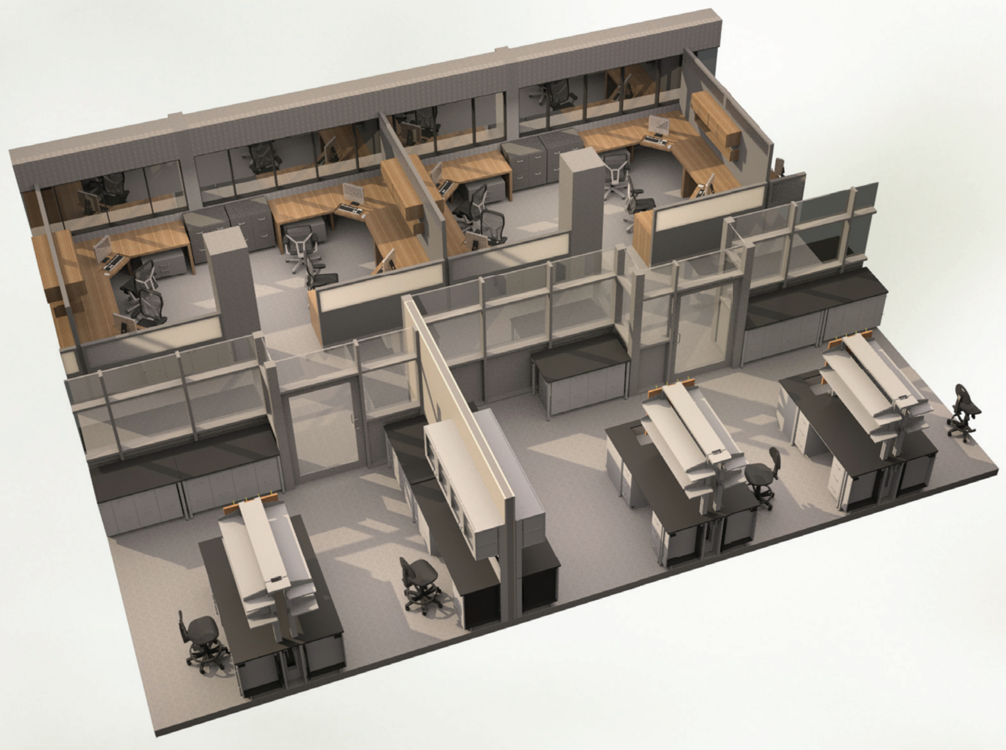
ENVIRONMENT CANADA,
BURLINGTON, ONTARIO

Canada Centre for Inland Waters Administration and Laboratory Building

Laboratory Modernization Plan (LMP)



DIALOG

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

Environment Canada
Environnement Canada

TABLE OF CONTENTS

Executive Summary

University of Alberta, National Research Council National Institute for Nanotechnology, Edmonton, Alberta

Introduction

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. It is the intent of the Laboratory Modernization Plan to provide a better process for managing capital projects for the long term recapitalization of the CCIW facility. The LMP will 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.

The Functional Program and Feasibility Study which were part of the studies leading to this Design Concept outlined a number of design initiatives that informed the ultimate LMP plan. For laboratories this includes designing for maximum flexibility and adaptability to facilitate future renovations as the science and organization of CCIW evolve over time. This includes the use of a standard lab module, promoting open laboratories where possible, the use of modular & mobile casework, and the use of overhead service carriers. Bringing views and natural light into the laboratory space is also identified as an objective to implement for CCIW. The Government of Canada "Workplace 2.0 Fit Up Standards April 2012" has been identified as the design guideline for the CCIW office space and is intended to be the standard for staff work and collaborative spaces which are open, flexible and dynamic workspaces and which allows for innovative and better use of resource as well as technology upgrades which will enable researchers to work and collaborate.

A number of documents have been used to generate the conceptual laboratory design options illustrated in the Design Concept Report in order that the A&L laboratories can accommodate the flexibility, adaptability and scalability required in a modern research facility. Included among these documents is the *"Lab Standard Space Standards & Design Guidelines – Draft"* prepared by Health Canada and the Public Health Agency of Canada (PHA) which should be considered during the more detailed design of the facility to provide consistency in laboratory design. The project should also endeavor to meet the ventilation standards of the *"ANSI/AIHA Z9.5, The American National Standard for Laboratory Ventilation"* which establishes control requirements for ventilation and best practices for personnel safety.

The implementation strategy for the LMP will 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. With the exception of several recently renovated or high value laboratories such as the Ultra Trace Laboratories of the NLET, all research and analytical laboratories will be provided with the resources that meet the standards expected in a world class facility such as the CCIW. The goal will be to provide a variety of laboratory configurations within the existing floor plates which are as flexible and modular as practical whereby any individual space can be enclosed as necessary to accommodate function, safety, and isolation requirements.

Project Cost Estimate

The Project Cost Estimate for the Design Concept of the A&L Building Floors 4 to 7 has been developed by Hanscomb Ltd. and is intended to provide an assessment of the total project costs associated with the Laboratory Modernization Plan of the Canada Centre for Inland Waters in Burlington, Ontario as illustrated in the Design Concept 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 modernization of the laboratories, office and common areas on floors 4 to 7, as well as limited upgrades to the existing mechanical and electrical systems serving these floors. The cost estimate also includes the overall project costs normally associated with this type of development including those for phasing of the work in order to maintain on-going operations of the laboratories and work areas, as well as project soft costs such as Furniture, Fixture and Equipment & Information Technology and design costs. The cost estimate is not intended to accommodate other work which is beyond the scope indicated in the Design Concept plans and reviews.

The project has been budgeted based on 3rd Quarter 2015 costs with an assumed start of construction in the 1st Quarter 2018 and using a Construction Management project delivery. The cost of construction of the LMP for Floors 4 to 7 has been estimated from $41,760,000 to $43,150,000 for the options presented.

The costs assume that the modernization will be designed to a minimum of LEED Silver or the Green Globe standard in accordance with Federal Government policy.

The rates in the preparation of this Cost Estimate include labour and material, equipment, subcontractor's overheads and profits. Escalation to sub-trade bids have been allowed at 2.5% per annum, based on the work completed at each phase of the project.

Design scope allowance of 10% has been included in the construction cost. 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. Furniture, Fixtures and Equipment **(FF&E)** and Information Technology **(IT)** have been included at a percentage of construction costs. An allowance of 5% has been made to cover construction Post Contract Cost **(PCC)** unknowns. An allowance of 20% on construction has been included for project **Ancillaries** (soft costs) including design fees and construction management.

The following items have been specifically excluded from the Design Concept Cost Estimate:

a) Owner's staff and management expenses

b) Financing and/or fund raising expenses

c) Laboratory scientific equipment

The following is a proposed capital funding expenditure for the LMP.

Option 1

1. **Total Construction Cost (2015):** $31,800,000
2. **Post Contract Cost:** $1,590,000
3. **Ancilliaries:** $6,360,000
4. **Furniture, Fixture & Equip/IT:** $2,400,000
5. **Current Project:** $42,150,000
6. **Escalation:** $4,400,600
7. **Escalated Project:** $46,550,000

Option 2

1. **Total Construction Cost (2015):** $32,600,000
2. **Post Contract Cost:** $1,630,000
3. **Ancilliaries:** $6,520,00
4. **Furniture, Fixture & Equip/IT:** $2,400,000
5. **Current Project:** $43,150,000
6. **Escalation:** $4,500,000
7. **Escalated Project:** $47,650,000

Option 3

1. **Total Construction Cost (2015):** $31,200,000
2. **Post Contract Cost:** $1,560,000
3. **Ancilliaries:** $6,600,300
4. **Furniture, Fixture & Equip/IT:** $2,400,000
5. **Current Project:** $41,760,000
6. **Escalation:** $4,350,000
7. **Escalated Project:** $46,110,000

Participants

The LMP Design Concept Report and related studies was undertaken with the assistance of many participants from Environment Canada, Public Works and Government Services Canada and the Design Team. Their participation is appreciated.

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01 Facility Assessment

University of Calgary Energy Environment Experiential Learning, Calgary, Alberta

1.1 Introduction

The Facilities Assessment which is described in the following sections of the LMP Design Concept Report is intended to provide a brief summary of the condition of the existing architectural, structural, mechanical, electrical and laboratory components of the Administration and Laboratory (A&L) Building of the National Water Research Institute (NWRI) of the Canada Centre for Inland Waters. The existing facilities are described in more detail in the RS 2.2.1 Investigation Report which was developed in support of this Design Concept. The purpose of the investigation was to examine all components of the A&L Building, including laboratory equipment, building structure, building envelope, interior finishes, mechanical and electrical systems and conduct a building code review. All assessments were based on visual inspection of observable building elements and many of the building's structural, architectural, mechanical and electrical elements in the office, corridor and laboratory areas were covered with various finishes, thus preventing a thorough inspection. There were other areas which allowed a reasonable visual assessment of the existing systems including the North and South Service Cores on each floor as well as several laboratories which had ceilings and existing equipment removed prior to other renovation work which allowed a more thorough inspection. The objectives included:

a) Review and assess the existing conditions of entire space from Floors 4 to 7 and other areas where affected and any other conditions that may require work to ensure safety of the facility and its occupants;

b) Review the existing documents and reports, maintenance history and concerns, potential impact on the existing systems, and health and safety requirements;

c) Research and review original construction documents and any historical documents describing modifications to the site or building;

d) Review site and/or building conditions and compare conditions to existing documents.

e) Pursue more detailed investigation of site and/or building conditions including; deconstruction of components to determine a more comprehensive understanding of the existing conditions such as the composition of the built elements or the cause of the problem;

f) Record findings of the investigation by recording in detail, including drawings and photographs, the location of the problem or situation, providing a description of the condition, the design capacity of the building system;

g) Identify all deficiencies, potentials and constraints with the existing systems;

h) Prepare the report which includes the results of site investigations, review of the project scope of work and recommendations of alternative remedial measures for deficiencies and options for improvements

The following documents have been made available and reviewed in preparation of the report:

a) Existing 'As-Built' Constructions Documents dated 1970 prepared for the original construction.

b) Digital Building Information Modeling files (Revit) prepared by Environment Canada.

c) CCIW Lab Report prepared by Environment Canada dated October 2011

d) Asbestos Assessment Report prepared by Pinchin Environmental, dated July 12, 2013

e) Fire Protection Compliance Monitoring Inspection Report dated March 2011

f) Building Condition Report prepared by PWGSC, dated September 2009

g) Administration & Laboratory Central Exhaust System Study, Filer Engineering Ltd, July 2013.

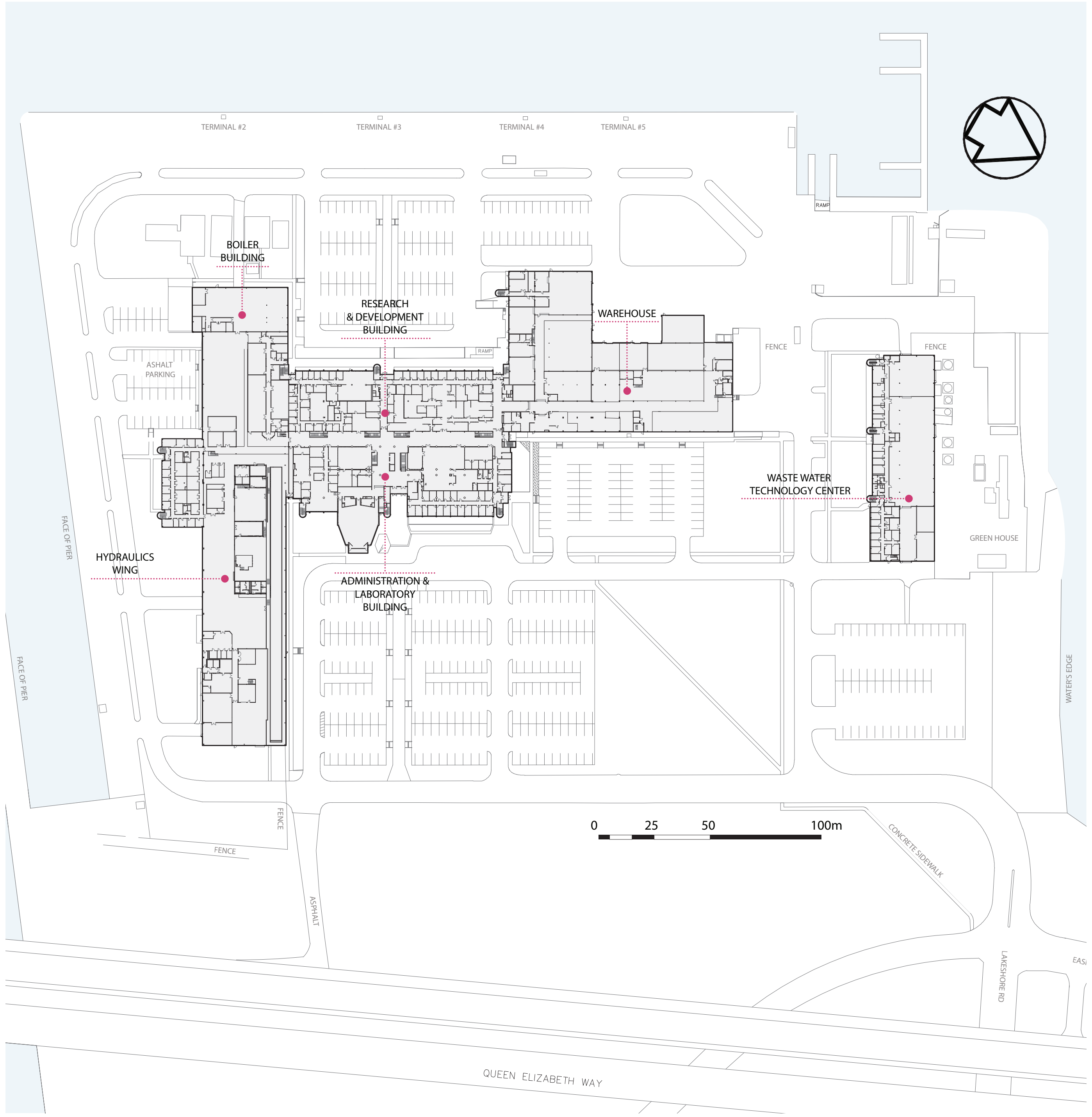
1.2 CCIW Overview

The CCIW is one of the National Water Research Institute's (NWRI) two main centres, located at 867 Lakeshore Road in Burlington Ontario. It is considered one of the world's leading water research centres. The CCIW 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.

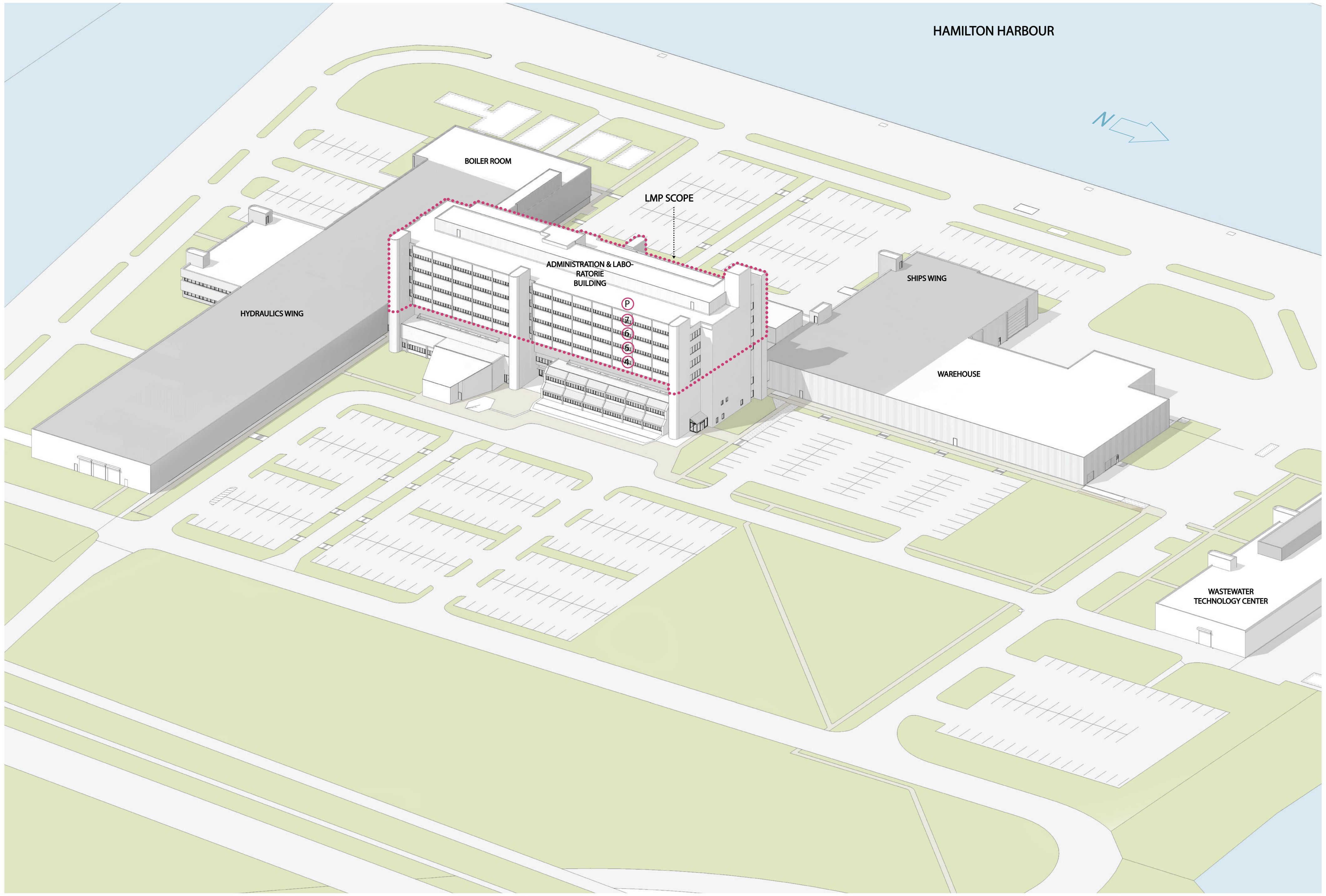
The CCIW houses the central facilities of the (NWRI) and other EC programs, including the Ecosystem Monitoring and Assessment Network (EMAN) coordinating office; Ontario regional offices of EC, including those related to Great Lakes and meteorological programs; and the Wastewater Technology Centre (WTC),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

Staff working at the CCIW includes aquatic ecologists, hydrologists, toxicologists, physical geographers, modelers, limnologists, environmental chemists and research technicians. The National Laboratory for Environmental Testing 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 National Laboratory for Environmental Testing involves engineering and technical operations, such as the planning and management of field sampling programs.

Location Plan



Site Plan



Site Axonometric

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.
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. **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. This building is not part of the current investigation.

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. This building is not part of the current investigation.

1.3 A&L 4th to 7th Floors Overview

The A&L Building's 4th to 7th floors are arranged with laboratories backing on a central service core with staff offices located on the building exterior. The laboratories occupy approximately 1,100 m² per floor with support spaces, offices and common areas occupying approximately 1,500 m². The center service core which contains the plumbing, piping, drainage, and fume hood exhaust risers to the Penthouse on the roof level are centrally located on each floor and back on to the laboratories. There are approximately 115 designated laboratories on the 4 floors and these are evenly distributed and range from 25 to 31 labs per floor, although a number of these are being used for storage space or are inactive. There are also approximately 50 offices on each floor as well as some additional support spaces such as copier rooms, kitchenettes and washrooms. Floors 4 to 7 also includes support spaces such as Wash Up & Sterilization Rooms, Cold Rooms, Technician Support Areas and Bottle Wash Areas.

All existing A&L laboratories are based on a standard module of 7.31m deep from the corridor demising wall to the service core walls with exhaust and fume hoods located on or perpendicular to the service core wall. The labs do not have a standard module width and vary from 3.12m to 9.45m with 6.30m being the most common size. There are no laboratories with a dedicated office or separated write up area within the suite and all researcher and technicians offices are located on offices located at the exterior perimeter wall of the building.

A majority of the analytical laboratories are located on the 7th Floor under the Emergencies, Operational Analytical Laboratories and Research Support (EOALRS) with some related research and analytical laboratories located on floors 4 to 6. The EOALRS which is part of the NLET is the primary analytical component of Environment Canada and provides services to laboratories within the CCIW and elsewhere across the country. The 5th & 6th floors are occupied almost exclusively by the Watershed Hydrology & Ecology Research Division (WHERD) & the Aquatic Contaminants Research Division (ACRD), with the 6th floor hosting the single laboratory devoted to Ecotoxicology & Wildlife Health Division (EWHD). The 4th floor is primarily devoted to the Aquatic Contaminants Research Division (ACRD), as well as the Department of Fisheries & Oceans (DFO) which operates in a tenancy arrangement with Environment Canada. The Water Quality Monitoring & Surveillance (WQMS) division has a total of 5 laboratories and support rooms distributed between the 4th and 5th floors.

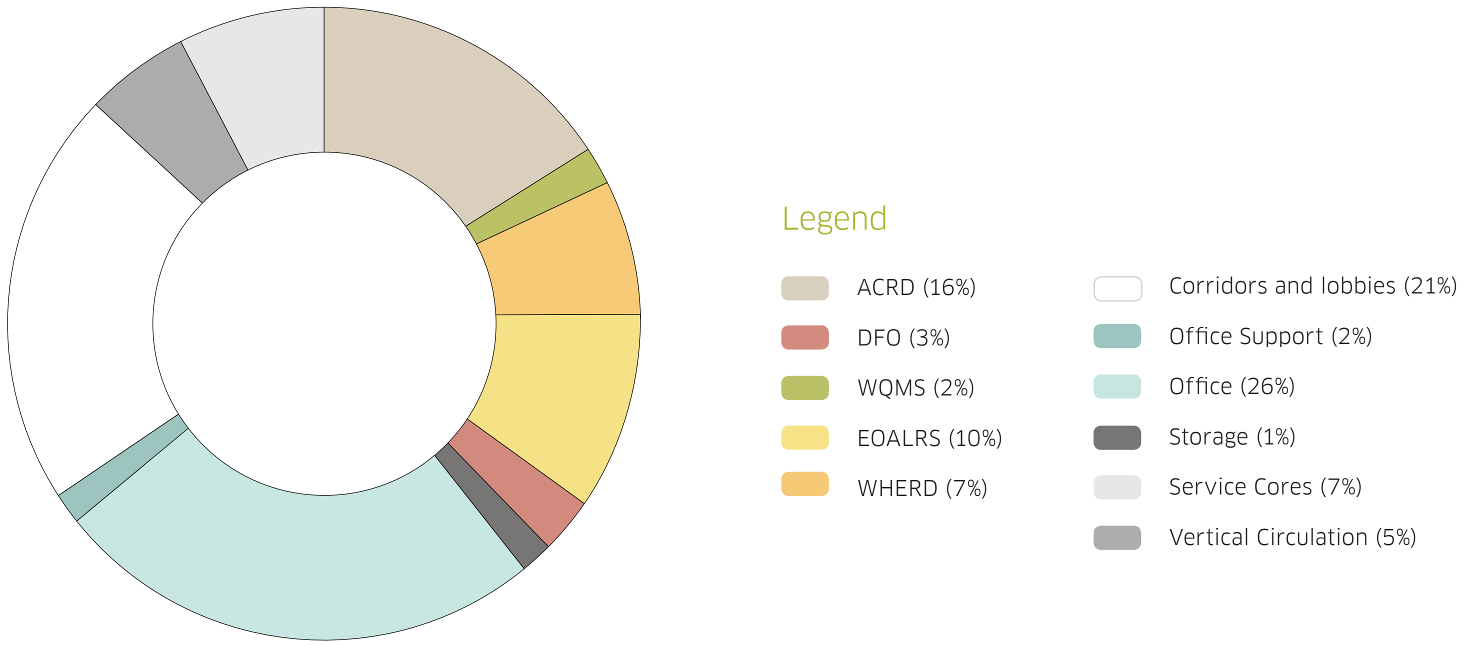
In addition to the laboratories contained in the A&L, a number of the Divisions have laboratories in other areas of the CCIW such as the Hydraulics Building, Research and Development or in the Wastewater Technology Centre. These are located elsewhere due to a number of reasons including the type of science, proximity to shipping or receiving or space limitations in the A&L Floors 4 to 7.

Through interviews and information gathered from users during the programming phase it is apparent that the current layout of the laboratories in the A&L Building are not always suitable for their intended purposes, as many have retained their original footprint from the design in the early 1970's. Over the history of the facility, the majority of labs have maintained their original configuration and equipment and have been assigned to new users based on availability rather than the science that is undertaken there. In some instances labs are too large or too small but the ability to re-configure is limited due to the existing layout and infrastructure.

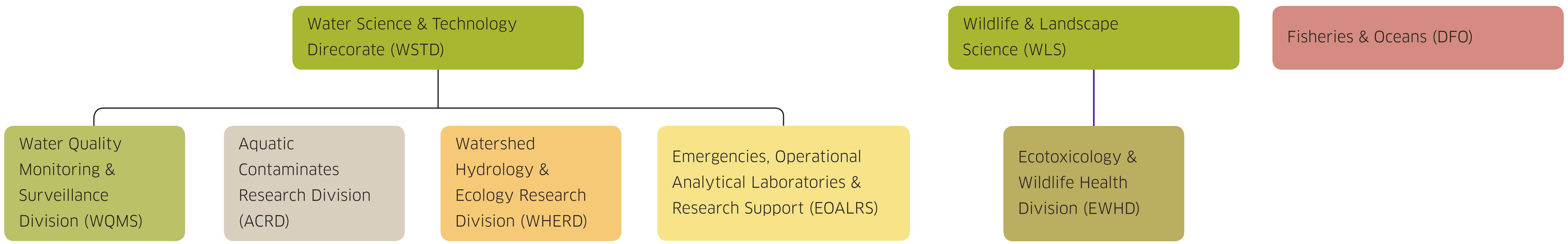
The redevelopment of floors 4 to 7 as part of the LMP is an opportunity to go back to basics and develop a system of laboratory modules that are efficient and flexible and allow for sharing and collaboration between groups. This approach is not always possible under the current arrangements as researchers and scientists are not always grouped according to the work that they undertake and lack the infrastructure and systems such as meeting and collaborative spaces to increase the potential for interaction between users within their area of expertise and with other divisions. The following is a summary of the existing spatial requirements of the laboratories, offices and support space of floors 4 to 7 of the A&L Building:

CCIW A&L Building Floors 4 to 7 Space Allocations	
Aquatic Contaminants Research Division (ACRD)	1,691m²
Water Quality Monitoring and Surveillance (WQMS)	208m²
Watershed Hydrology and Ecology Research Division (WHERD)	741m²
Ecotoxicology and Wildlife Health (EWHD)	1,064m²
Emergencies, Operational Analytical Laboratories & Research Support (EOALRD)	1,064m²
Department of Fisheries and Oceans (DFO)	304m²
Dedicated Cold & Store Rooms	160m²
Research Offices	2,709m²
Meetings Rooms (1 per Floor)	123m²
Corridors & Lobbies	2,293m²
Service Core (North & South)	805m²
TOTAL	**10,120m²**

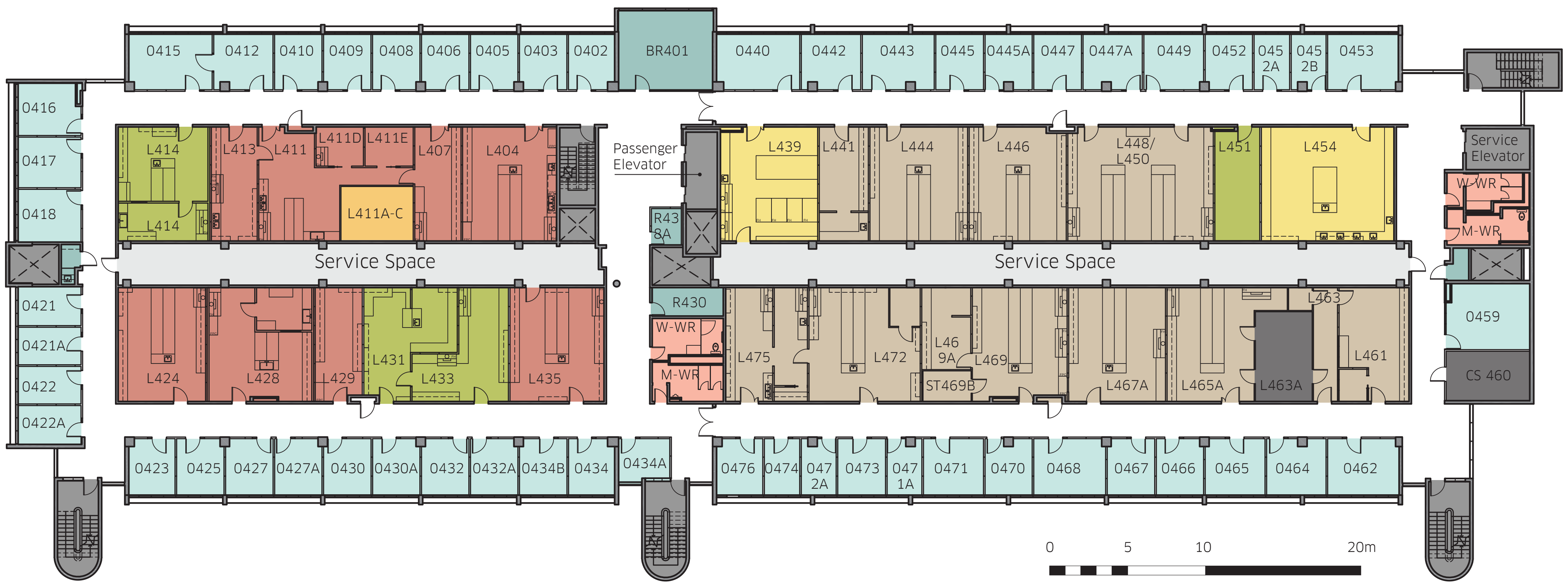
A&L Floors 4-7 Space Distribution



Canada Centre for Inland Waters – Organizational Structure



4th Floor (Existing)

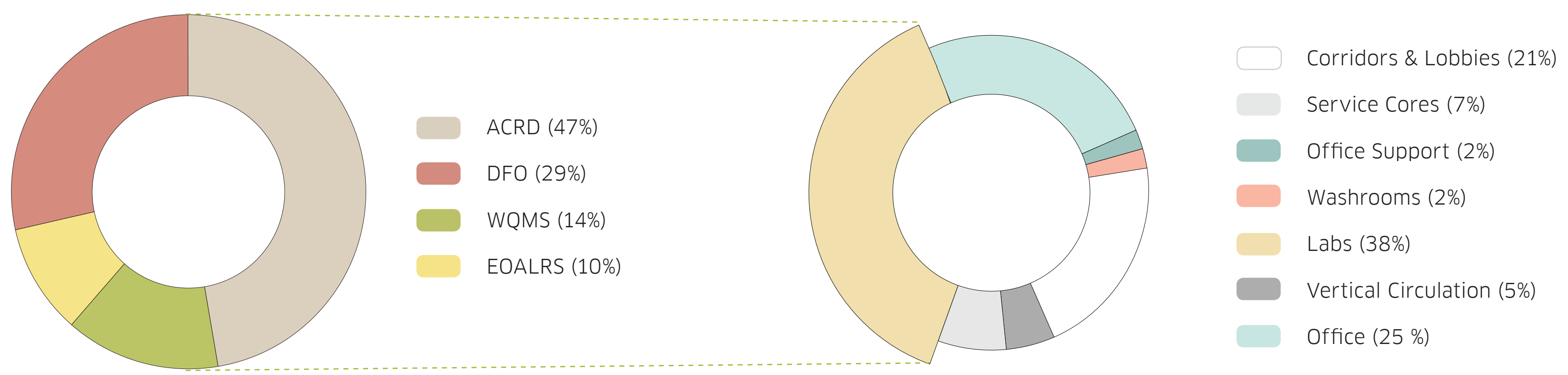


Legend

- Watershed Hydrology & Ecology Research Division (WHERD)
- Aquatic Contaminants Research Division (ACRD)
- Emergencies, Operational Analytical Labs & Research Support (EOALRS)
- Eco-Toxicology and Wildlife Health Division (EWHD)
- Water Quality Monitoring and Surveillance (WQMS)
- Department of Fisheries and Oceans (DFO)
- Monitoring & Data Services Directorate (MDSD)

4th Floor Lab Distribution

4th Floor Space Distribution

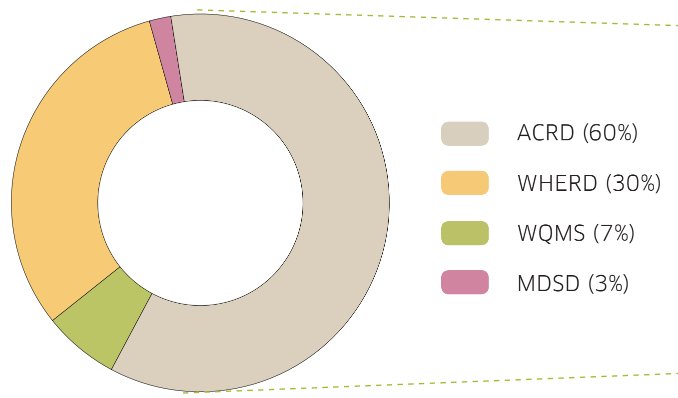


5th Floor (Existing)

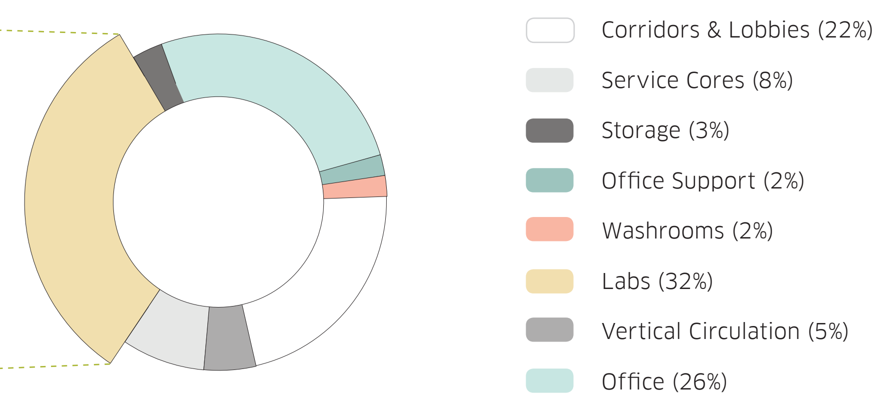
Legend

- Watershed Hydrology & Ecology Research Division (WHERD)
- Aquatic Contaminants Research Division (ACRD)
- Emergencies, Operational Analytical Labs & Research Support (EOALRS)
- Eco-Toxicology and Wildlife Health Division (EWHD)
- Water Quality Monitoring and Surveillance (WQMS)
- Department of Fisheries and Oceans (DFO)
- Monitoring & Data Services Directorate (MDSD)

5th Floor Lab Distribution



5th Floor Space Distribution

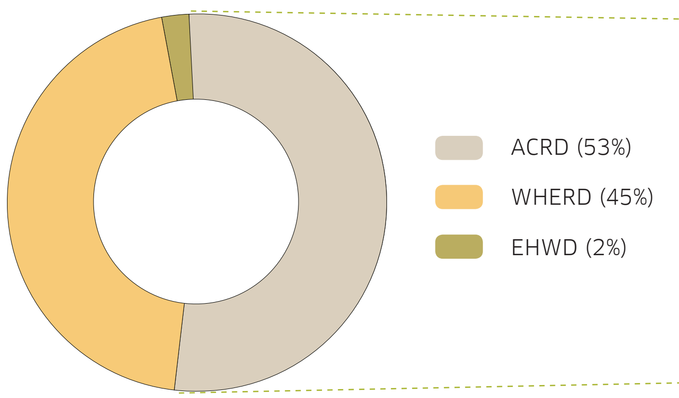


6th Floor (Existing)

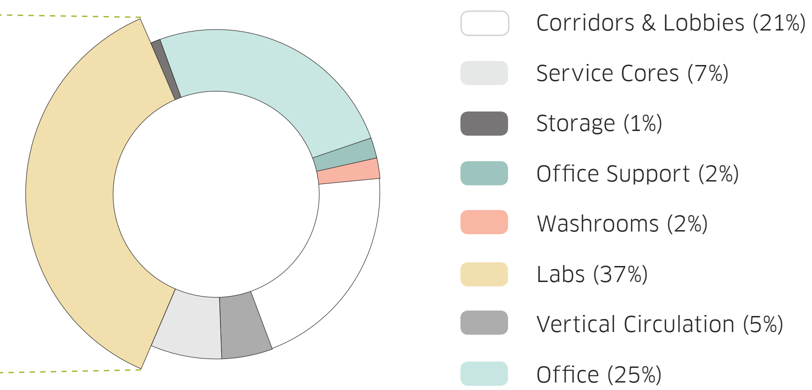
Legend

- Watershed Hydrology & Ecology Research Division (WHERD)
- Aquatic Contaminants Research Division (ACRD)
- Emergencies, Operational Analytical Labs & Research Support (EOALRS)
- Eco-Toxicology and Wildlife Health Division (EWHD)
- Water Quality Monitoring and Surveillance (WQMS)
- Department of Fisheries and Oceans (DFO)
- Monitoring & Data Services Directorate (MDSD)

6th Floor Lab Distribution



6th Floor Space Distribution



7th Floor (Existing)

Legend

- Watershed Hydrology & Ecology Research Division (WHERD)
- Aquatic Contaminants Research Division (ACRD)
- Emergencies, Operational Analytical Labs & Research Support (EOALRS)
- Eco-Toxicology and Wildlife Health Division (EWHD)
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- Department of Fisheries and Oceans (DFO)
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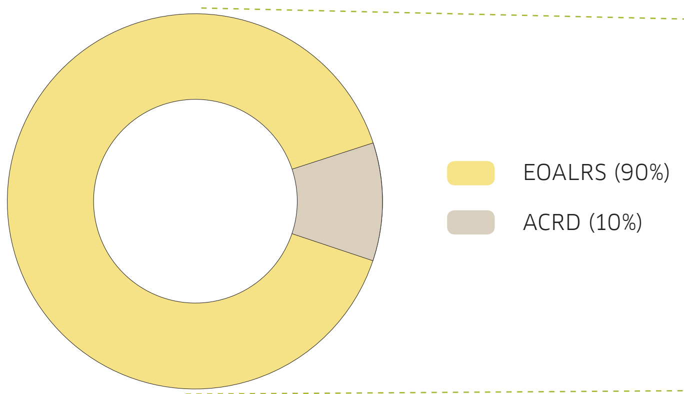
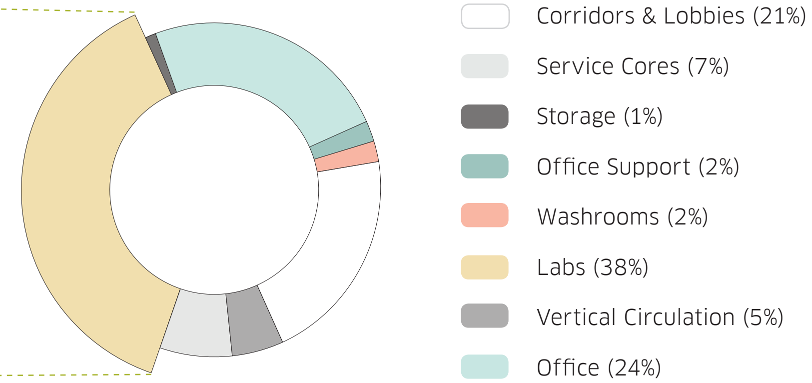
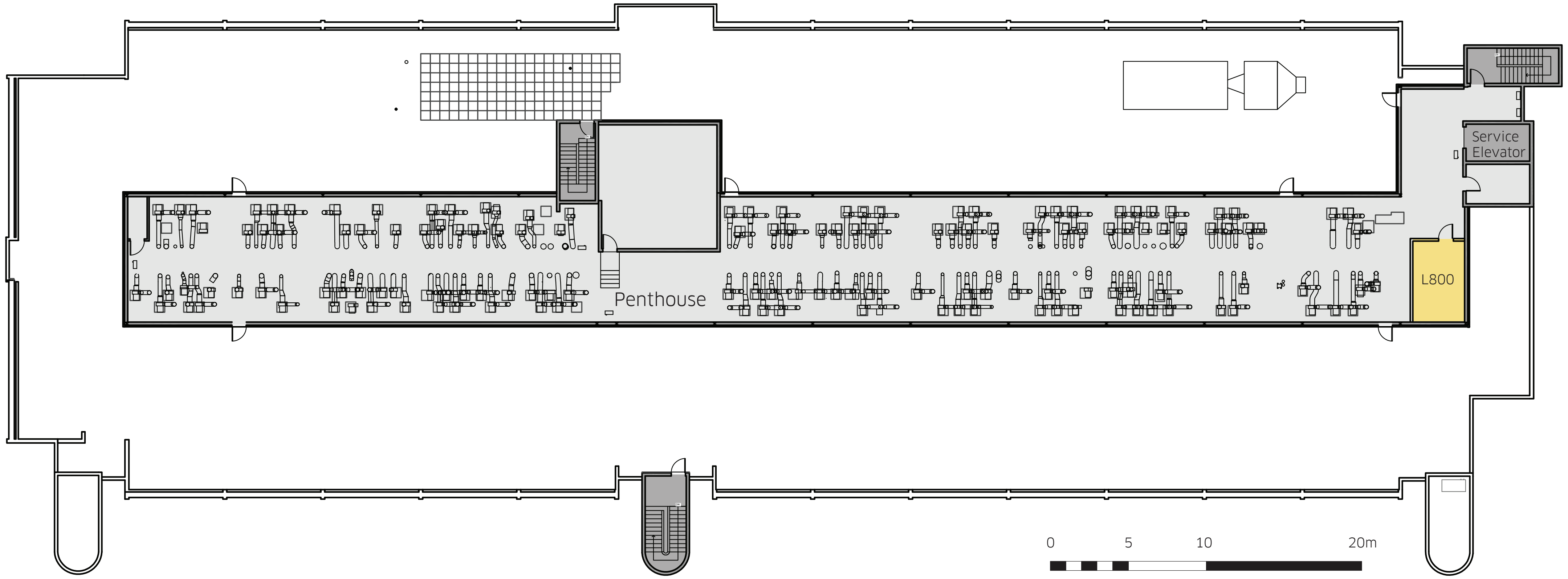
7th Floor Lab Distribution



7th Floor Space Distribution



Penthouse Floor (Existing)



Legend

- Watershed Hydrology & Ecology Research Division (WHERD)
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- Eco-Toxicology and Wildlife Health Division (EWHD)
- Water Quality Monitoring and Surveillance (WQMS)
- Department of Fisheries and Oceans (DFO)
- Monitoring & Data Services Directorate (MDSD)

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

1.4 Building Code Review

This Building Code Review summarizes the fire protection and life safety building code concepts of the National Building Code of Canada 2010 (NBC) and the National Fire Code of Canada 2010 (NFC) relative to the NWRI Building located at 867 Lakeshore Road, Burlington, ON. The building code review is specific to the life safety for Floors 4 to 7 of the Administration and Laboratory Building of the NWRI. The review is a general report of code compliance, observations, findings and existing site conditions with regards to the conformance of the building facility if a significant upgrade was undertaken and the facility were to meet the building codes currently in effect. For this review the requirements of the Canada Occupational Health and Safety Regulations (COSHR), the National Building Code of Canada (NBC), 2010 edition and the National Fire Code, 2010 edition will apply as the building is located on federal Crown lands; the implementation of the Fire Protection Standard is now overseen by the respective Departmental Fire Protection Coordinator (DFPC) as the Authority Having Jurisdiction (AHJ). This report is limited to the A&L Building only within the context of the much larger facility.

Applicable Building Code

The applicable building code for this Project is the NBC 2010 (NBC). The NBC sets out the technical provisions for the design and construction of new buildings and applies to the alteration and change of use of existing buildings. This review is relative to life safety and fire protection. The requirements for fire and structural protection of buildings are established in Part 3 of the NBC. All references in this report refer to Part 3 of Division B of the NBC unless otherwise noted.

Applicable Fire Code

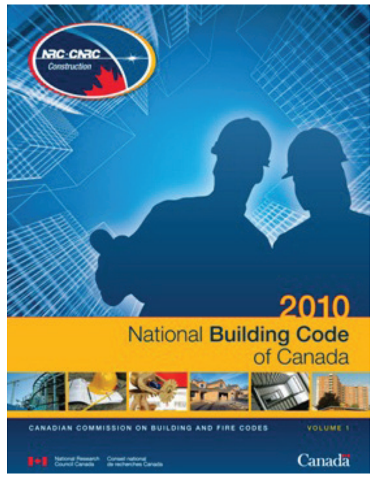
The applicable Fire Code for the LMP is the National Fire Code 2010 (NFC). The NFC establishes requirements for the operation and maintenance of the fire- related features of buildings in use. The NFC contains provisions regarding fire safety and fire protection features that must be added to existing buildings when certain hazardous activities or processes are introduced in these buildings. Provisions of the NFC are not duplicated entirely within the NBC. For this reason, some NFC provisions will apply to original construction, alterations or changes in use.

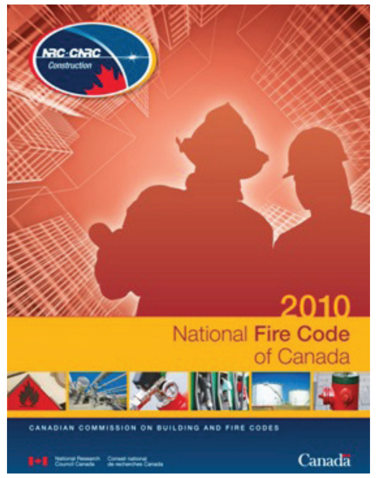
Treasury Board Fire Protection Standard

The NBC and NFC are the applicable codes as referenced in the Treasury Board of Canada Secretariat's Fire Protection Standard (FPS) effective April 1, 2010 for all Government of Canada real property. These codes are also referenced as applicable in Section 2.2.(1) of the Canada Occupational Safety and Health Regulations (COHSR). The government policy that prescribes the NBC and/or NFC is the Treasury Board (TB) Fire Protection Standard (TBFPS) (effective date April 1, 2010). The objective of this policy is to "…protect and minimize losses to federal real property and protect the lives of those who use these properties from fire-related risks. "This policy requires that each government department establish a Departmental Fire Protection Coordinator who is responsible to establish cooperation with all parties to the policy. However, the policy establishes that the Department that has administrative responsibility for a building (i.e., Custodian Department) is accountable for the application of the NBC and NFC as defined by applicable sections.

Based on the TB Standard, an existing building is subject to the NFC only, up to the time of any alteration or change of use. At the time of any alteration or change of use, the NBC is applicable. For the purposes of this analysis, the 2010 edition of the NBC have been applied for fire and life safety features in anticipation of future renovations to which the NBC will apply.

The requirements of the Ontario Building Code (OBC 2012) are not represented in this report. The OBC is not an applicable Code for federal government buildings, but can be applied as mandated by the project authority as a courtesy to the local municipality. The two Codes are similar, however, some significant differences exist between the Codes such that application of both Codes will either result in added features (and added costs) or compliance with both Codes will be in conflict with one or the other.





Building Description and Occupancy Classification

The Administration and Laboratory Building which is part of the National Water Research Institute (NWRI) Building on the CCIW campus is a multi-storey building comprised of five distinct structures. It is understood that the building was originally constructed in 1971-72 and is comprised of five buildings that are fully integrated for purposes of building code classification (i.e. one single building approach). Since the building was constructed in 1971, it is assumed that the requirements of the 1970 NBC were enforced at the time of construction. The entire building is unsprinklered, except renovated portions within the Hydraulics building (renovated in 2012) which has been provided with sprinkler protection. It is understood that a study is currently underway to update the building with sprinklers.

The major occupancy type of the NWRI as defined in the (NBC), Part 3, is difficult to determine due to the variety of occupancies in the building. The major occupancies such as laboratories, repair garages, workshops and storage would be defined as a 'Group F – Industrial' major occupancy. It would have to be determined whether these would fall under other specific levels such as Division 1 - High Hazard, Division 2 - Medium Hazard, or Division 3 - Low Hazard as each area varies depending on specific usage and materials (e.g. chemicals) and equipment involved. Based on the Investigation we believe that Floors 4 to 7 of the A&L Building would fall under the F-3 Classification due to the relatively low hazard of usage and materials. There are also other minor occupancies within the NWRI and A&L Building including Group A, Division 2 - Assembly (cafeteria, auditorium, library); and Group D - Business and Personal Services (offices, open office areas). The determination of the occupancy types in each area would have to be reviewed with the Departmental Fire Protection Coordinator (DFPC).

Administration & Laboratory (A&L) is a 7 storey structure with a partial basement, Rooftop Mechanical Penthouses (mechanical and elevator), served by 5 enclosed exit stairs, 2 passenger elevators and a service elevator. The 1st and 2nd floors house the main facility entrance, administrative offices, cafeteria, auditorium and library. The 3rd floor is used exclusively as Service Space (mechanical/electrical). The 4th through 7th floors are comprised of perimeter offices and interior laboratories, arranged around two Centre Service Cores. An enclosed 2 storey area, referred to as the Mall, interconnects the A&L, R&D, Hydraulics Lab and Warehouse structures at the 1st and 2nd floor levels with 5 open circulation stairs. Building area or footprint of the A&L/Mall is 3,612m² with the Floors 4 to 7 having a building area of just under 3,000m².

Research & Development (R&D) is a 2 storey structure with a crawl space, Service Penthouse (mechanical), served by 3 enclosed exit stairs. Both floors are comprised of perimeter offices and interior laboratories. Building area is 2,898m².

Hydraulics Lab is a 2 storey structure, served by enclosed 2 exit stairs and an interior bridge (between upper office area and the upper Mall). The 1st storey of the structure comprises the laboratories, while the 2nd storey is made up of offices. Building area of the Ground Floor Hydraulics Lab is 7,002m² and the Second Floor Offices is 742m².

Boiler Plant is a 1 storey structure with 2 mezzanine areas housing the main heating equipment for the entire facility. Building area of the 1 storey structure with 2 mezzanine areas is 856m².

Warehouse is a 2 storey fully sprinklered structure, served by 3 enclosed exit stairs and a freight elevator. The 1st storey houses various workshops, storage areas and shipping/receiving areas, while the 2nd storey is occupied with separate office and laboratory areas. Building area of the 1st story is 5,492m².

The overall ground floor footprint or area of the NWRI as measured under the NBC 'building area' is approximately 20,600m². The NWRI would be considered a single building as defined by the current NBC, regardless of the fact that it is made up of five separate buildings because it lacks fire walls and fire separations required for consideration as multiple buildings.

Project Characteristics / Construction Type

The construction requirements for the A&L Building are based on the major occupancy, building area and number of storeys. The building would be required to be constructed in accordance with the provisions of Article 3.2.2.78 Group F, Division 3, Any Height, Any Area, Sprinklered. The following construction requirements apply:

1) Except as permitted by Articles 3.2.2.79 to 3.2.2.88., a building classified as Group F, Division 3 shall conform to Sentence (2).

2) Except as permitted by Article 3.2.2.16, the building referred to in Sentence (1) shall be of noncombustible construction, and

   a) Except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the building shall be sprinklered throughout,

   b) Floor assemblies shall be fire separations with a fire-resistance rating not less than 2h, except that floor assemblies are permitted to be fire separations with a fire-resistance rating not less than 1h in a storage garage with all storeys constructed as open-air storeys,

   c) Mezzanines shall have a fire-resistance rating not less than 1 hr, and

   d) Loadbearing walls, columns and arches shall have a fire-resistance rating not less than that required for the supported assembly

As the NWRI and A&L Building is not currently sprinklered it would not be in conformance with the construction type required under the NBC 2010. The NWRI is not considered a high building in accordance with the NBC as it is not more than 36 m in height, measured between grade and the floor level of the top storey. As such, the high building requirements of Subsection 3.2.6. are not applicable to this Project.

Fire Separations and Closures

Construction, based on the application of the 2010 NBC, is required to meet the following fire separation requirements with fire protection ratings.

Exit Stairs: Fire separation with 2 hour FR rating

Vertical Service Space (Shafts): Fire separation with 1 hour FR rating

Janitor's Closet: No fire separation (1h FRR required in non-sprinklered building

Major Electrical Rooms: Fire separation with 1 hour FR rating

Storage Rooms: Unrated fire separation

Mechanical Rooms with Fuel-Fired Equipment: Fire separation with 1 hr FR rating

Of particular note is that storage rooms are not required to be fire separated from the remainder of the building per the NBC except as may be required to suit the stored materials. Electrical equipment that is required to be located in a service room by a CSA C22.1, "Canadian Electrical Code, Part I," is to be installed in a service room separated from the remainder of the building by a fire separation with a 1 hour fire-resistance rating (NBC Sentence 3.6.2.1.(6)).

Penetrations

Service penetrations through fire separations are required to be fire stopped in accordance with Article 3.1.9.1. Penetrations are to be sealed by a listed fire stop system that has an F rating not less than the fire protection rating for closures in the fire separation in conformance with Table 3.1.8.4. (e.g., a 1 hour fire separation requires a fire stop system with an F rating of 45 minutes).

Typical Unprotected Penetration in Laboratory Rear Wall (to Service Space)

Fire Dampers

The NBC requires fire dampers to be installed in ducts that penetrate assemblies that are required to be fire separations as per Article 3.1.8.7. with exceptions for fire damper installations described in Article 3.1.8.8. Generally, fire dampers are required to be provided in ducts, in the plane of the fire separations. Exemptions include exhaust duct risers and ducts penetrating fire separations not required to have a fire resistance rating. Of particular note here is no of penetrations of the fume hood and other exhaust systems through the demising wall between the laboratories and Service Cores or through the floor of the Service Core from floor to floor. NFPA 45 Standard on Fire Protection for Laboratories Using Chemicals, Section 8.10.3.1 prohibits the use of automatic fire dampers in chemical exhaust hood systems. The design and installation of ducts from chemical fume hoods shall be in accordance with NFPA 91, Standards for Exhaust Systems for Air Conveying of Vapors, Gases. Therefore other measures have to be taken to provide the required fire separation with a 1h fire-resistance rating required under 3.2.78 of the NBC. In accordance with Section 2-1.11., ducts that pass through a fire barrier wall having a fire-resistance rating of 2 hours or more shall meet the following:

- Be constructed and supported so that 10 ft (3m) of the duct on each side of the fire barrier can resist a 2-hour fire scenario
- Be protected by sealing the opening around the duct with a listed or approved material of a fire-resistance rating equivalent to that of the fire barrier wall.

It is recommended that at a minimum, measures be taken to seal all existing abandoned or unsealed openings in the demising wall between the Service Core and the Laboratories to the equivalent fire resistance rating of the existing concrete block wall. It is further recommended that as part of a LMP that measures be implemented to provide the required fire-resistance ratings as required under the NBC, latest edition.

Occupant Load

The occupant loads of Floors 4 to 7 of the A&L Building will be based on Code prescribed occupant load factors and design occupant loads. NBC, Table 3.1.17.1. dictates an occupant load factor of 9.3 m^2/person for office occupancies or one per office. For the laboratories, a factor of 20m^2/person has been used. The design occupant loads can be applied and the design occupant load of the space can be less than that which would be calculated from the occupant load factor, where it can be shown that the space will be used by fewer persons. Based on the Code-prescribed occupant load factor of 9.3 m^2/person for the offices and the application of the Laboratory use occupant load factor to the areas including common corridor and utility/support spaces) an occupant load per floor of 75 persons per floor has been developed. This occupant load has been assessed based on design occupant loads which reflect the design intent, actual number of person for which the space is designed.

Egress and Exits - Number of Exits and Travel Distance

The NBC requires that each storey be served by a minimum of two exits. The travel distance from the most remote point in the floor area to an exit is permitted to a maximum of 45 m in a sprinklered space. (30 m in a non-sprinklered space). Floors 4 to 7 of the A&L Building are served by five exit stairs. The minimum of two exits located remote from each other on Floors 4 to 7 is met by existing Stairs but the maximum allowable travel distance in a non-sprinklered building of 30 m is exceeded in a number of areas. The exiting of the building is required to demonstrate that sufficient capacity exists to serve the occupant load. Exit capacity is based on the most restrictive point in the path of the travel.

The A&L is provided with five exit stairs from Floors 4 to 7 with Stair S01, S03, S04 and S05 leading directly to the exterior from the stairs, and Stair S02 exiting into the Mall area at the ground floor. This would have to be reviewed as part of any future renovation of the A&L Building as it exceeds the allowable limit for exiting through a Lobby. The NBC requires that exits be not less than 1100 mm wide and with no one exit providing more than 50% capacity. The existing exit stairs require a minimum of 1100mm wide stair treads of at least 280 mm deep and no more than 180 mm rise. Stairs require handrails and guardrails in accordance with 3.4.6 of the NBC. The minimum width of stair treads, depth and handrails and guardrails are not met in the current building.

Code Compliance and Recommendations

A number of items have been identified which will require compliance to address the applicable sections of the NBC and NFC. The issues identified throughout the facility are described within a number of reports under their applicable components. Due to the extensive nature of correcting some of the identified items, it is further recommended that the 'Authority Having Jurisdiction' (being the DFPC), be consulted to determine what interim measures, if any, can be employed to ensure that occupant health and safety is not compromised.

In accordance with the NBC 2010, a number of areas would have to be addressed. These include:

a) NBC 3.2.2.78. - Floor assemblies shall be fire separations with a fire resistance rating of not less than 2 hours. A review of existing structural drawings indicate that the concrete thickness of the cast in place concrete floor structure for Floors 4 to 7 is only 115mm to 125mm. This thickness of concrete may not provide the required fire resistance rating and would have to be reviewed in further detail if renovations to the A&L Building were being considered.

b) NBC 3.1.8.1. - Service Core doors are not fire rated (located in required fire separations).

c) NBC 3.1.8.4., 3.1.8.11., 3.1.8.12, and 3.1.8.13. – There are a number of instances where doors in fire separations do not have the required fire resistance rating, including the 5 main exit stairs from Floors 4 to 7. Under the NBC, these doors would require a door with a 1 ½ hour fire resistance rating and the amount of glazing would be limited. Similarly, the doors to the Service Cores would require a fire resistance rating in accordance fire separation of the floor assembly.

e) NBC 3.4.6.4.(7) and 3.4.6.5.(5) – The 5 Exit Stairs from Floors 4 to 7 handrails do not have adequate extensions and returns and a handrail is only provided on one sides. Handrails are required on both sides of the stairs. The guardrails at the side of the stair and top landings are also less than the required height of 1100mm.

f) NBC 3.4.6.4 – The 5 Exit Stairs from Floors 4 to 7 stair treads run are not compliant with the building code with a run of 254mm. Minimum run under the NBC is 280mm. The stair tread width is 1067mm and the NBC requires a minimum 1100mm.

g) NBC 3.4.2.5.(1)(f) - The travel distance from the most remote point in the floor area to an exit is permitted to a maximum of 45 m in a sprinklered space. (30 m in a non-sprinklered space). As the A&L is non-sprinklered, there are a number of instances where the travel distance to an exit exceeds the 30 m allowable travel distance.

1.5 Barrier Free Accessibility Review

This Barrier Free Accessibility Review summarizes the building code and accessibility concepts of the National Building Code of Canada 2010 (NBC) and the CAN/CSA B651-2012 "Accessible Design for the Built Environment relative the NWRI Building located at 867 Lakeshore Road, Burlington, ON. The accessibility review is specific to Floors 4 to 7 of the Administration and Laboratory Building of the NWRI. The review is a general report.

It is apparent as part of the initial review of the facilities and available documentation that there are a number of areas that do not meet the current standard for accessibility in accordance with Treasury Board of Canada, Accessibility Standard for Real Property – "Accessible Design for the Built Environment – CAN/CSA B651-2012". In order to meet these accessibility standards, a number of renovations and changes would be required. These will be developed during consultation with Environment Canada and User Groups; foremost among these discussions will be accessibility and reasonable accommodation of staff with disabilities while maintaining the safety, security and operational effectiveness of laboratory equipment and processes.

While the project falls under the jurisdiction of the federal government and may not be required to meet all provincial regulations, consideration should be given to the Accessibility for Ontarians with Disabilities Act (AODA) mandate that all facilities meet the requirement for accessibility and the removal of barriers for all citizens and provide for an enhanced quality of the environment for services and work. These should be reviewed with Environment Canada as part of a more detailed design phase to determine if these requirements are applicable to the LMP Project.

With the exception of service rooms, all other areas of the building are required to be provided with a barrier-free path of travel suitable for wheelchairs. The NBC contains specific barrier-free provisions and in addition, federal government requirements under CSA-B651-12 Barrier-Free Design also apply to this building.

Barrier-free design features will include the following

a) All controls such as light fixtures, manual pull stations, etc. are required to be mounted at a minimum of 900 mm and a maximum height of 1200 mm and be operable with one hand.

b) A minimum clearance of 300 mm is required to be provided on the push side beside the latch of all doors in a barrier-free path of travel. A minimum clearance of 600 mm is required to be provided on the pull side beside the latch of all doors in a barrier-free path of travel.

c) Sills greater than 13 mm in height or other floor obstructions are not permitted.

d) Wall mounted fixtures and obstructions are not permitted to project up to 100 mm into a corridor. Projections beyond 100 mm are permitted only when located above 1980 mm or within 680 mm of the floor.

e) The main entrance is required to be barrier-free, including the provision of power-door operators.

f) Where drinking fountains are provided, at least one fountain is required to be barrier-free.

Washrooms and Individual Washrooms

a) 1500 mm x 1500 mm in front of accessible stalls

b) Barrier-free toilets require a clear transfer space of 900 mm wide by 1800 mm, the 1800 mm is to include a recess of 300 mm behind the wall supporting the toilet

c) Where more than one accessible toilet is provided, both right and left handed layouts should be provided

d) A barrier-free toilet stall requires internal dimensions of 1600 mm wide by 1800 mm deep including a 300 mm behind the wall supporting the toilet

e) For accessible urinals, a clear area in front accessible urinal of 900 mm x 1800 mm is required

f) Individual unisex barrier-free washroom - floor area not less than 3.5 m^2, minimum dimension of 1700 mm

g) Clear area in front of barrier-free shower entrance of 2250 mm x 2250 mm

h) Shower stall with curb - Interior area of 1065 mm x 1065 mm

Accessible Male and Female Washroom have been provided on each of Floors 4 to 7 of the A&L. While these washrooms have been re-configured from the original in an attempt to provide some accommodation, they do not meet the full requirements of B651. Deficiencies exist for turning circles in washrooms, door hardware and operating controls. There are no accessible urinals in any washrooms on the laboratory floors. With the exception of washrooms, most other areas of the floors provides reasonable accommodation for persons with disabilities although there are many instances where equipment and laboratory benches make access to controls difficult. It is recommended that Washrooms be upgraded to provide full accessibility in accordance with Treasury Board Standards. It is also recommended that a review be undertaken with Environment Canada and a Technical Committee to determine to what extent laboratories would be configured to accommodate persons with disabilities including lab benching, fume hoods and other equipment.

1.6 Architectural Review

The Administration and Laboratory Building is a seven storey structure completed in the early 1970's with a partial basement and crawl space, service penthouses (mechanical and elevator), served by 5 enclosed exit stairs, 2 passenger elevators and a service elevator. The first and second floors house the main building entrance and security desk, administrative offices, cafeteria/kitchen, auditorium and recently renovated library. The third floor is used exclusively as service space (mechanical/electrical). The fourth through seventh floors are comprised entirely of laboratories, offices and support spaces.

The laboratory layout is a typical design from this era with perimeter offices and interior laboratories which back on a 2100mm wide mechanical service core. A corridor extends around the perimeter of each floor and separates the offices from the laboratories. With little glazing on the interior corridor, the laboratories have almost no access to natural daylighting.

The two primary interior partitions are 140mm concrete block between the corridor and the laboratories and demountable walls between labs and the corridor and office areas. The cast in place concrete walls which form the structural system for stairs, elevators and other vertical support or lateral resisting elements have been left exposed in most areas. A few areas also have painted hollow metal frames systems with plain or wired glass. The interior partitions and their finishes would be considered to be in fair overall condition, free of damage outside of normal wear patterns, except in some high-traffic location where localized damage has occurred.

The ceiling systems are predominantly standard suspended metal T-bar system with lay-in acoustic tiles, located in offices, conference rooms, training rooms and laboratories with a ceiling height of 2.74m in laboratories and 2.44m in corridors. The floor finishes used throughout Floors 4 to 7 are predominately vinyl tile in the laboratories with carpet used in many offices.

The floors 4 to 7 labs occupy approximately 1,400m² per floor with office and common areas occupying approximately 1,600m². There are approximately 115 designated laboratories on the 4 floors which evenly distributed and range from 25 to 31 labs per floor, although a number of these are being utilized for storage space or are inactive. There are also approximately 50 fixed offices on each floor as well as additional support spaces for copy rooms, kitchenettes and washrooms.

The labs do not have a standard module and vary from 3.12m to 9.45m with 6.30m being the most common size. A number of labs are interconnected by doors or open to an adjacent laboratory. Approximately 20-25% of the laboratories have been renovated or upgraded since the building was completed in the early 1970's and have more up to date fume hoods and modular laboratory furniture. A number of Analytical Labs which are part of the EOALRS and meet Canadian Association of Laboratory Accreditation (CALA) standards are located on the 7th floor and include L719/L721 Liquid Chromatography-Mass Spectrometry and L724/l725 Mass Chromatography & Gas Chromatography Labs.

A new L752 Ultra-Trace Laboratory has recently been completed which has its own air-handling system, up to date equipment and fume hood with a separate strobic exhaust system and another Ultra-Trace Laboratory is to be constructed on this floor in the area currently designated as L760.

The laboratories at the A&L Building floors 4 to 7 use a variety of fume hoods, laminar flow hoods, bench top hoods, elephant trunk exhaust arms and environmental chambers for ventilation of chemicals and volatile materials. In addition to the fume hoods, there are Class II Biosafety cabinets in some of the BSL 2 Labs. The fume hoods are typically 1500mm and 1800mm long with some 1200mm and 2400mm long units and include approximately 64 of the original sash units with bypass. Others have been replaced by newer compensating fume hoods. The original make-up air to the by-pass type fumes hoods as an earlier energy reduction measure has been disconnected and this feature is no longer in operation.

As with many areas of the A&L Building, the laboratory benching and countertops are varied in their condition and suitability to current standards. It is recommended that as part of the LMP or any major renovations that laboratory benching and countertops be a modular system which can be interchangeable. All benchtops should be a non-absorptive, seamless one-piece design such as stainless steel or epoxy. As with the benching, the decision on materials would have to be determined based on the particular usage of the laboratory.

Top – Typical Existing Laboratory Casework
Bottom – Typical Floor 4-7 Elevator Lobby

1.7 Structural Review

The typical structural bay sizes for the A&L Building are 6.30m [20'-8"] in the north-south direction x 3.66m [12'-0"] in the east-west direction (the 3.66m span covers the perimeter offices and an adjacent corridor). The next east-west structural bay spans 10.16m [33'-4"] across the laboratory spaces. These bay sizes are mirrored across a 2.44m [8'-0"] wide service corridor between two adjacent laboratories. The typical floor framing is a reinforced cast-in-place one way concrete slab supported on concrete beams (where the concrete beams span in the east-west direction). The suspended floor slab thicknesses vary between 115mm to 150mm and are supported by reinforced concrete beams that range in widths of 400mm to 460mm and depths of 460mm to 610mm.

The suspended concrete floor slabs and concrete beams used throughout the 4th to the 7th floors are in good overall condition with no visible signs of cracks or distress. Based on the office and laboratory usage observed on site, the imposed floor loads are currently well below the design loads. The superstructure is considered to be in good overall condition with no visual signs of settlement or failure. Low strength concrete is used along both sides of the service corridor to allow for changes to through-slab penetrations. The low strength concrete slabs span a short distance between the supporting beams and are generally 100mm in thickness. Although these 100mm thick slabs have many penetrations from the mechanical pipes, they are in good overall condition with no visual signs of cracks or failure.

The suspended concrete floor slabs and concrete beams used on the roof level and the Mechanical Penthouse service link appear to be in good overall condition with no visible signs of cracks or distress. No leaks were observed at the Mechanical Penthouse / Roof level. It appears that leaks are addressed by the facility management team on an as-needed basis to help prevent premature deterioration of the roof structure and the interior structural and non-structural elements.

Low strength concrete is also used within the sacrificial floor plates within the mechanical penthouse level to allow for changes to through-slab penetrations. The low strength concrete slabs span a short distance between the supporting beams and are generally 100mm in thickness. Although these 100mm thick slabs have many penetrations from the mechanical pipes, they are in good overall condition with no visual signs of cracks or failure.

There are three exterior stairwells along the east side of the building with curved concrete walls. There is another rectangular stairwell at the north-west corner and one interior stairwell south of the expansion joint. All concrete stairwells are framed with reinforced concrete walls that contribute to the lateral stability of the building. Two hundred millimeter reinforced concrete stair walls and 250mm thick reinforced concrete shear walls provide lateral stability to the structure. All stairwells have an exposed concrete surface with a rough board finish cast integrally with the building structure. The interior and exterior walls are considered to be in good overall condition with no visible signs of cracks or distress.

Typical interior reinforced concrete columns are 400mm square at the top level and increase in size by approximately 50mm to 75mm per floor to 760mm square or round reinforced concrete columns at the lower level. The foundation supporting all columns and walls consists of pilings and pile caps supporting concrete grade beams and walls.

Many of the structural elements are considered to be in good overall condition with only minor repairs and ongoing maintenance (such as exterior sealants, roofing, flooring and interior fitments) required to ensure continued satisfactory performance for the next 25 to 50 years.

One of the advantages of concrete over other building materials is its inherent fire-resistive properties; however, concrete structures must still be designed for fire effects. Structural components must be able to withstand dead and live loads without collapse even though the rise in temperature causes a decrease in the strength and modulus of elasticity for concrete and steel reinforcement.

Exterior View of A&L Building Showing Floor 4-7 Cantilever

1.8 Mechanical Review

Sanitary and Acid Waste Drainage: The drainage from all the washrooms, kitchenette, janitor's closets, and laboratories on the 4th to 7th floors are served by an existing 200mmØ sanitary main. The building is served by two types of risers; sanitary stack risers and acid waste stack risers (AWS). Sanitary stacks serve washrooms, kitchenettes, and janitor closets, while acid waste stack (AWS) serve all laboratory drainage requirements.

The AWS risers and associated piping serve the lab areas on floors 4 through 7, the service is constructed of acid resistant glass piping. There are 7 AWS risers; each riser is 100mmØ and is accompanied by a 75mmØ vent to the roof. The risers are consolidated on the third floor and continue to two (2) acid neutralization tanks located on the ground floor. Both tanks are buried below the finished floor elevation and are complete with access hatches, one tank is located near the entrance to the workshop/warehouse area, while the other tank is located underneath the stairs in the main "Mall Area", across from the main building entrance. The tank outlets are connected to the building sanitary sewage system. The CCIW building sewage mains are connected to a pumping station.

Domestic Potable Water: The domestic water service enters the building at in the lower Boiler Room in the lower mezzanine level. The service is approximately 8"Ø and serves both potable water and fire protection services. The main service is equipped with a backflow preventer.

A 6"Ø potable water service is extended from the ground floor up to the third floor where the service is divided into two pressure zones; floors 3-5 and floors 6 to 8. A pair of variable speed booster pumps boost the pressure of the potable water service up to floors 6 to 8. Pressure in these zones is controlled with pressure reducing valve (PRV) stations. No back flow prevention was visible on the potable water risers feeding the labs. The lab floors are served by 24 plumbing riser each consisting of domestic cold water, hot water, lab compressed air, lab natural gas and distilled RO water.

Reverse Osmosis (RO) Water: The existing building was designed with a still to generate distilled water, over the years this system was decommissioned and replaced with an RO generator and storage tank. The tank is located on the penthouse level and is gravity fed back down through floors 7 down to 3.

Lab Gases: Compressed air and natural gas distribution is extended from the ground floor boiler room up to the third floor mechanical space, where pressure reducing stations regulate the service pressure. The risers feed up from the third floor up to the six floor.

Compressed air is generated in a central location for the facility, three (3) air compressors are located on the ground floor mechanical room. The air compressors operate in unison to maintain compressed air system pressure.

On the lab floors there is a decentralized approach for miscellaneous lab gasses, the laboratories on floors 4 through 7 house multiple gas cylinders including: nitrogen, helium, methane, oxygen, hydrogen. Some labs include gas distribution manifolds within the room they serve.

Life Safety: Levels 4 through 7 are currently not sprinklered and are currently served by fire hose cabinets and fire extinguishers.

Heating System: The heating system for the facility is provided from various sources of energy which include; the Co-Generator, waste heat boiler, a direct contact hot water heating boiler (Sofame) and three steam boilers. The primary equipment is located in the boiler room on the ground floor, high and low pressure steam is distributed to the various sites on the complex including; Administration/ Laboratories wing, Research and Development wing, Ecotoxicology Laboratories, Workshop/Warehouse, and the Hydraulic Wet Laboratories.

Steam to glycol heat exchangers are located on the 3rd floor, these heat exchangers serve the preheat coils in the air handling units. Variable speed drives have been installed on the heating water pumps to improve system efficiency.

Cooling System: The primary cooling system for the complex consist of two 600Ton centrifugal chillers. The chillers are located in the boiler/chiller room on the ground floor. The chillers are paired up with two variable speed fan closed circuit fluid coolers on grade. The chilled water system is equipped with constant volume primary chilled water distribution and constant volume condenser water distribution.

As confirmed with facilities, it is understood that variable frequency drives (VFDs) will be added to the chilled water pumps this winter.

Air Handlers: Floors 4 to 7 are served by air handing systems 27, 28 and 31. Systems 27 & 28 are dual duct laboratory supply units and System 31 supplies the induction units. All three units are located in the Third Floor mechanical space.

Laboratory Exhaust: The laboratory exhaust systems in this building are extensive. All exhaust fans are located in the mechanical penthouse and serve every laboratory space throughout floors 4 through 7. Each lab has a dedicated exhaust fan with riser diameter varying based on the airflow requirement. Exhaust stacks are routed to the mechanical service corridor, and then rise within the corridor to exhaust fans in the penthouse.

View of A&L Building Penthouse Showing Exhaust stacks

1.9 Electrical Review

The main incoming power to the CCIW facilities is through a 27.6kV underground duct bank entering the high voltage compound at the southwest corner of the facility. Three 3MVA outdoor transformers provide 600V power to the facility. A 600V distribution within the boiler building provides dual redundancy to four (4) switchboards dedicated to the following areas: Admin & Lab (A&L), R & D, Chiller Distribution, and Boiler Room Distribution. The main distribution switchboards located throughout the main building have a main-tie-main breaker scheme with two 600V sources.

The A&L dual redundant switchboard feeds two distribution substations, one dedicated for the north side of the building and one for the south. Each substation contains a 1000kVA transformer terminated into a 120/208V, 3000A bus. Both substations are located in the 3rd floor electrical room.

Each substation (north and south) has two dedicated feeds each for both the east and west sides of the building. One feed is to a distribution panel located in the 3rd floor electrical room and the other is to a horizontal bus duct running in the 4th floor service corridor. The distribution panel feeds panelboards located mainly in the corridors while the bus duct feeds panels in the labs themselves. Each lab space has a dedicated lab panelboard, which feeds lighting and plugs loads for that lab.

Corridor panelboards are typically 225A, 120/208V, 3Ph, 84 cct double tub panels and feed receptacles and lights within offices and corridors.

The generator backup power supplies two different systems: a Life Safety System and a Critical Power System. The Life Safety System is backed up by a Kohler 605 kW (756 kVA, 600/347V) diesel powered emergency generator, located in the Emergency Generator Room adjacent to the Boiler Room area. A separate Critical Power System feeds building mechanical equipment, select lab equipment, UPS systems, and other equipment. The Critical Power System is fed from an 810 kW, 600V, Co-Generator unit is also located in the Boiler Room area. There is limited UPS power via standalone local UPS units as well as in newer labs.

Each laboratory is typically fed from a local 100A, 120/240V, 2P, 24/30/42 cct panelboard. These panels are recessed in the block wall at the back of each lab with rear access from the service corridor. These panelboards are generally fed with TECK cable from the 4th floor horizontal bus duct via 70A/2P or 100A/2P bus plugs.

Interior lighting in the A&L Building is provided from a variety of fluorescent fixtures, both recessed and surface mount, containing T8 lamps. The emergency lighting is provided from life safety panels on each floor. The life safety panels supply power to dedicated fluorescent fixtures located throughout the building. Emergency lighting battery pack, two lamp units and remote heads are located in some mechanical, electrical and stairwell areas. Exit lighting throughout the A&L Building is a mixture of different types and styles of fixtures.

The main telephone line enters the A&L Building via underground cables to the 2nd Floor Main Telephone Room located at the south end of the mall area. Telephone lines are distributed via closets on floor areas which provide service to end user locations by zone conduits and open plenum area wiring.

A Main Computer Room is located on the first floor area adjacent to the Main Lobby and Mall areas. Communications are provided to all floors via conduit risers and fibre optic trunk lines to local LAN racks installed at each level, located within the service corridors.

810 kW 600V Co-Generator Unit

1.10 Building Envelope Review

The Administration & Laboratory (A&L) which is part of the NWRI Building, a multi-storey, heated building was constructed in stages throughout the early 1970's and comprised of five separate buildings The A&L is a seven storey building housing the main facility entrance, administrative offices, cafeteria, kitchen, auditorium, library, offices, laboratories. Floors four to seven which comprise the main components of the LMP house the majority of laboratories with approximately 3,000m² on each floor (Labs at 1,400m² and Office and Common Areas at 1,600m²). 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.

The A&L building is approximately 98.5m (in the North-South direction) x approximately 30.5m (in the East-West direction). The North-South dimension of the building is interrupted by a 25mm expansion joint along gridline Dy, splitting the 98.5m dimension into two components of 37.80m south of the expansion joint plus 60.65m north of the expansion joint. The structural framing for the entire building "slides" on Teflon pads along this expansion joint.

The 4th through the 7th floors of the A&L building are comprised of perimeter offices and interior laboratories, arranged around two centre service shafts. The typical structural bay sizes are 6.30m in the north-south direction x 3.66m in the east-west direction (the 3.66m span covers the perimeter offices and an adjacent corridor). The next east-west structural bay spans 10.16m across the laboratory spaces. These bay sizes are mirrored across a 2.43m wide service corridor between two adjacent laboratories.

The typical floor framing is a reinforced cast-in-place one way concrete slab supported on concrete beams (where the concrete beams span in the east-west direction). The suspended floor slab thicknesses vary between 115mm to 150mm and are supported by reinforced concrete beams that range in widths of 400mm to 460mm and depths of 460mm to 600mm. Low strength concrete is used along both sides of the service corridor to allow for changes to through-slab penetrations.

The fourth floor is framed with 150mm thick one way concrete slabs spanning 3.15mm (the typical 6.30mm north-south structural bay divided by two) and supported onto 400mm wide x 600mm deep concrete beams. The fifth to seventh floors are framed with 115mm thick one way concrete slabs spanning 2.13mm (the 6.30m north-south structural bay divided by three) and supported onto 460mm wide x 460mm deep concrete beams. Some of the one way slabs have been thickened from 115mm thick to 150mm in order to accommodate embedded electrical and service ductwork running parallel to the beams within the slabs.

Construction of the exterior walls of Floors 4 to 7 of the A&L Building is primarily concrete (cast-in-place) on the north elevation, part of the south elevation, the 3rd floor east and west elevations as well as the auditorium, perimeter columns and perimeter stairwells. Architectural precast concrete is used as the cladding on the east and west elevations and to a lesser extent on the north and south elevations. The precast is used as a spandrel element and spans approximately 6m between exposed structural concrete columns on the building exterior. The back-up for the panels is an 1800mm deep cast in place beam at the slab edge above and a 900mm high concrete block upstand wall below the exterior strip windows. Continuous aluminum windows infill the space between the precast panels. The construction of the exterior precast panel acts as a rainscreen and the as-built drawings indicate a vapour barrier and 38mm of rigid insulation. Reinforced concrete with a rough board finish is cast integrally with the building structure and interior surfaces are finished with wood strapping and rigid insulation, metal lath and plaster on some of the exterior walls, predominately on the north and south ends and stairwells. The exterior walls with precast panels appear to have 38mm of rigid insulation applied to the outside face of the cast in place or concrete block walls. This may result in a thermal resistance value which is likely around R-8. The perimeter stairwells which project as half round structures on the east elevation of the A&L do not have any insulation and are finished with exposed concrete an a rough board finish. A cementitious coating has been added to two of the A&L stairwells (Centre East and South East), but this materials does not appear to be maintaining its finish. Other exterior materials consist of prefinished metal cladding, insulation, and galvanized metal liner at the A&L roof level Mechanical Penthouse. Painted metal louvres are the main exterior element on the 3rd floor east and west elevations.

There is some evidence of localized rust staining, cracking and spalling of some cast-in-place concrete or the cementitious coatings, but it is likely that these are not a significant issue and is just surface cracking that is telegraphing through the surface materials. There is a small risk of water penetration could occur and cause more significant damages, but it is believed that these can be mitigated through a regular maintenance program. It would be expected that the joint sealants between the precast concrete panels and the exposed columns would deteriorate over time. This would be expected in a building of this age and depending on the maintenance cycle, would have to be repaired from time to time.

Aside from the relatively low thermal performance of the precast wall system and the cast-in-place concrete walls and columns, the exterior walls of the A&L Building on Floors 4 to 7 should continue to perform as required for the foreseeable future. The overall performance of the exterior walls, including the glazing would have to be considered if a major upgrade of the laboratories was undertaken. The thermal value and air-tightness of the building envelop of the current facility would not meet the standards expected in a high performance building and would have to be addressed as part of the long term modernization plan.

The exterior windows of Floors 4 to 7 of the A&L building are dark bronze anodized aluminum with a 25mm insulating glass lite. The 4th to 7th floor windows are continuous, interior glazed strip windows between columns on the four building elevations with several single units adjacent to stairs or corridors. The windows extend from approximately 915mm above finished floor to approximately 2134mm above floor level and are supported by the concrete block wall at the sill and the cast in place concrete spandrel beam at the head. All windows are non-operable. The windows are generally in acceptable condition with no evidence of failure of the seals, although given the age of the units it would be expected that these would fail from time to time. The thermal resistance value of a glazing unit such as these would likely be in the R-1 to R-2 range and the aluminum window frames do not appear to be thermally broken. These windows would be expected to have a fairly high level of thermal conductivity and it is likely that they exhibit a higher rate of air leakage than would be considered acceptable under today's standards. It is understood that occupants have complained about draft and discomfort from the windows.

Aside from the relatively low thermal performance the windows, they should continue to function as required for the foreseeable future. As noted above, the overall performance of the exterior walls and windows including insulation values, air-tightness and glazing performance should be considered if a major upgrade of the laboratories was undertaken. The thermal value and air-tightness of the building envelop of the current facility would not meet the standards expected in a high performance building and would have to be addressed as part of any long term modernization plan.

N-E view of A&L Building

1.11 Hazardous Materials

Description of Hazardous Materials

An Asbestos Assessment of the CCIW was undertaken by Pinchin Environmental on behalf of Environment Canada in July 2013 and a subsequent Designated Substances & Hazardous Materials Survey dated March 24, 2015. These assessments established the location and type of Asbestos Containing Materials (ACM) and DS&HM present in the building that was apparent to the surveyors and is noted in the Reports prepared for EC. It should be noted that this assessment was undertaken by EC as part of their long term management of the asbestos and is not intended for construction nor renovation purposes. The objective of the assessment was to establish the location, condition and type of Designated Substances and hazardous Materials that are present. The full report must be referenced for the complete results of the assessment. This report was prepared to fulfill the Owner's requirements under Ontario Ministry of Labour (MOL) Regulation 278/05 (O.Reg 278/05).

Asbestos was confirmed or visually presumed to be present in the following building materials:

- Texture finish
- Pipe insulation
- Mechanical insulation
- Duct insulation
- Plaster
- Drywall joint compound
- Asbestos cement (transite in fume hood and cabinets)
- Asbestos cement (transite in fume hood exhaust ductwork)
- Vinyl sheet flooring
- Vinyl floor tiles
- Bakelite on countertops

Due to the age of the building it is expected that other hazardous materials as described by applicable Federal and Provincial Regulations such as the Ontario Ministry of Labour (MOL) Regulation 278/05 (O.Reg 278/05) will be found. It is possible that a Designated Substances Survey (DSS) will find the following:

- Lead
- Mercury
- Silica
- Polychlorinated Biphenyls (PCB)
- Mould or microbial contaminants

These are typically found in the following materials:

- Chrysotile asbestos in vinyl floor tiles and mastic
- Lead in wiring, conductors and solder
- Lead in paint finishes
- Mercury vapour in fluorescent lamps
- Free crystalline silica present in concrete, mortar and common building materials

Key Findings from Environmental Reports

Parging cement, containing chrysotile asbestos, is present on pipe fittings (elbows, valves, tees, hangers, etc.) on the majority of insulated systems throughout the site. Parging cement is a friable insulation, jacketed with canvas and ranges from damaged to good condition. Non-asbestos parging cement is also present on the high pressure steam lines in the Upper Mechanical Room of the A&L Building.

A white preformed block insulation (commonly referred to by the trade names Magnesia Block or Mag Block), containing chrysotile and amosite asbestos, is randomly present on straight sections of steam and condensate system pipes. Magnesia block is a friable insulation, jacketed with canvas and ranges from damaged to good condition. Non-asbestos sweat wrap insulation (brown layered paper), is present on straight sections of cold water system pipes, sanitary drains and rain water leaders. Pipes insulated with friable asbestos insulations may be present in inaccessible spaces such as above solid ceilings, in chases, in column enclosures and within shafts.

Ducts present throughout the A&L Building are insulated with fibreglass and jacketed with canvas. Parging cement, containing chrysotile asbestos, is present over the fibreglass at edges, seams and pins on some of this ductwork. Parging cement is a friable insulation, jacketed with canvas and is in good condition. Non-asbestos red mastic is present on ducts in the A&L Building. Remaining ducts are either uninsulated or insulated with non-asbestos fibreglass and jacketed with either canvas or foil.

Asbestos Cement Products (Transite): Transite board is present in fume hoods and chemical storage cabinets in laboratories throughout the site. Transite board is also present on walls within the A&L Building Switch Gear Room. Transite pipes are present as exhausts from fume hoods. Transite is a non-friable material that was visually determined to contain asbestos. All transite is in good condition. Assume transite to contain asbestos of a type other than chrysotile.

Vinyl Sheet Flooring: Two distinct types of asbestos-containing vinyl sheet flooring are present in the building. Asbestos in vinyl sheet flooring is present in the paper backing layer (underpad) only. Vinyl sheet flooring is a non-friable material and is in good condition. Remaining vinyl sheet flooring was determined to be non-asbestos based on historical knowledge of the type of flooring (resilient or rubber) or based on the lack of a paper backing layer (underpad).

Other Building Materials: Bakelite is present as a countertop finish within the Laboratories throughout the site. Bakelite is a non-friable material that is presumed to contain asbestos based on visual identification. All Bakelite is in good condition. Assume Bakelite to contain asbestos of a type other than chrysotile.

Recommendations

Prior to any construction of the A&L Building, all materials identified by a DS&HM Survey to be present will typically be removed as part of the renovation of the building and in accordance with acceptable environmental remediation practices. Prior to any planned demolition or renovations a more through and intrusive investigation for designated substances should be conducted in accordance with the Ontario Occupational Health and Safety Act, Section 30, to determine the location and amount in accordance with Regulations in effect at that time.

1.12 Vertical Transportation

Two duplexed passenger elevators are located in the front lobby of the A&L Building. The passenger elevators date from the original construction of the facility in the early 1970's (manufactured and installed by Otis Elevator) but were completely rebuilt in 2001 with new machines, controllers and door operators, and utilizing Thyssen Krupp's Northern technology. Stops and starts are smooth, cars level accurately at every floor. Given their current condition, and with continued good maintenance, the passenger elevators can likely be expected to perform over the next 25 years. The two elevators do not meet the requirements of CSA-B651-2012 to accommodate a stretcher although this capacity is available in a service elevator in the building. Review of the as-built documents suggest that the centre elevator core of the NWRI Building was designed to accommodate three cabs in the shaft although only two were constructed. Phase one (firefighter recall) is provided on the 1st floor and firefighter key switch located in the COP of elevator one. A key switch allows one elevator to be placed on emergency power. The Elevator Machine Room is accessed from the Mechanical Penthouse.

- Type: Geared traction Variable Voltage Variable Frequency AC
- Capacity: 1135 kg/14 persons (2,500 lbs.)
- Rated Speed: 2 m/sec. (400 ft./min.)
- Stops/Openings: Car 1 - 7 stops, 1st to 7th floor, no penthouse access
- Car 2 - 6 stops, 1st to 7th floor, no access to 3rd floor, no penthouse access
- Cab Dimensions: 2000 x 1200 mm (width x depth)
- Doors: Type - centre opening; Width - 1050 mm wide

There is also one service elevator in the north end of the NWRI Building. It dates from the original construction of the facility in the early 1970's, but was completely rebuilt in 2003 with new machines, controllers and door operators. Given its current condition, and with continued good maintenance, the passenger elevators can likely be expected to perform over the next 25 years. Other than normal maintenance, no major repairs/replacement are anticipated for the service elevator. The service elevator allows access to the basement service tunnel to the WTC Building and to the Mechanical Penthouse. Phase one (firefighter recall) is provided on the 1st floor and firefighter key switch located in the COP of the elevator. The Elevator Machine Room is accessed from an outside stair on the roof.

- Type: Geared traction Variable Voltage Variable Frequency AC
- Capacity: 3175 kg (7,000 lbs.)
- Rated Speed: 1.76 m/sec. (350 ft./min.)
- Stops/Openings: 9 stops, 9 openings – Basement Service Tunnel to Mechanical Penthouse
- Cab Dimensions: 2400 x 1725 mm (depth x width)
- Doors: Type - centre opening; Width - 1200 mm;

1.13 List Of Documents Used (Abridged)

Guidelines

- Lab Standard Space Standards & Design Guidelines – Draft prepared by Health Canada and the Public Health Agency of Canada (PHA)
- LABS21, Environmental Performance Criteria
- Public Works and Government Services MD Guidelines (Latest Edition)
- CDC - Biosafety in Microbiological and Biomedical Laboratories
- Canadian Standards Association, ASHRAE, ANSI
- Treasury Board of Canada, Accessibility Standard for Real Property – "Accessible Design for the Built Environment – CAN/CSA B651-2012.

Codes

- The NRC National Building Code of Canada 2010
- The NRC National Fire Code of Canada, 2010
- The NRC National Plumbing Code of Canada 2010
- The NRC Model National Energy Code for Buildings 1997
- The Canadian Electrical Code
- The Canada Labour Code
- International Mechanical Code – Latest Version

Regulations

- The Canada Occupational Health and Safety Regulations
- Ontario Occupational Health and Safety Act, Section 30,
- Ontario Provincial and Municipal Acts, Codes, By-laws and regulations appropriate to the project

Standards

- Standards and Directives of the Treasury Board (TB):
- Accessibility Standard for Real Property;
- Fire Protection Standard;
- CSA Z316.5 Fume Hoods and Associated Exhaust Systems
- Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA) Standards;
- SMACNA HVAC Duct Construction Standards
- SMACNA HVAC System Duct Design
- SMACNA Air Duct Leakage Test Manual
- Seismic Restraint Manual Guidelines for Mechanical Systems
- SEFA 1.2, Scientific Equipment & Furniture Association

02 Programming

University of British Columbia, Centre for Comparative Medicine, Vancouver, British Columbia

2.1 Introduction

The programming analysis for CCIW covers both the qualitative and quantitative factors that define the requirements of the LMP to help further the capabilities currently undertaken at this world-class scientific research facility. Specifically, it describes various criteria and data for the building, including design objectives, spatial requirements and relationships, and other function-specific systems for existing spaces. The purpose was to describe the requirements which the LMP must satisfy in order to support and enhance the function of the laboratories at CCIW for the foreseeable future.

2.2 Laboratory Design Goals

In order to cultivate a world class laboratory facility, the design of the A&L LMP must incorporate the users' current program needs in terms of space, environmental control, support services, function, and sustainable design. In addition, as both technology and research mandates evolve at CCIW, the LMP design will need to be adaptable enough to conform to those unforeseen yet inevitably different program needs the facility will face in the coming decades.

The fundamental aspect of an adaptable building is modularity through the use of planning modules at various scales of design. Planning modules are measured units used to appropriately size the various components of a facility. These help to create regularity and repetition in the size, shape, and arrangement of programmed spaces, service distribution, fixed equipment, and furniture – creating a set of standards based on interchangeable parts that are easily modified. As developed, these modules provide the following benefits:

University of Calgary, Clara Christie Centre for Mouse Genomics, Calgary Alberta

Scalability (Macro-scale – lab expansion/sub-division)

Development of areas based on growth by module, where all modules are capable of being easily converted to meet the research requirements of other programs. A 'lab module' can be subdivided for a tissue culture lab, or doubled, tripled, or quadrupled to account for the expansion of a research mandate. The current trend in lab planning is that all or most of the laboratory modules should be designed as wet labs so that in future reconfigurations all required services such as fume hood exhaust, gas, water can be drawn as needed.

Adaptability (Meso-scale – lab infrastructure reconfiguration)

Design of areas that function as a "kit of parts" or spaces that can be used for various functions, with standardized service provisions and flexible built components that are easily reconfigured. From user interviews at CCIW, it has been indicated that the rate of change or re-configuration of laboratories has increased significantly over the past ten years and there is no indication that this will not increase going forward. As such, the modernized laboratories must consider flexible design schemes with the ability to both increase services for research and analytical applications, and conversely be able to reduce the services where required.

Flexibility (Micro-scale – lab casework reconfiguration)

Development of areas and layouts that can be easily reconfigured or changed by lab users with minimal disruption to the building infrastructure or to ongoing activities in the building. This would involve incorporating lab casework systems with a variety of components that could easily be changed by the user to accommodate changes in lab requirements.

A goal of the LMP is that the A&L building will be able to provide a variety of laboratory configurations within the existing floor plate arrangement. The objective is to provide as open a laboratory environment as practical, whereby any individual space can be enclosed as necessary to accommodate function, safety, and isolation requirements. Although some services and surfaces will be fixed elements in any laboratory, such as sinks and chemical hoods, there are several options available to meet the adaptable needs for various types of research. Current design practice is to locate fixed elements such as laboratory chemical hoods and sinks at the perimeter of the laboratory, ensuring maximum mobility of interior equipment and furniture. Although fixed casework is common at the perimeters, movable pieces are at the center to maximize flexibility. The central parts of the laboratory are configured with sturdy mobile carts, adjustable tables, and equipment racks.

University of Calgary, EEEL, Calgary, Alberta

Saskatchewan Disease Control Laboratory, Regina, Sask.

University of Alberta, NINT, Edmonton, Alberta

Laboratory Neighborhood

The laboratory neighborhood concept is an approach to planning laboratory buildings that brings together in a single space all the resources that the researcher uses on a daily basis. A laboratory neighborhood includes not just laboratories and lab support but also office and office support areas, supplies, and all shared equipment including computer equipment. Laboratory neighborhoods are expected to promote greater productivity, eliminate the need to duplicate expensive laboratory support space, and promote a sense of scientific community.

Laboratory neighborhoods should be clearly organized for ease of movement. For the laboratory floors of CCIW's A&L building, the bifurcation of the floor plate by the central circulation corridor and a central service space create four potentially contiguous spaces which may form ideal laboratory neighborhoods. These neighborhoods can traverse divisional boundaries to include any laboratory that has a natural affinity for adjacent placement, whether that be due to collaboration relationships or similar infrastructure/equipment requirements

Laboratory Furniture

The selection of casework and other laboratory furniture is a critical aspect of the strategy to achieve increasing adaptability in laboratory design. Many modern laboratory casework systems work like a kit of parts with the ability to add or subtract components easily by the users. As requirements shift, unused benchtops could convert to full-height storage shelving or other cabinetry options, and just as easily return to a bench configuration at a later date. Depending on the type of equipment being used and desired flexibility, the casework may be on castors (i.e. movable), on freestanding tables unsecured to the walls or floor (i.e. moveable), or fixed if vibration or cost is a concern. Mobile carts can make excellent equipment storage units and are often used in research labs as computer workstations. Mobile carts also allow for increasingly more complex computer hardware to be stacked and then moved to equipment stations as needed.

Fume Hoods

There are a number of factors which will have to be considered as part of the LMP for the future fume hood exhaust system and selection of fume hoods. Understanding the intended use of the labs can help determine the number needed, because the most energy-efficient option is to reduce the number of hoods where possible without reducing safety. One way to eliminate a hood is by using alternate devices that can safely support the intended activities. For example, where fume hoods are improperly used for storage in the current condition (a violation of COSH regulations), a ventilated cabinet should be used instead, as it exhausts less air and has a smaller impact on building's energy usage. The CCIW currently has a number of instances, especially in some of the analytical and dry labs, where ventilated storage cabinets require fewer ACH than fume hoods. Other alternatives to the traditional hood include capture hoods, ventilated benches, snorkels, laminar flow hoods, glove boxes, biosafety cabinets and ductless hoods can all be used. There are a number of these types of exhaust systems at the CCIW which should be considered wherever possible.

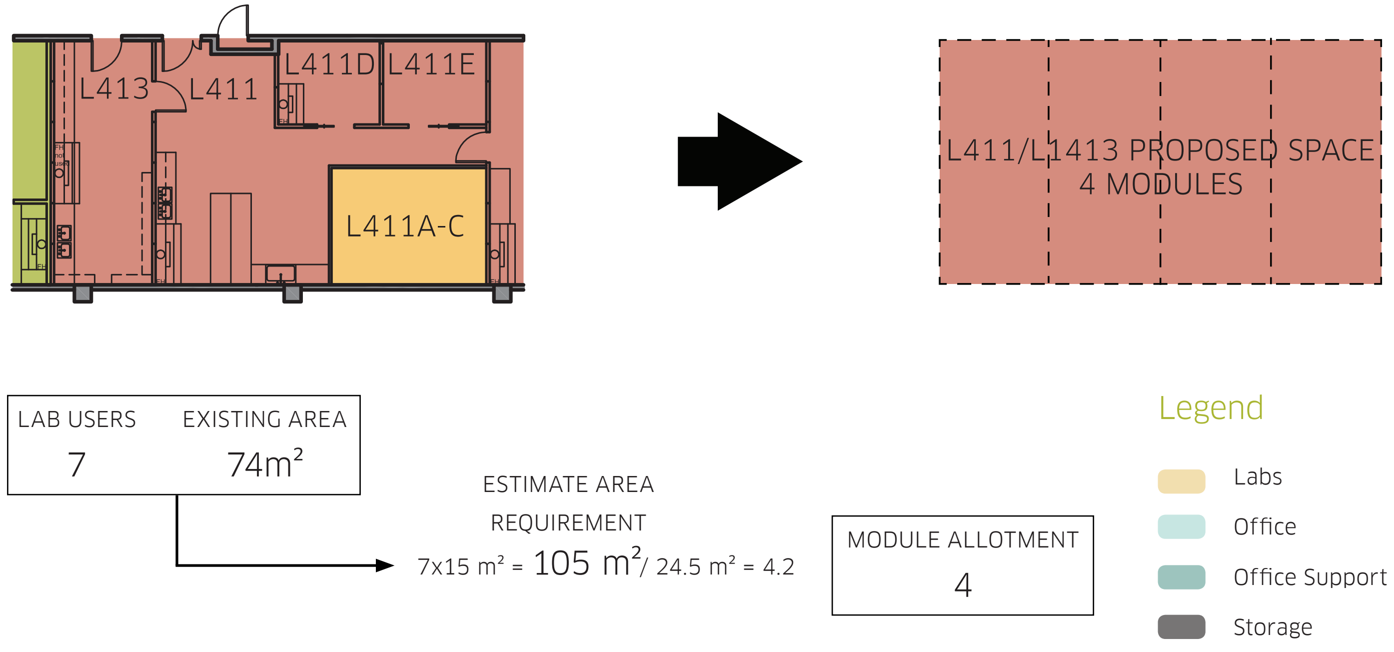
2.3 Laboratory Programming

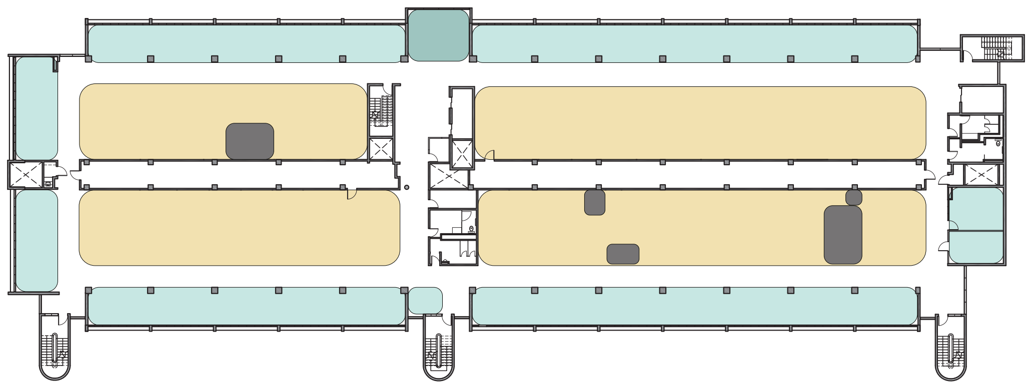
One of the key factors of the laboratory programming involves determining how the existing space uses on floors 4 to 7 should be reapportioned through the LMP. Due to the wide prevalence of lab designs that include inefficient divisions of spaces and large in-lab storage areas, the LMP is tasked with realizing greater space efficiency in the laboratory area. The space requirement investigation is grounded on lab-specific data accumulated though user group meetings, on-site investigations, and responded user questionnaires, as well as laboratory design guidelines concerning best practices for space utilization.

The first step is to determine how much net area each lab should be granted in a future module-based floor arrangement. This involved examining established laboratory design guidelines as a benchmark to determine space requirements per lab user. Within the guideline published by Public Health Agency of Canada & PWGSC, entitled "Lab Standards: Space Standards & Design Guidelines" (March 2014), the determined area required by laboratories was between 10.0 m² and 16.5 m² per user, depending on the intensity of equipment usage. With the aim of maintaining conservative assumptions it was decided to use a value toward the upper end of this range - 15.0 m² - as the average requirement per lab user. This value is then multiplied by the known number of users in each lab to obtain the projected area requirements for each lab. As a qualitative check, each lab's new projected area value was then compared to the lab's existing area and cross-referenced with the user comments concerning area requirements to ensure the projections were not diverging too far from user expectations. The last step involved dividing the projected lab area requirement by the area of one 3.4m x 7.3m module (24.5m² / 264 SF) to determine the number of module units each lab should be allotted.

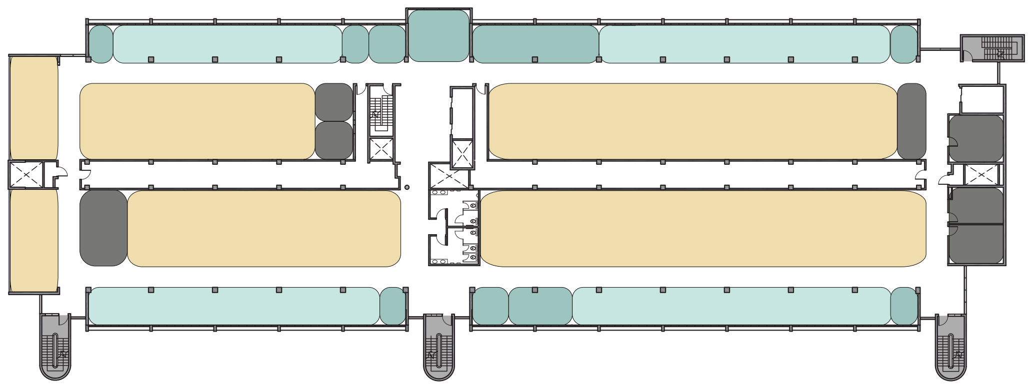
Using labs L411/L413 as an example, the lab's seven full time users warrant an area of 7 x 15m² = 105m² which when divided by the module area of 24.5m² results in 4.2 'modules'. This number is then rounded to the closest whole integer to arrive at the module requirement for each lab.

For the distribution of space throughout each floor, a primary goal was to relocate the storage spaces occupying space in the designated lab area to the floor quadrant peripheries in order to maximize the opportunity for contiguous laboratories.





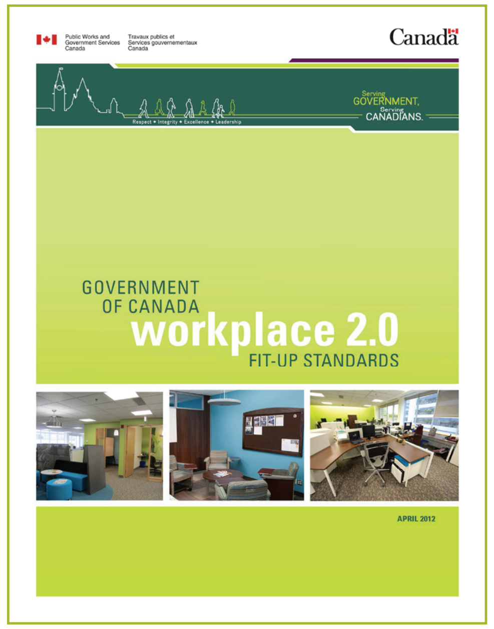
Existing 4th floor space usage



Alternate planning strategy to maximize contiguous lab space

2.4 Workspace Design Goals

The researchers at CCIW require both laboratory and office space. Their desire to be aware of procedures and to have a constant presence in the laboratory usually demands that office space be located near their associated laboratory. The emergence of computer-based research and data monitoring outside of the laboratory, in addition to the requirements of personal safety and researcher collaboration, have all prompted offices to be located outside the laboratory proper. Within floors 4 through 7 of the A&L building, offices are generally positioned near their primary laboratory spaces, however due to divisional reorganization and laboratory re-assignment over time this rule is not universal. As part of the LMP design, the 'defragging' of the office space to align with assigned laboratory spaces is an achievable goal.



One of the most significant alterations to be expected in the LMP is the application of Workplace 2.0 to the laboratory office space. Workplace 2.0 is an office design standard championed by Public Works and Government Services Canada (PWGSC) to create modern workplaces that will attract, retain, and enable public servants to work more efficiently and sustainably. The primary initiatives of Workplace 2.0 involve promoting smaller workstations, introducing more office support space, restructuring office workflows with modern communication technology, and introducing more opportunities for exterior views and access natural lighting for all. Though offices sizes vary within the 4th through 7th floors, most are approximately 3.4m x 3.0m for a total of 11 m² and serve just one researcher. According to the guidelines for space allocation in Workplace 2.0, most of these office holders would be reduced to an open office workstation with a maximum area of 4.5 m² while temporary users and those who work outside of their office 60% of their working year would receive 3.0 m². The area freed from office use can then be reallocated for support spaces such as meeting rooms, quiet rooms, shared equipment rooms, kitchenettes, and other collaboration spaces, each of which are noted deficiencies in the current A&L building programming.

2.5 Workspace Programming

The offices on floors 4-7 of the A&L Building consume approximately 677 m² per floor for a total of 2,710 m². It was determined from on-site inspection that there are currently 204 offices within the four floors, occupied by workstations for 288 persons. Currently the office users have access to very little support space. Apart from the central meeting room in the centre of the west side of the floor plate, the only other support a shared equipment room located next to the central washrooms and improvised kitchenette spaces at the north and south end of each floor.

Due to the nature of the work at CCIW, it has been estimated that at least 25% of the users would not be defined as full time users (FTU) under Workplace 2.0 guidelines due to their need to be out in the field or otherwise out of office. As a result, it has been estimated that each floor has an average of 56 FTU, and the calculations of required support space have been based on this estimate.

Applying the WP 2.0 fit-up standards to these 56 FTUs per floor, each floor would receive at least 2 small meeting rooms, 2 quiet rooms, 1 30 m² kitchenette, 1 shared equipment area for printers, 2 undesignated support rooms, 3 printer stations, and 1 first-aid room, in addition to the 1 medium-sized meeting room each floor already has.

CCIW A&L Building Floors 4 to 7 Workplace 2.0 Space Calculations

Office Support Space @ 56 FTUs / Floor

	Count per Floor	m² per Floor
Small Meeting (14m²)	2	28
Medium Meeting (30m²)	2	60
Large Meeting (60m²)	0	
Quite Rooms (5 m²)	2	10
Kitchenettes	1	30
Shared Office Equip.	1	17
Undesignated Sup. Rms.	2	20
TOTAL		**165**

03 Design Concept

3.1 Introduction

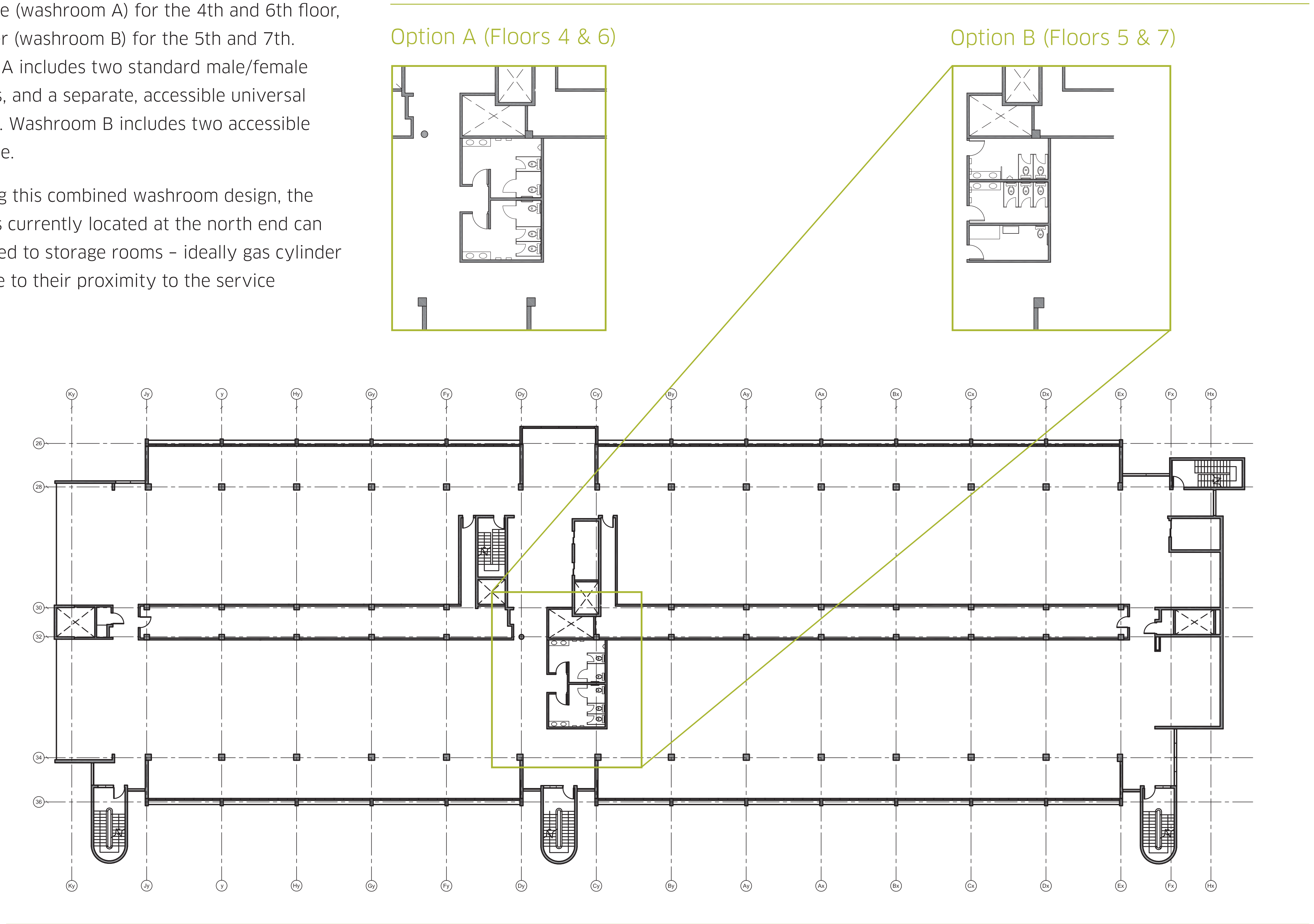
After investigating a variety of space planning arrangements, it was determined that the most functional and cost-effective option for the modernized lab and office space on floors 4-7 is to maintain the current relationship between outboard offices and inboard labs backing on the central service space. Though major partitions and structural components are to remain, all existing laboratory and office space has been assumed to be included in the modernization plan - apart from those labs recently renovated, or under the process thereof.

WASHROOMS

There are currently four washrooms per floor on the four floors of the LMP scope; two (male/female) are located in the centre of the floor and two (male/female) are located on the north end of the floor. Among these 16 washrooms, none are compliant with CSA B651 (or the NBC) for barrier free design, and as such will need to be redesigned through the LMP.

The design proposed for the LMP would see the two existing washrooms merged to a single washroom per floor. To accommodate the required fixture count and barrier free design provisions within this area, the footprint of the washrooms would increase to consume the shared equipment room to the west. The strategy includes implementing two washroom designs; one (washroom A) for the 4th and 6th floor, and another (washroom B) for the 5th and 7th. Washroom A includes two standard male/female washrooms, and a separate, accessible universal toilet room. Washroom B includes two accessible male/female.

In achieving this combined washroom design, the washrooms currently located at the north end can be converted to storage rooms – ideally gas cylinder storage due to their proximity to the service elevator.



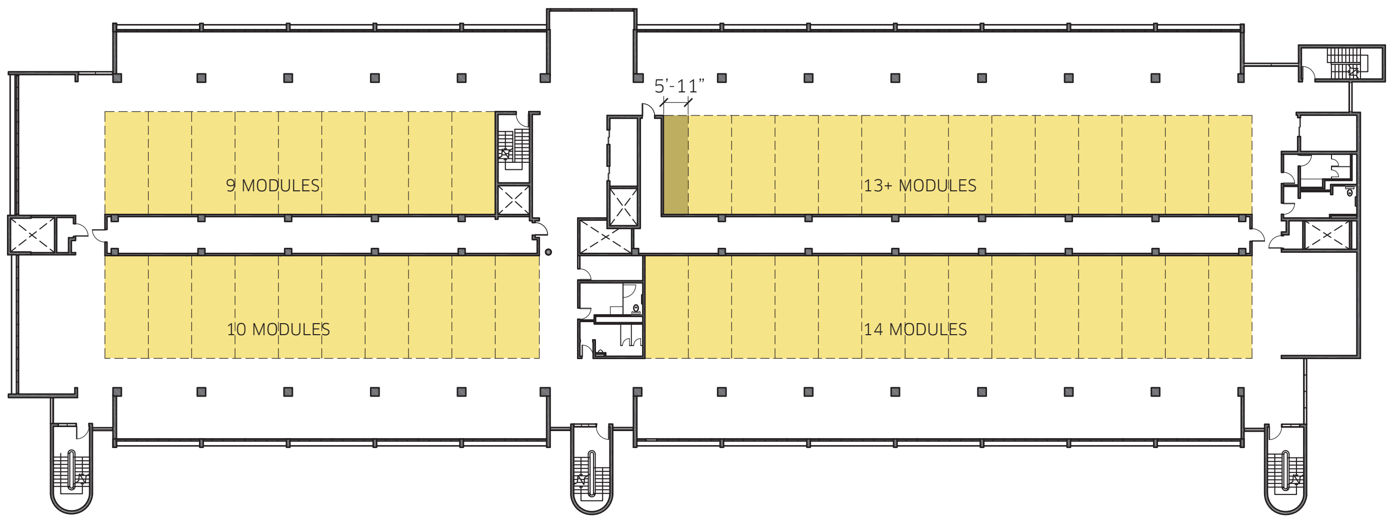
Typical LMP base plan w/ life safety and washroom re-designs

3.2 Space planning

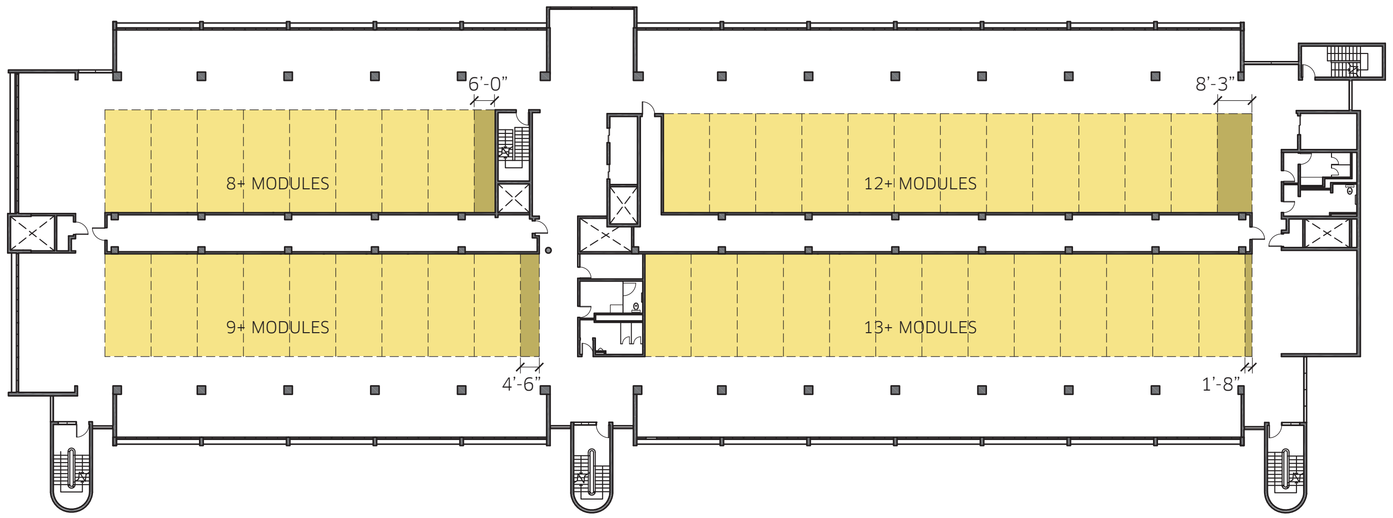
LABORATORY MODULE

The width of the designed lab module is a critical factor in determining the ultimate adaptability of the laboratory space. If the module is too wide, there will be too much circulation area and not enough space for casework and equipment – resulting in an inefficient use of space. If the lab module is too narrow, then either the aisle will be too narrow, creating an unsafe research environment, or there will be room for casework on only one perimeter wall.

CCIW has a loose lab module of roughly 3.15m wide by 7.32m deep. Most laboratory modules for newly designed facilities are 3.20m wide, and vary in depth from 6.12m to 10.05m, depending on the lab requirements. Recent trends show a laboratory module of 3.35m is increasingly used to accommodate deeper equipment such as Mass Spectrometers, biosafety cabinets, and high-performance fume hoods. In order to ensure laboratories can be reconfigured with the noted wider equipment with ease, as required in the future, the recommendation is to proceed with a 3.35m (11'-0") module for the LMP..



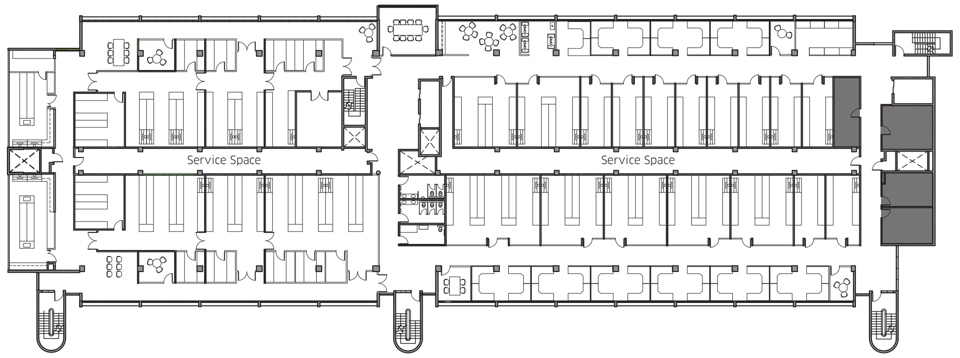
3150mm (10'-4") Laboratory Module



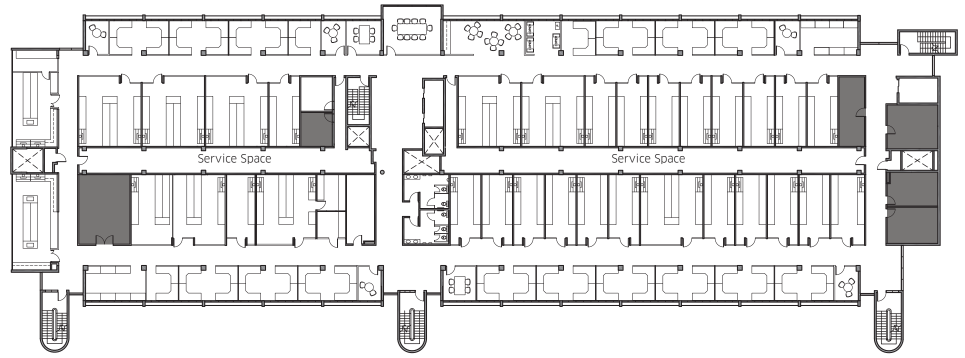
3353mm (11'-0") Laboratory Module

STORAGE

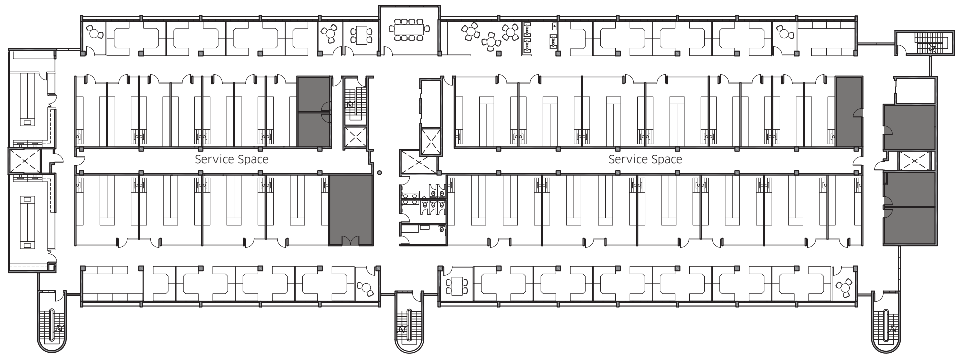
Storage must be provided for the various materials that are used to serve the research requirements. Many laboratories in the A&L building have become cluttered with stored materials related to their research, reducing the productivity and efficiency of the workplace. The introduction of general storage spaces on each of the four laboratory levels will be considered as an initiative to alleviate the existing complications with laboratory clutter. A second initiative is to introduce more efficient methods of storage within the labs themselves through modern casework solutions.



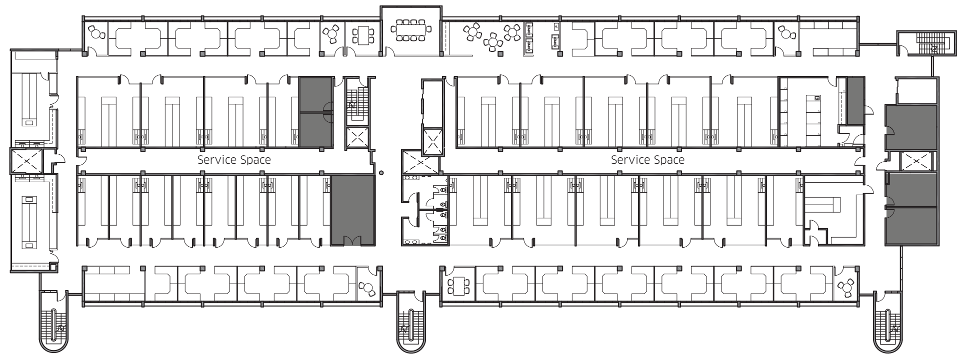
4th FLOOR PLAN



6th FLOOR PLAN



5th FLOOR PLAN



7th FLOOR PLAN

Support Areas By Floor

	(PROPOSED)	(EXISTING)		(PROPOSED)	(EXISTING)
4th FLOOR	163 m^2	64 m^2	6th FLOOR	137 m^2	81 m^2
5th FLOOR	148 m^2	122 m^2	7th FLOOR	126 m^2	72 m^2

SOUTH END LABORATORIES

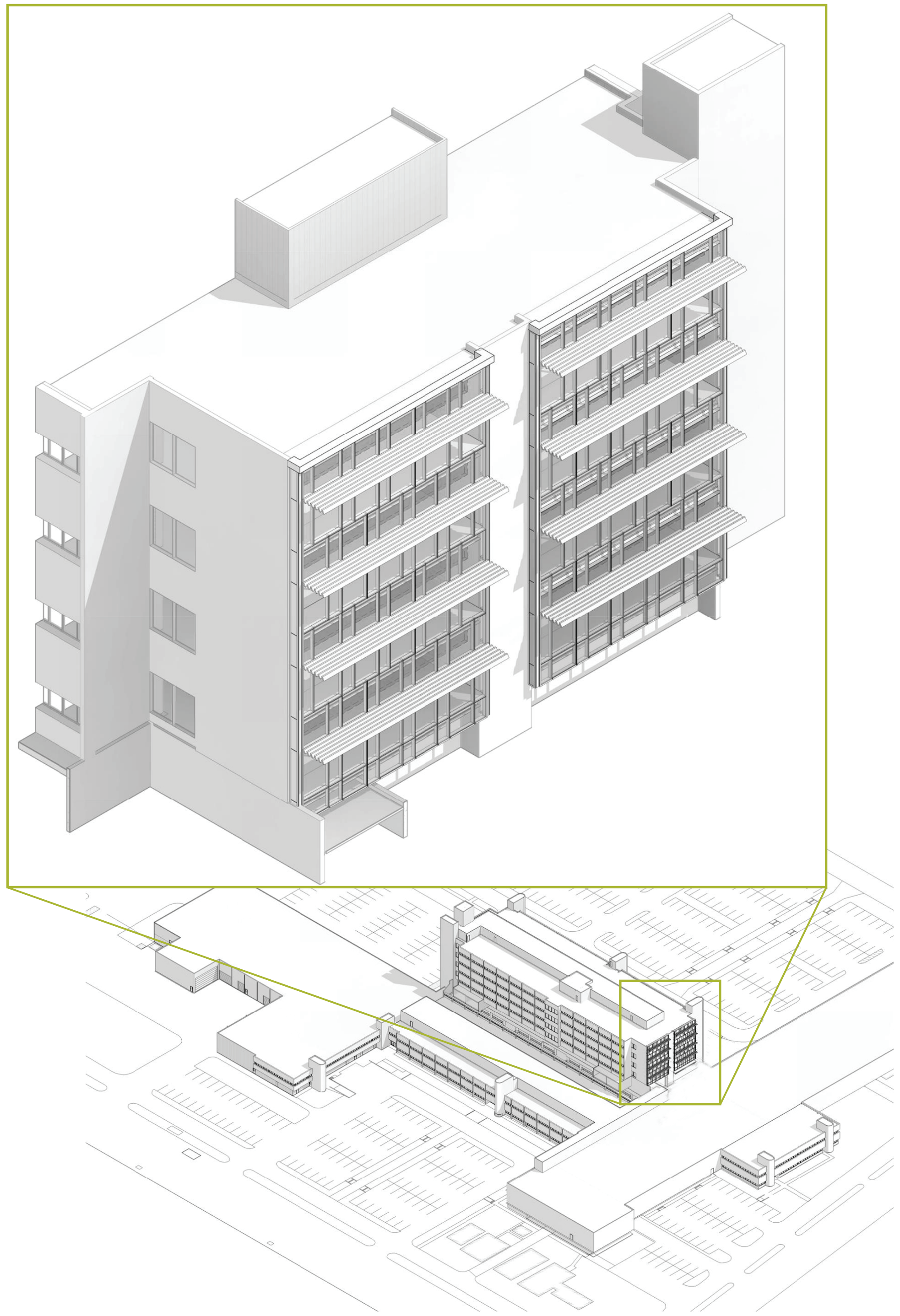
The Design Concept proposes to develop the south end of the four floors of the LMP scope, which is currently occupied by offices, into new laboratory spaces. The intention is for this space to become the first phase of the LMP; to be brought on-line as quickly as possible. We believe there are a number of advantages to this approach. Foremost is that it would provide approximately 384m² (96m² per floor) of prime lab space which could be used as an immediate swing space for existing labs set to be renovated in the LMP. This lab space would allow for the equivalent of 75% of an existing south floor plate of labs to be accommodated. Though the magnitude of the LMP phasing would determine the extent of temporary/off-site swing space required, the use of the south labs make it feasible for the phasing to be accommodated without need for capital investment in swing space.

In addition to the phasing benefits, the creation of the south labs presents the opportunity for the CCIW to provide a series of showcase or exemplary labs. The location and prominence within the A&L floor plate would provide opportunities to reach out to other organizations that undertake compatible analytical or research science and would like to co-locate within the CCIW on a commercial basis. The relative isolation from the other labs on a floor plate could also be an asset to operate in a semi-autonomous environment, if required.

Typical 4-7th floor showing south end laboratories

Legend

- Labs
- Office
- Office Support
- Storage



Axonometric showing optional south-wall recladding & shading devices

View from typical 4-7 floor laboratory through new workstation area

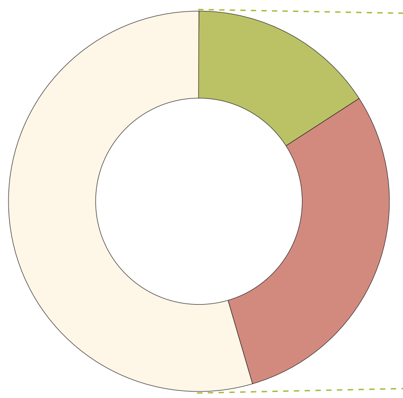
4th Floor (Option 1)

Legend

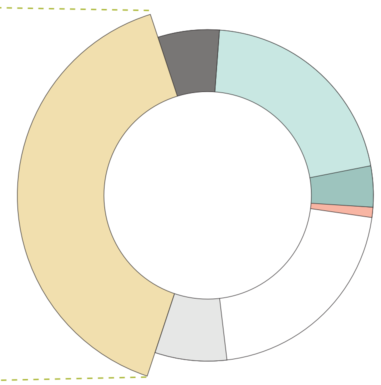
- Watershed Hydrology & Ecology Research Division (WHERD)
- Aquatic Contaminants Research Division (ACRD)
- Emergencies, Operational Analytical Labs & Research Support (EOALRS)
- Eco-Toxicology and Wildlife Health Division (EWHD)
- Water Quality Monitoring and Surveillance (WQMS)
- Department of Fisheries and Oceans (DFO)
- Monitoring & Data Services Directorate (MDSD)
- Unassigned

4th Floor New Lab Distribution

- WQMS (16%)
- DFO (29%)
- Unassigned (55%)



4th Floor New Space Distribution



- Corridors & Lobbies (21%)
- Service Cores (7%)
- Storage (6%)
- Office Support (4%)
- Washrooms (1%)
- Labs (40%)
- Office (21%)

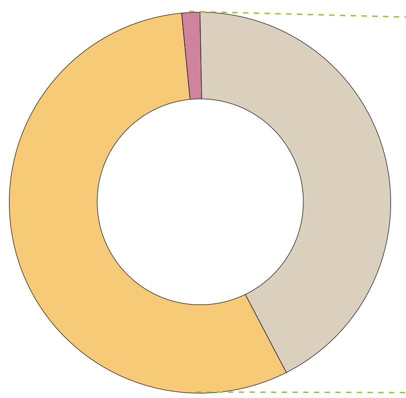
5th Floor (Option 1)

Legend

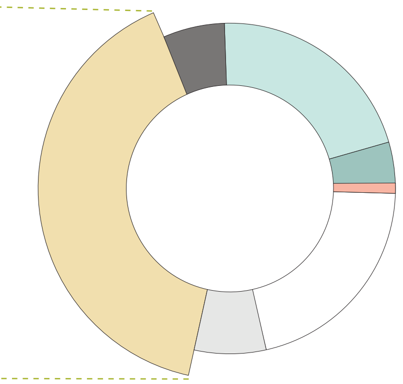
- Watershed Hydrology & Ecology Research Division (WHERD)
- Aquatic Contaminants Research Division (ACRD)
- Emergencies, Operational Analytical Labs & Research Support (EOALRS)
- Eco-Toxicology and Wildlife Health Division (EWHD)
- Water Quality Monitoring and Surveillance (WQMS)
- Department of Fisheries and Oceans (DFO)
- Monitoring & Data Services Directorate (MDSD)
- Unassigned

5th Floor New Lab Distribution

- ACRD (42%)
- WHERD (56%)
- MDSD (2%)

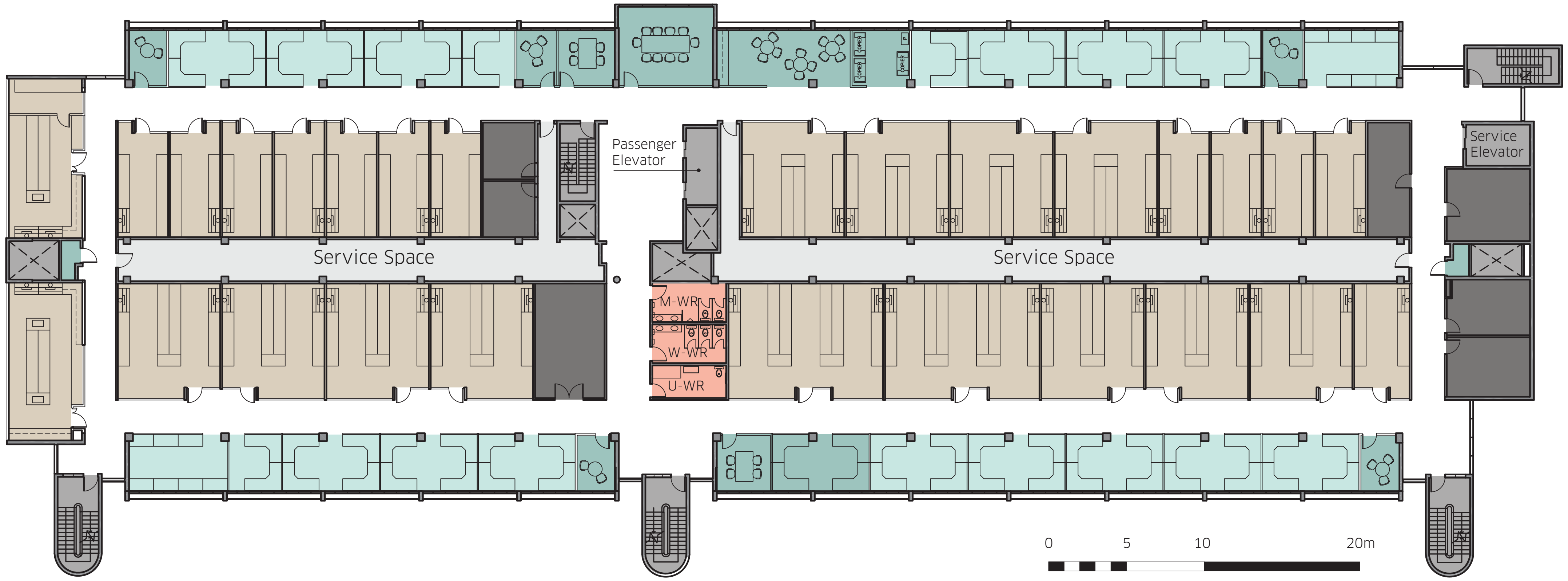


5th Floor New Space Distribution



- Corridors & Lobbies (21%)
- Service Cores (7%)
- Storage
- Office Support (2%)
- Washrooms (2%)
- Labs (38%)
- Vertical Circulation (5%)
- Office (25 %)

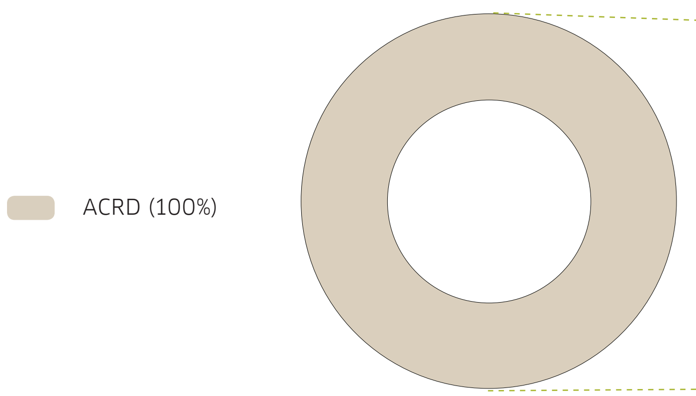
6th Floor (Option 1)



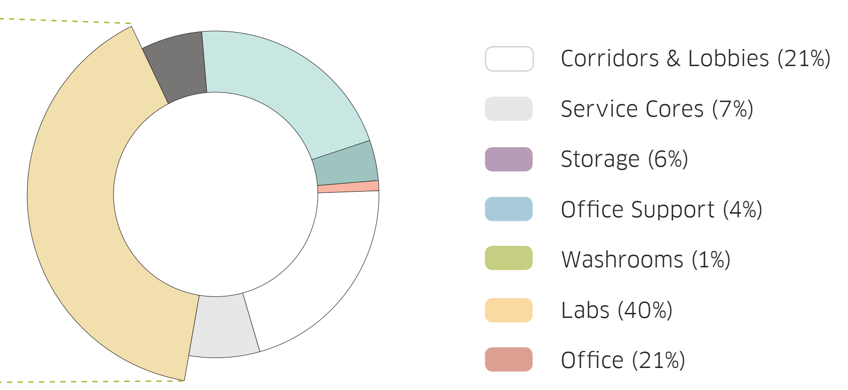
Legend

- Watershed Hydrology & Ecology Research Division (WHERD)
- Aquatic Contaminants Research Division (ACRD)
- Emergencies, Operational Analytical Labs & Research Support (EOALRS)
- Eco-Toxicology and Wildlife Health Division (EWHD)
- Water Quality Monitoring and Surveillance (WQMS)
- Department of Fisheries and Oceans (DFO)
- Monitoring & Data Services Directorate (MDSD)
- Unassigned

6th Floor New Lab Distribution



6th Floor New Space Distribution



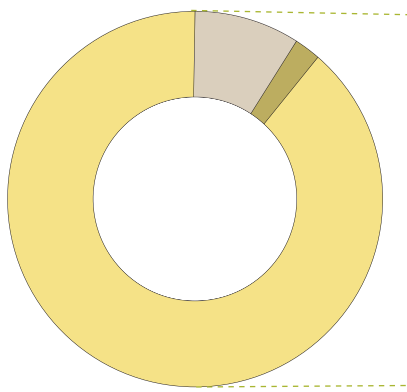
7th Floor (Option 1)

Legend

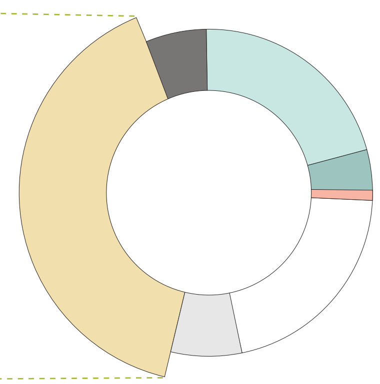
- Watershed Hydrology & Ecology Research Division (WHERD)
- Aquatic Contaminants Research Division (ACRD)
- Emergencies, Operational Analytical Labs & Research Support (EOALRS)
- Eco-Toxicology and Wildlife Health Division (EWHD)
- Water Quality Monitoring and Surveillance (WQMS)
- Department of Fisheries and Oceans (DFO)
- Monitoring & Data Services Directorate (MDSD)
- Unassigned

7th Floor New Lab Distribution

- ACRD (9%)
- EWHD (2%)
- EOALRS (89%)

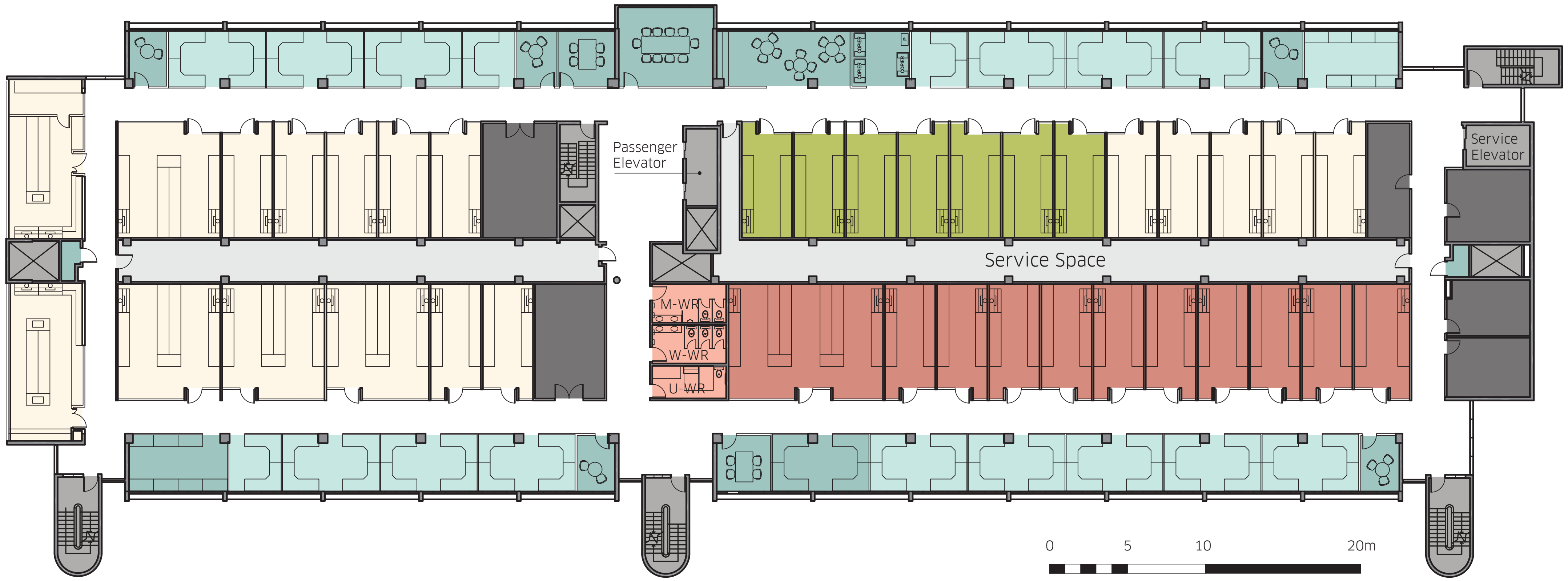


7th Floor New Space Distribution



- Corridors & Lobbies (21%)
- Service Cores (7%)
- Storage
- Office Support (2%)
- Washrooms (2%)
- Labs (38%)
- Vertical Circulation (5%)
- Office (25 %)

4th Floor (Option 2)



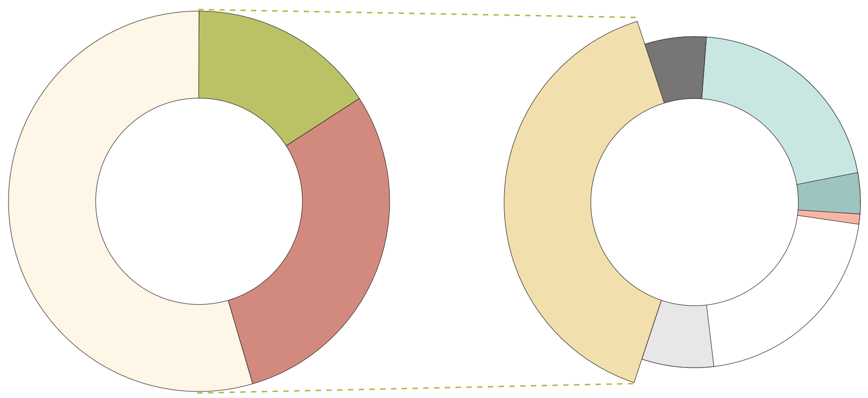
Legend

- Watershed Hydrology & Ecology Research Division (WHERD)
- Aquatic Contaminants Research Division (ACRD)
- Emergencies, Operational Analytical Labs & Research Support (EOALRS)
- Eco-Toxicology and Wildlife Health Division (EWHD)
- Water Quality Monitoring and Surveillance (WQMS)
- Department of Fisheries and Oceans (DFO)
- Monitoring & Data Services Directorate (MDSD)
- Unassigned

4th Floor New Lab Distribution

- WQMS (16%)
- DFO (29%)
- Unassigned (55%)

4th Floor New Space Distribution



- Corridors & Lobbies (21%)
- Service Cores (7%)
- Storage (6%)
- Office Support (4%)
- Washrooms (1%)
- Labs (40%)
- Office (21%)

5th Floor (Option 2)

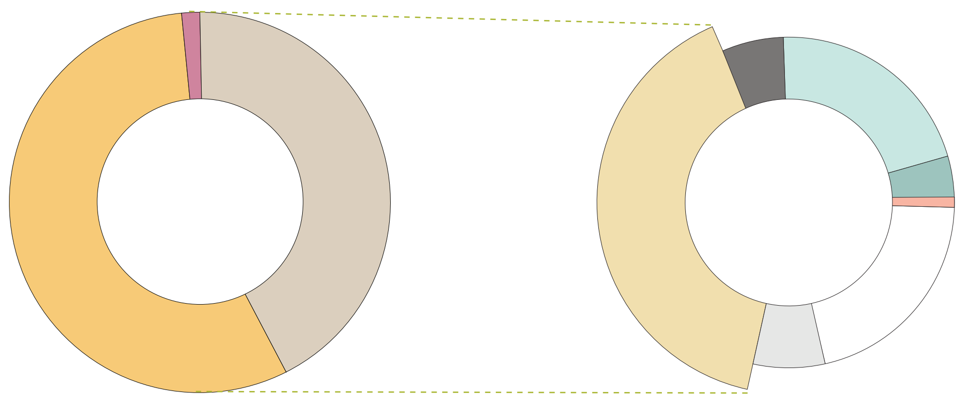
Legend

- Watershed Hydrology & Ecology Research Division (WHERD)
- Aquatic Contaminants Research Division (ACRD)
- Emergencies, Operational Analytical Labs & Research Support (EOALRS)
- Eco-Toxicology and Wildlife Health Division (EWHD)
- Water Quality Monitoring and Surveillance (WQMS)
- Department of Fisheries and Oceans (DFO)
- Monitoring & Data Services Directorate (MDSD)
- Unassigned

5th Floor New Lab Distribution

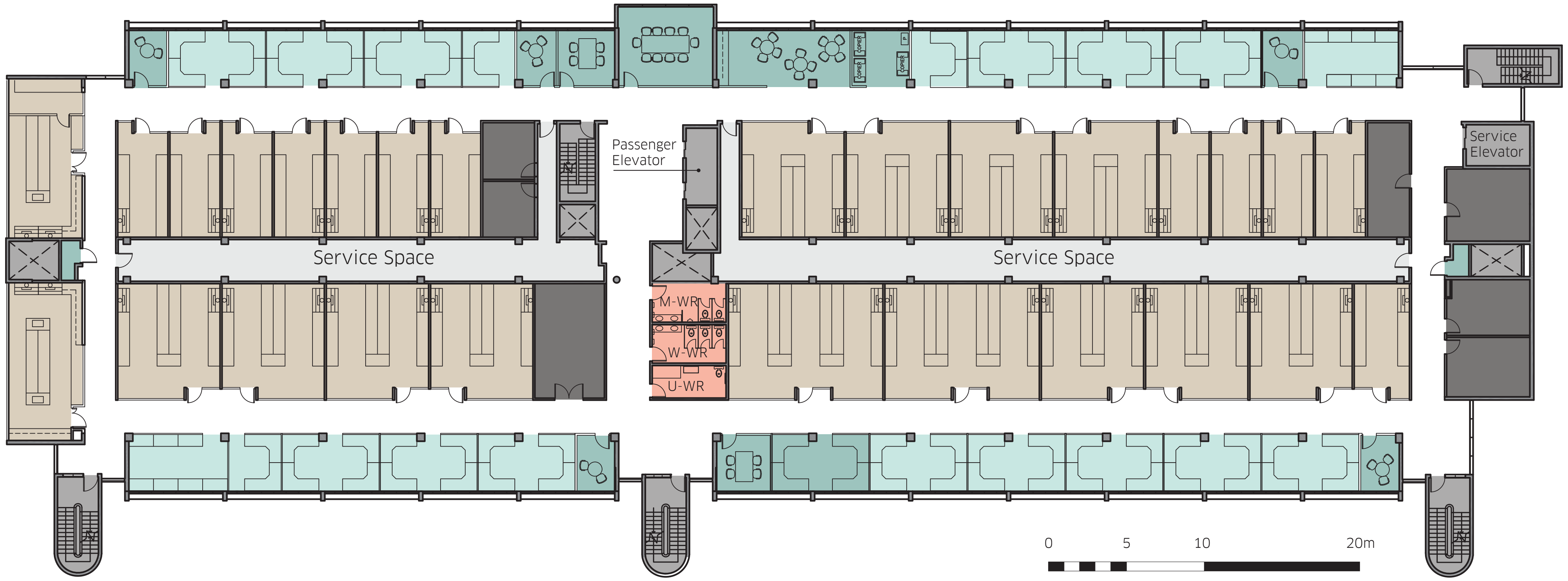
- ACRD (42%)
- WHERD (56%)
- MDSD (2%)

5th Floor New Space Distribution



- Corridors & Lobbies (21%)
- Service Cores (7%)
- Storage
- Office Support (2%)
- Washrooms (2%)
- Labs (38%)
- Vertical Circulation (5%)
- Office (25 %)

6th Floor (Option 2)



Legend

- Watershed Hydrology & Ecology Research Division (WHERD)
- Aquatic Contaminants Research Division (ACRD)
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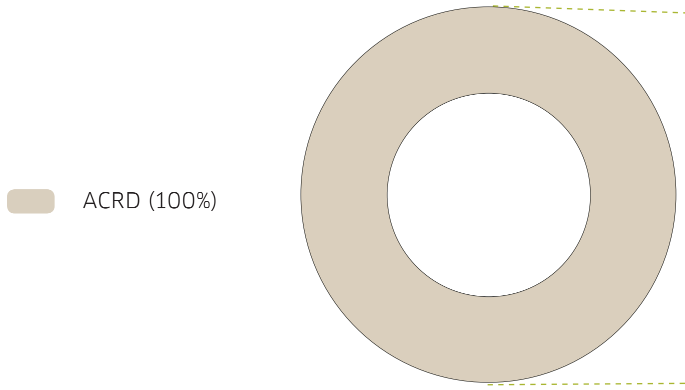
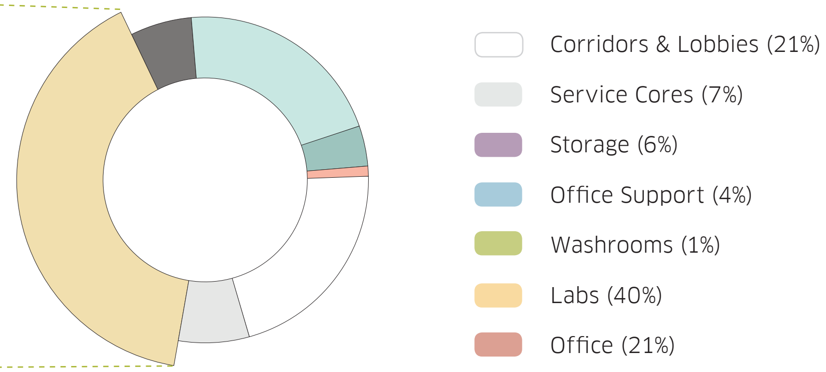
- Eco-Toxicology and Wildlife Health Division (EWHD)
- Water Quality Monitoring and Surveillance (WQMS)
- Department of Fisheries and Oceans (DFO)
- Monitoring & Data Services Directorate (MDSD)
- Unassigned

6th Floor New Lab Distribution



6th Floor New Space Distribution



7th Floor (Option 2)

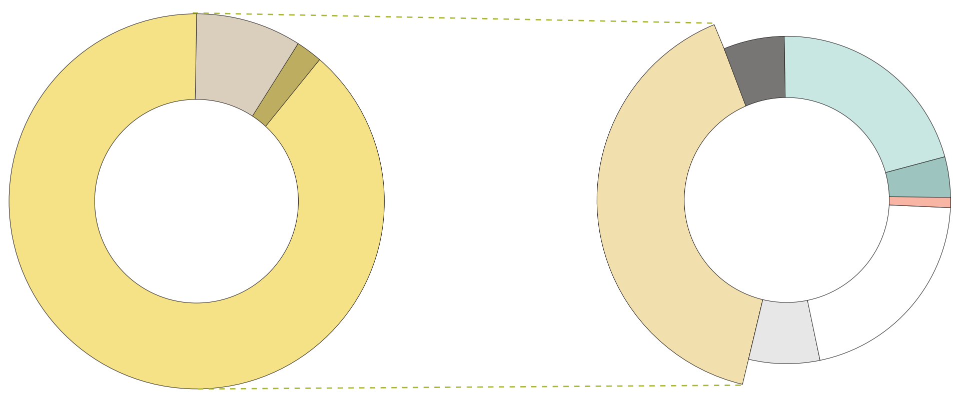
Legend

- Watershed Hydrology & Ecology Research Division (WHERD)
- Aquatic Contaminants Research Division (ACRD)
- Emergencies, Operational Analytical Labs & Research Support (EOALRS)
- Eco-Toxicology and Wildlife Health Division (EWHD)
- Water Quality Monitoring and Surveillance (WQMS)
- Department of Fisheries and Oceans (DFO)
- Monitoring & Data Services Directorate (MDSD)
- Unassigned

7th Floor New Lab Distribution

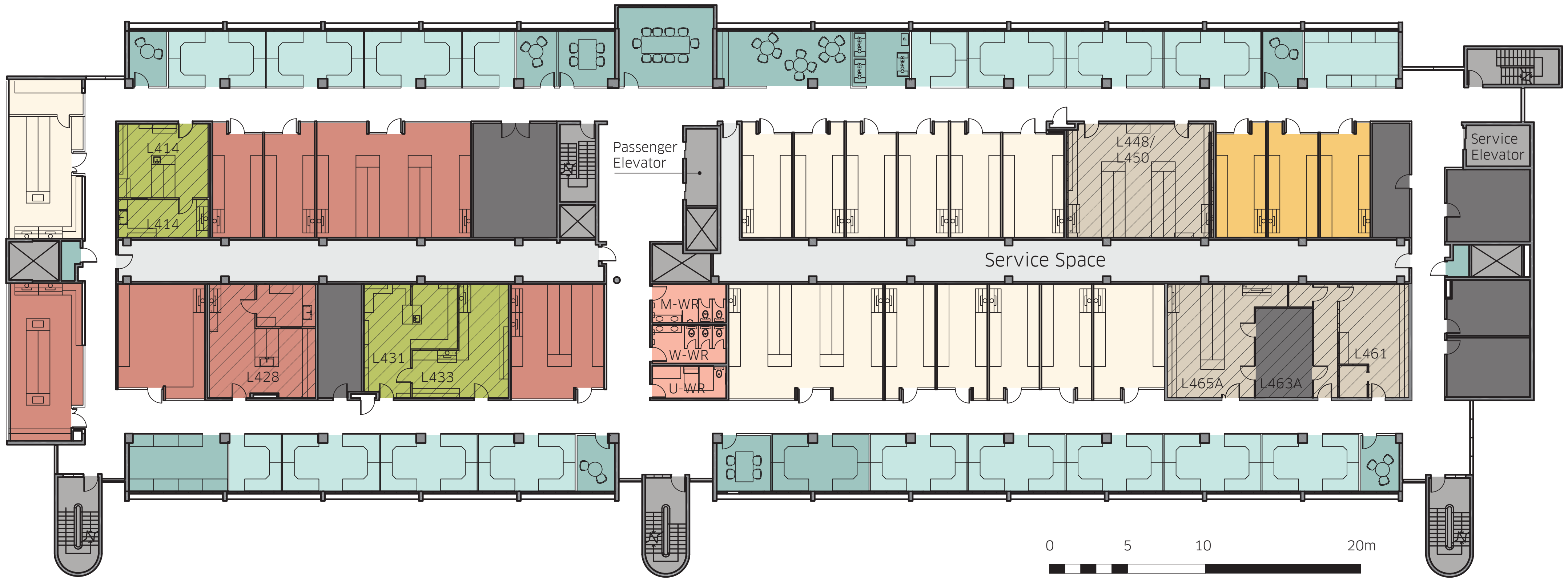
- ACRD (9%)
- EWHD (2%)
- EOALRS (89%)

7th Floor New Space Distribution



- Corridors & Lobbies (21%)
- Service Cores (7%)
- Storage
- Office Support (2%)
- Washrooms (2%)
- Labs (38%)
- Vertical Circulation (5%)
- Office (25 %)

4th Floor (Option 3)

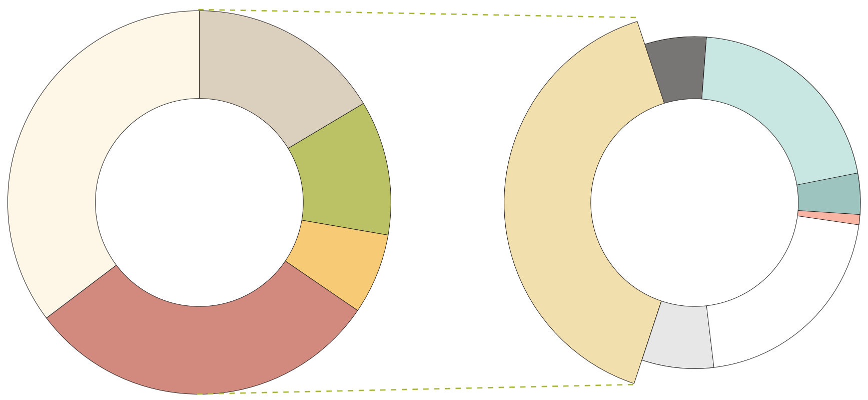


Legend

- Watershed Hydrology & Ecology Research Division (WHERD)
- Aquatic Contaminants Research Division (ACRD)
- Emergencies, Operational Analytical Labs & Research Support (EOALRS)
- Eco-Toxicology and Wildlife Health Division (EWHD)
- Water Quality Monitoring and Surveillance (WQMS)
- Department of Fisheries and Oceans (DFO)
- Monitoring & Data Services Directorate (MDSD)
- Unassigned
- Denotes Existing

4th Floor New Lab Distribution

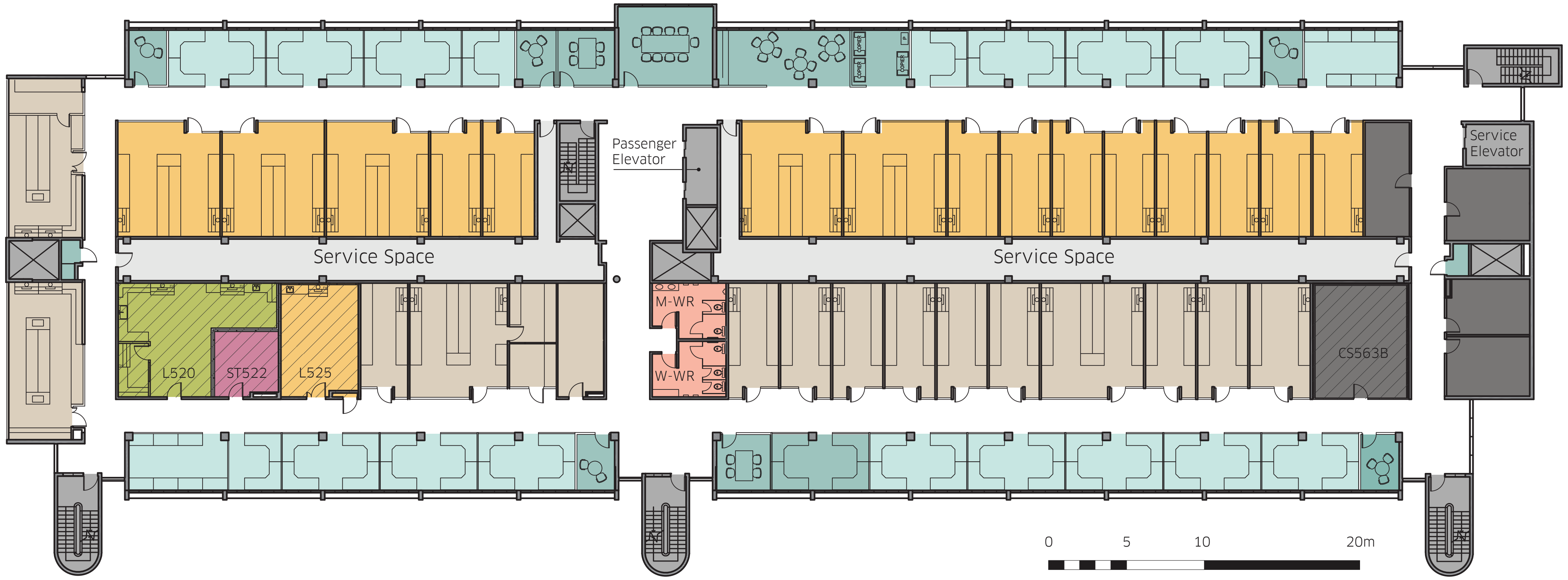
- ACRD (16%)
- DFO (31%)
- WQMS (11%)
- WHERD (6%)
- Unassigned (36%)



4th Floor New Space Distribution

- Corridors & Lobbies (21%)
- Service Cores (7%)
- Storage (6%)
- Office Support (4%)
- Washrooms (1%)
- Labs (40%)
- Office (21%)

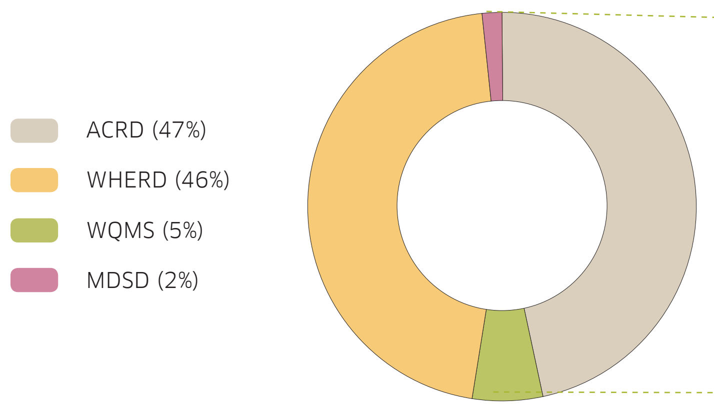
5th Floor (Option 3)



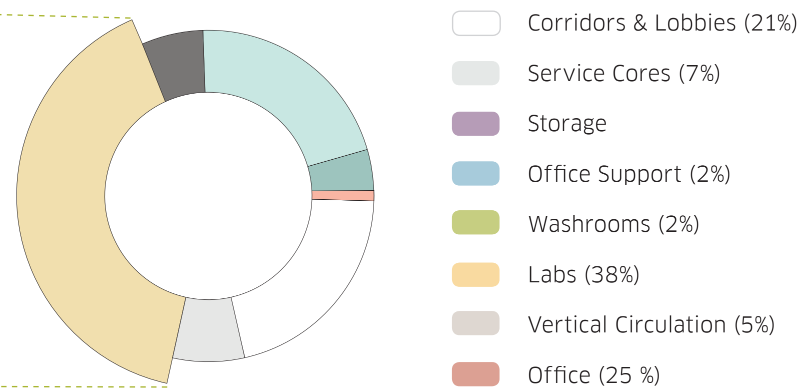
Legend

- Watershed Hydrology & Ecology Research Division (WHERD)
- Aquatic Contaminants Research Division (ACRD)
- Emergencies, Operational Analytical Labs & Research Support (EOALRS)
- Eco-Toxicology and Wildlife Health Division (EWHD)
- Water Quality Monitoring and Surveillance (WQMS)
- Department of Fisheries and Oceans (DFO)
- Monitoring & Data Services Directorate (MDSD)
- Unassigned
- Denoted Existing

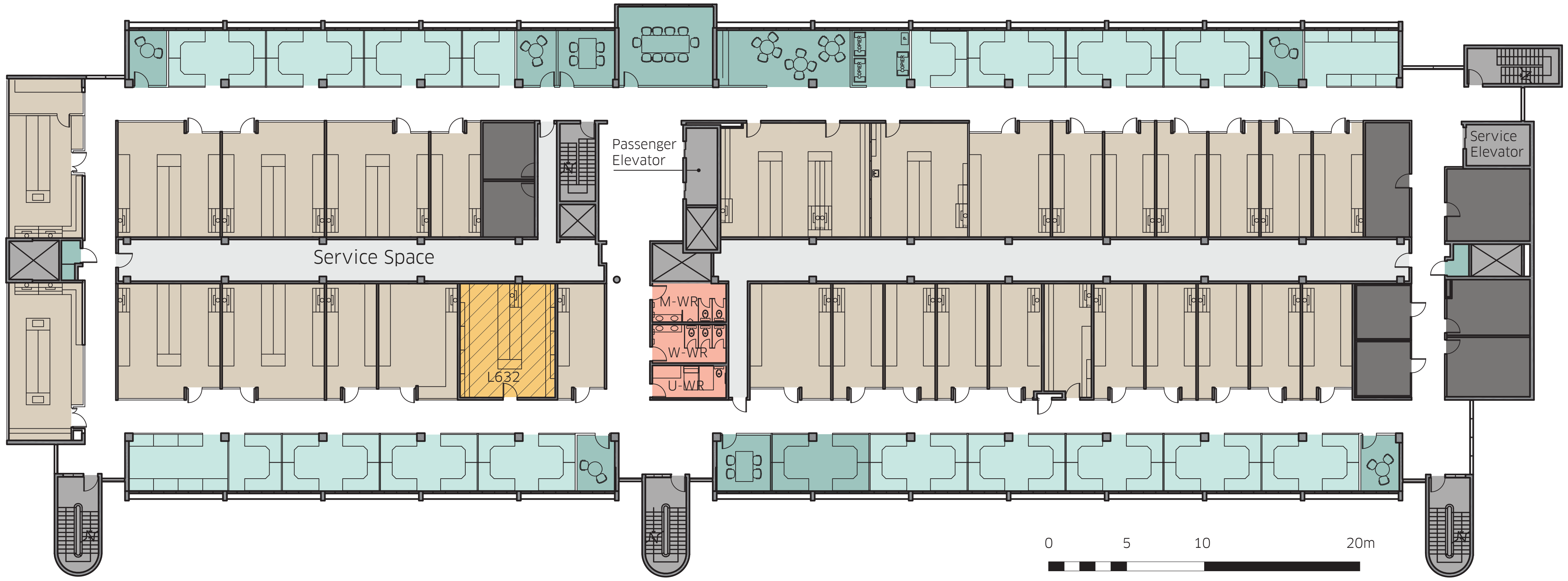
5th Floor New Lab Distribution



5th Floor New Space Distribution



6th Floor (Option 3)

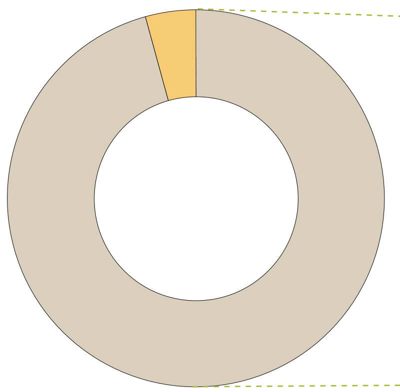


Legend

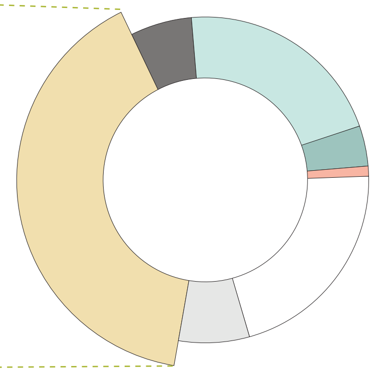
- Watershed Hydrology & Ecology Research Division (WHERD)
- Aquatic Contaminants Research Division (ACRD)
- Emergencies, Operational Analytical Labs & Research Support (EOALRS)
- Eco-Toxicology and Wildlife Health Division (EWHD)
- Water Quality Monitoring and Surveillance (WQMS)
- Department of Fisheries and Oceans (DFO)
- Monitoring & Data Services Directorate (MDSD)
- Unassigned
- Denotes Existing

6th Floor New Lab Distribution

- ACRD (96%)
- WHERD (4%)

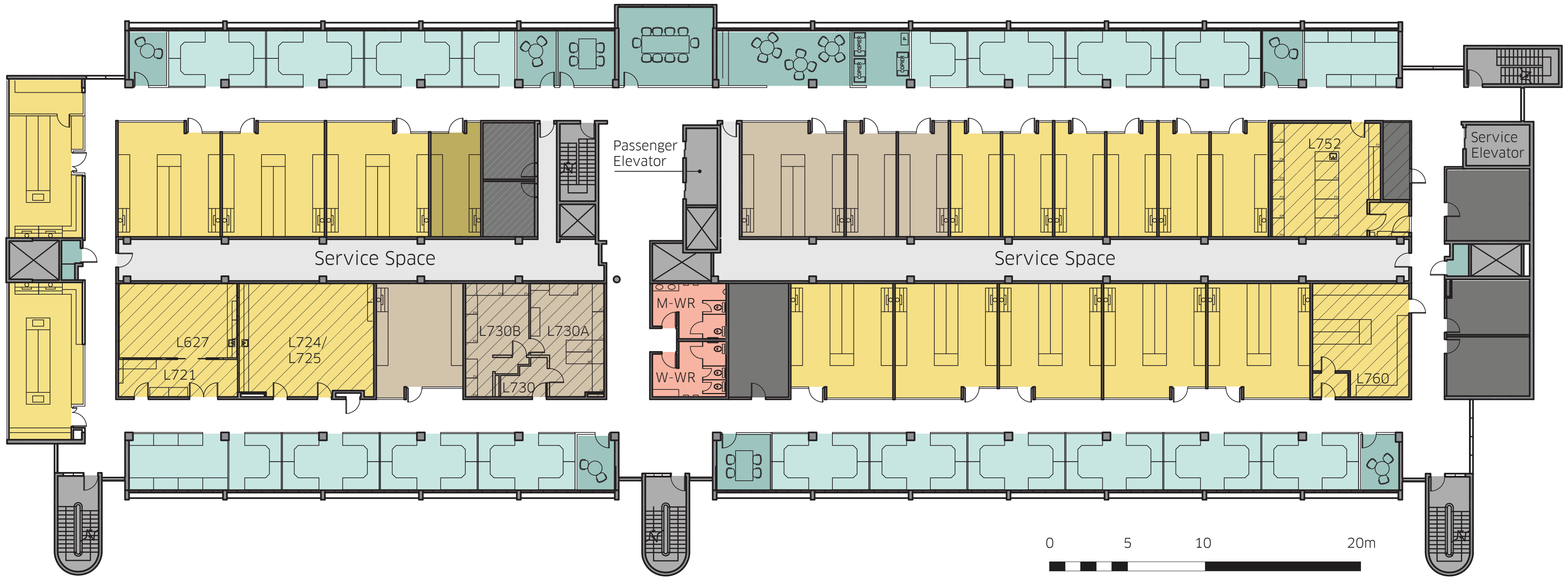


6th Floor New Space Distribution



- Corridors & Lobbies (21%)
- Service Cores (7%)
- Storage (6%)
- Office Support (4%)
- Washrooms (1%)
- Labs (40%)
- Office (21%)

7th Floor (Option 3)



Legend

- Watershed Hydrology & Ecology Research Division (WHERD)
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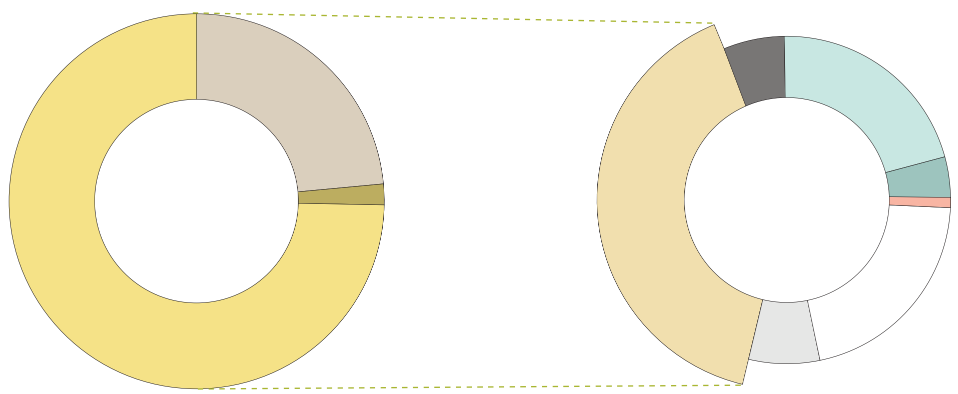
- Eco-Toxicology and Wildlife Health Division (EWHD)
- Water Quality Monitoring and Surveillance (WQMS)
- Department of Fisheries and Oceans (DFO)
- Monitoring & Data Services Directorate (MDSD)
- Unassigned
- Denoted Existing

7th Floor New Lab Distribution

7th Floor New Space Distribution

- ACRD (24%)
- EWHD (1%)
- EOALRS (75%)



- Corridors & Lobbies (21%)
- Service Cores (7%)
- Storage
- Office Support (2%)
- Washrooms (2%)
- Labs (38%)
- Vertical Circulation (5%)
- Office (25 %)

View from typical 4-7 floor laboratory through new workstation area

Option 1

Option 1 involves converting the south end of floor 4 into a contained, contiguous 'lab suite'.

Pros:

The lab suite would become a unique showcase laboratory area for CCIW. Unlike the typical design where laboratories are inboard of the workstations & office support rooms, the lab suite would extend to a perimeter, glazed corridor. Not only would this afford a much more direct relationship between these labs and exterior environment, it would also allow for external passage around a contained laboratory environment (BSL2/CALA certified) - a provition not feasible for the rest of the LMP scope.

The lab suite could be envisioned to host existing laboratories of the A&L building that have research affinities, possibly spanning multiple directorates. Alternatively, it could host research activities from an institution or science-based organisation outside of Environment Canada.

Cons:

The lab suite removes all the dedicated workstations from the south area of floor 4, which would limit the capacity of workstations that could be situated on floors 4-7. Also, the lab suite uses a single-loaded external corridor, the corridor consumes more space than with the standard/existing design.

Option 2

Option 2 is identical to Option 1, apart from the south end of floor 4. Whereas Option 1 would see this area converted into a lab suite, Option 2 would implement a continuation of the standard laboratory and office modules used elsewhere in the LMP.

Pros:

The implementation of standard laboratory modules in this area would more easily enable the expansion of directorates that require more lab space, as the proposed lab suite of Option 1 would likely be implemented as a specialty lab environment geared to certain types of research. Furthermore, with the aim of encouraging more contiguous laboratories grouped by directorate, the continuation of the standard lab module would more easily enable growth by accumulation of adjacent lab modules. Though all unassigned labs are shown to be on the fourth floor, these could be distributed throughout the four floors of the LMP.

Also, Option 2 would provide more workstations to the A&L Building, which would ensure those non-lab users currently located on floors 4-7 could remain after the LMP.

Cons:

The only detraction to Option 2 would be not achieving the potential benefits of the lab suite in Option 1, though the ultimate usefulness of the lab suite would be determined by Environment Canada when the detailed design of Phase 5 would occur (see 3.11, Phasing Strategy).

Option 3

Option 3 is similar to Option 2, however rather than renovating all labs apart from those under construction on the 5th and 7th floors, Option 3 would maintain all labs in good condition that have received recent renovations.

Pros:

By maintaining recently renovated laboratories, the LMP would avoid redundant capital costs for laboratory upgrades that are presently functioning satisfactorily.

Cons:

Leaving the recently renovated laboratories in place creates a number of problems for the Lab Modernization Plan. Firstly, by creating disconnected renovation areas, Option 3 would result in a noticeable lack of uniformity that would otherwise be achieved with a full renovation. This would be the case both aesthetically with the disharmony in lab design, and functionally with the inability to uniformly group labs by division.

Secondly, while those labs to be left may be in good condition now, by the time the LMP is to be completed in 2022 (see 3.11, Phasing Strategy) some will be approaching the need for renewal. When they do undergo renovation, that work will interrupt the fully functional adjacent labs that had recently been renovated in the LMP, leading to costs related to lab downtime.wFurthermore, though capital costs for the LMP may be reduced by leaving certain labs intact, the same down-time should be expected for fully renovated labs as the existing labs to remain would be islands surrounded by the construction activity of the adjacent LMP work.

3.3 Laboratory Design

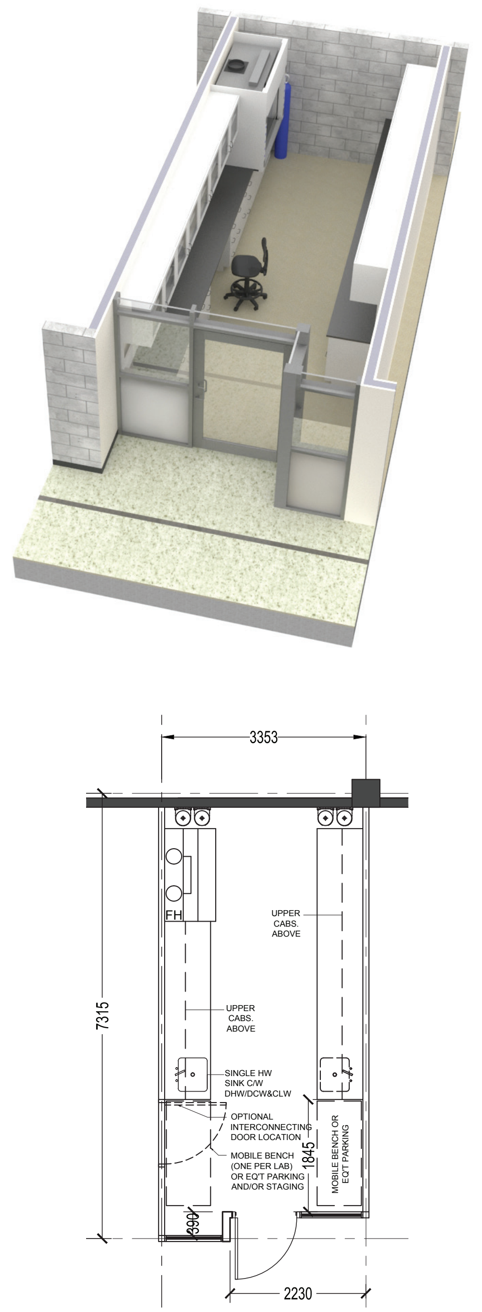
One of the more important design provisions intended to guide the modernization of the laboratories in the LMP project involves implementing a regular laboratory design typology in which its associated components would find consistent placement throughout the entire A&L.

This typology includes locating the fume hoods along the back wall due to its adjacency to the service corridor, and also to minimize disruption to the airflow & workflow from travel corridors. Casework will be located in a parallel direction to the laboratory module, creating repeating peninsulas at regular intervals. All casework that does not host fixed services (e.g. plumbing) will be moveable.

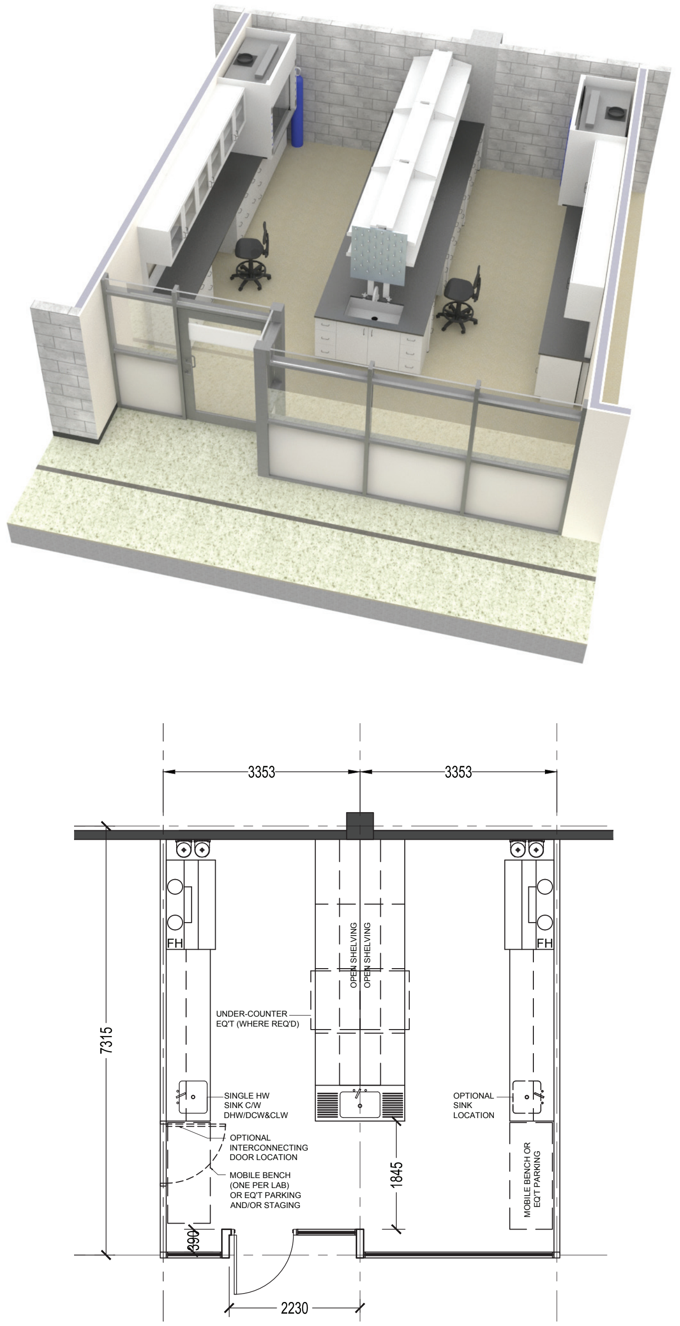
To ensure sufficient flexibility for lab modification, all fixed services will be directed to the laboratory perimeter where possible, and pushed toward the back of the lab, thus reducing the amount of fixed casework required. Movable casework can be easily replaced with equipment should the needs of the lab change in the future.

For the lab circulation corridor, staging spaces will be provided for either mobile casework or equipment. Doorways from the exterior corridor will open onto the aisles between casework peninsulas and will swing outward according to best practices of laboratory life safety. Partitions will be limited to separate only those labs which require environmental segregation. Casework located along these partitions toward the front of the lab will be mobile to enable the addition of doorways in line with the lab circulation corridor

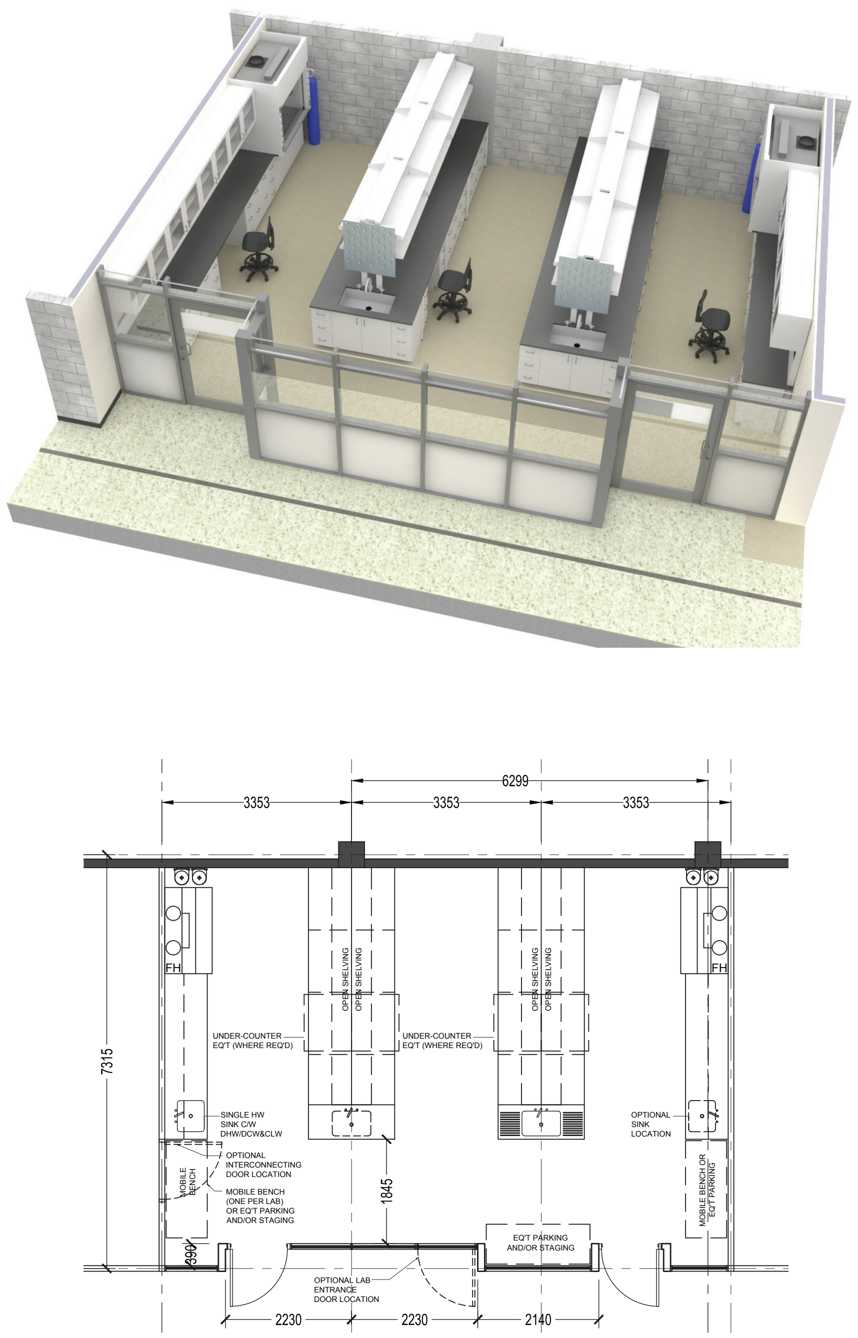
Lastly, the wall between the laboratory and the corridor will be heavily glazed to enable exterior views and natural light penetration in the laboratory, made possible by the modernization of the office space.



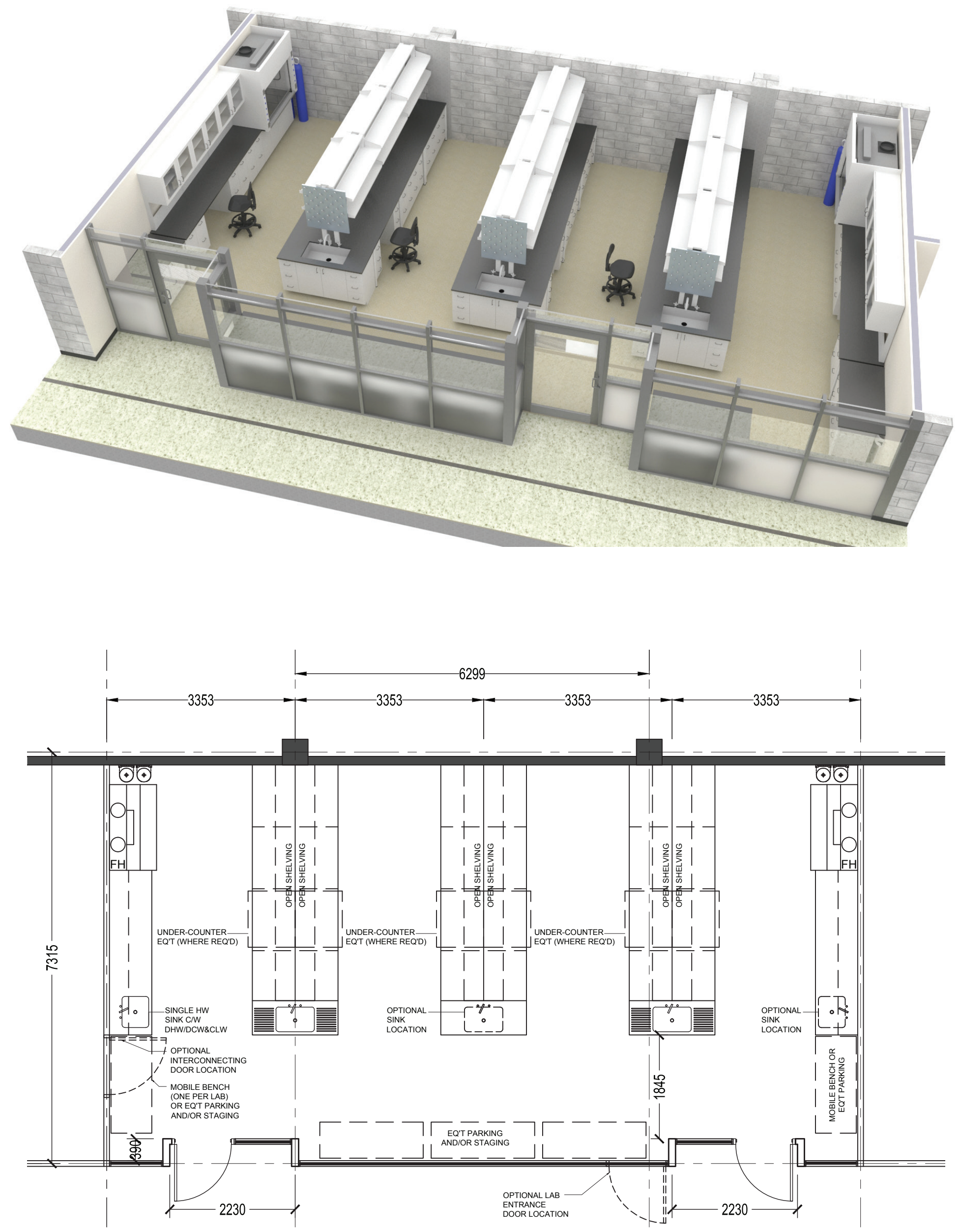
Top & bottom – Single Module Laboratory Plan & Rendering



Top & bottom – Double Module Laboratory Plan & Rendering



Top & bottom – 3 Module Laboratory Plan & Rendering



Top & Bottom – 4 Module Laboratory Plan & Rendering

3.4 Workplace Design

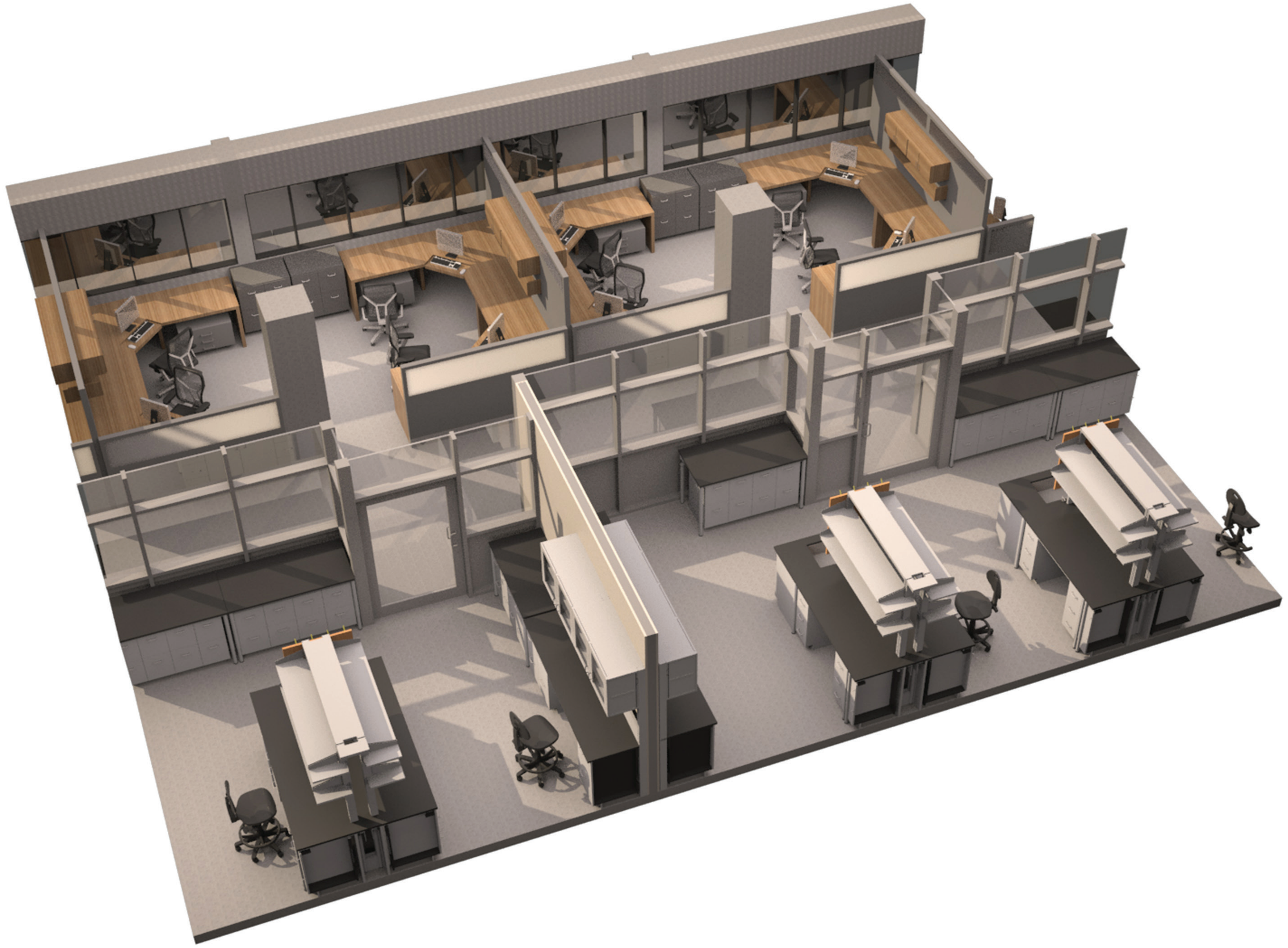
As determined by the Government of Canada Workplace 2.0 fit-up standards, the typical LMP floor will receive 2 small meeting rooms, 2 quiet rooms, 1 kitchenette, 1 shared equipment area for printers, 2 undesignated support rooms, 3 printer stations, and 1 first-aid room, in addition to the 1 existing medium-sized meeting room.

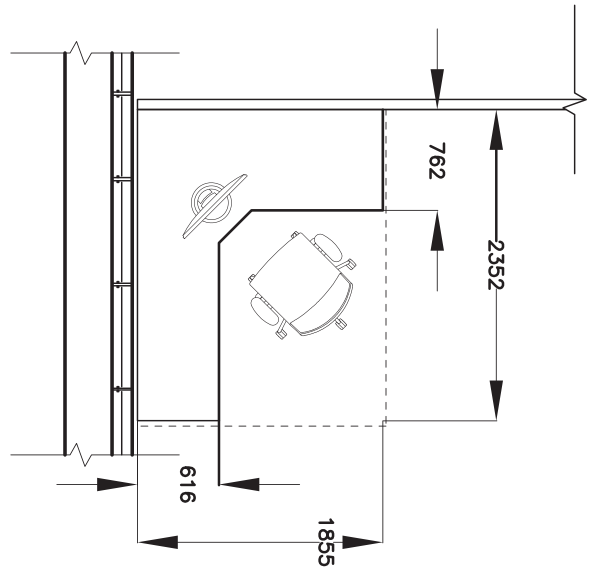
The layout shown here uses the general strategy of grouping office support spaces within the centre of the floor plate, and in turn creating a generally contiguous workstation area. The underlying logic here being that the contiguous workstation area would be more flexible to alterations in layout than may be desired. An alternate strategy, shown in the top-right (north-west) corner would see the enclosed office support spaces break-up the workstation area to minimize the ambient noise.

The workstations are intended to be modular for easy modification, with medium-height partitions perpendicular to the wall. Partitions with translucent panels would be used along the corridor wall to maximize natural light penetration into the laboratory area.

Typical Floor Workplace Layout

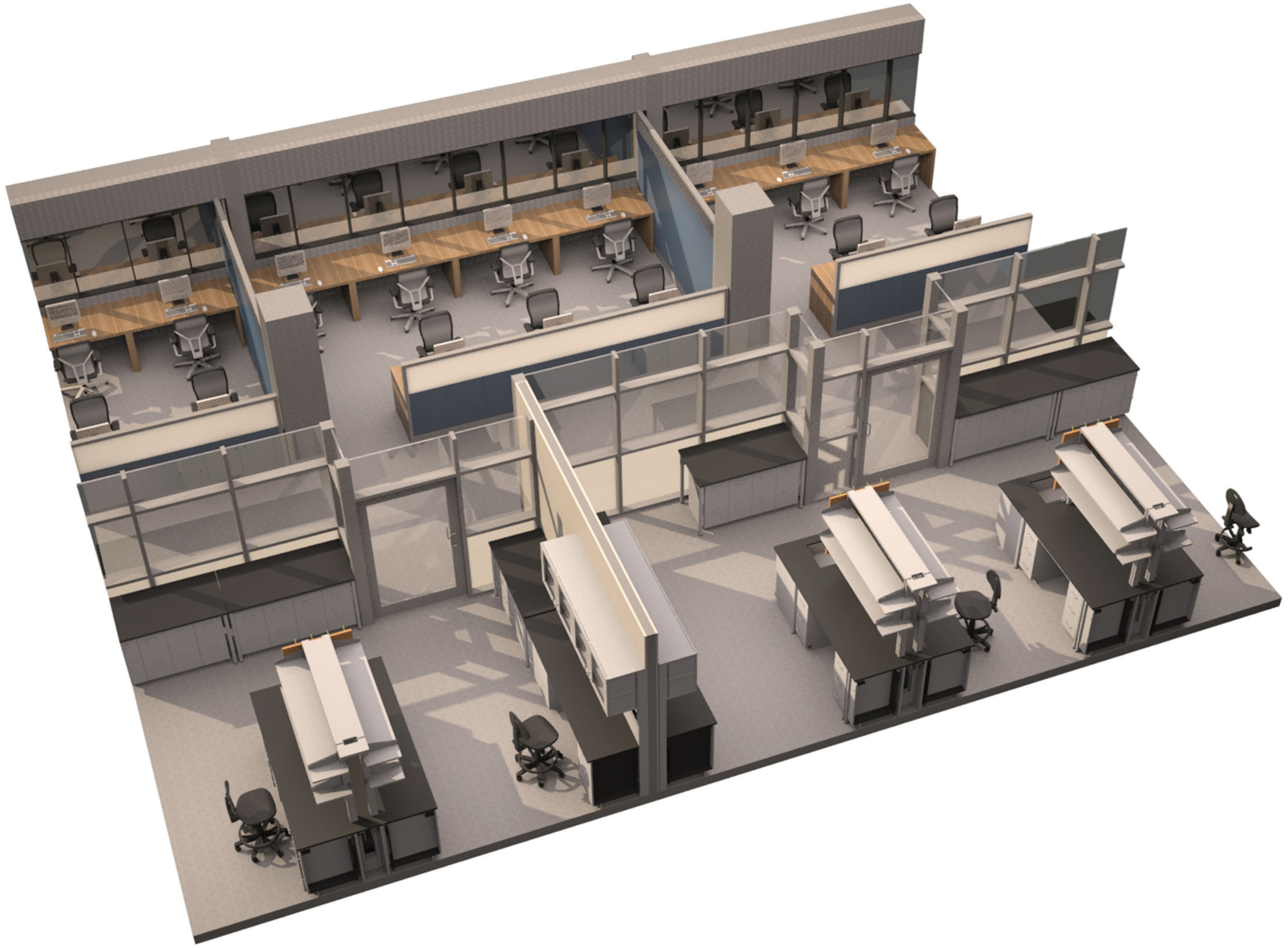
4.5m² Workstations

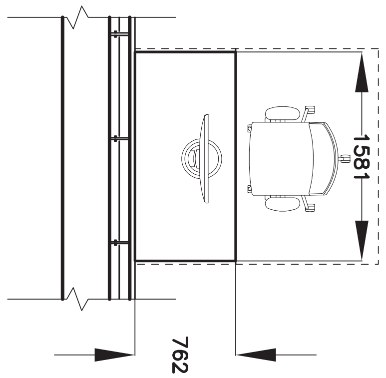




4.5 m² Workstations Rendering & Plan

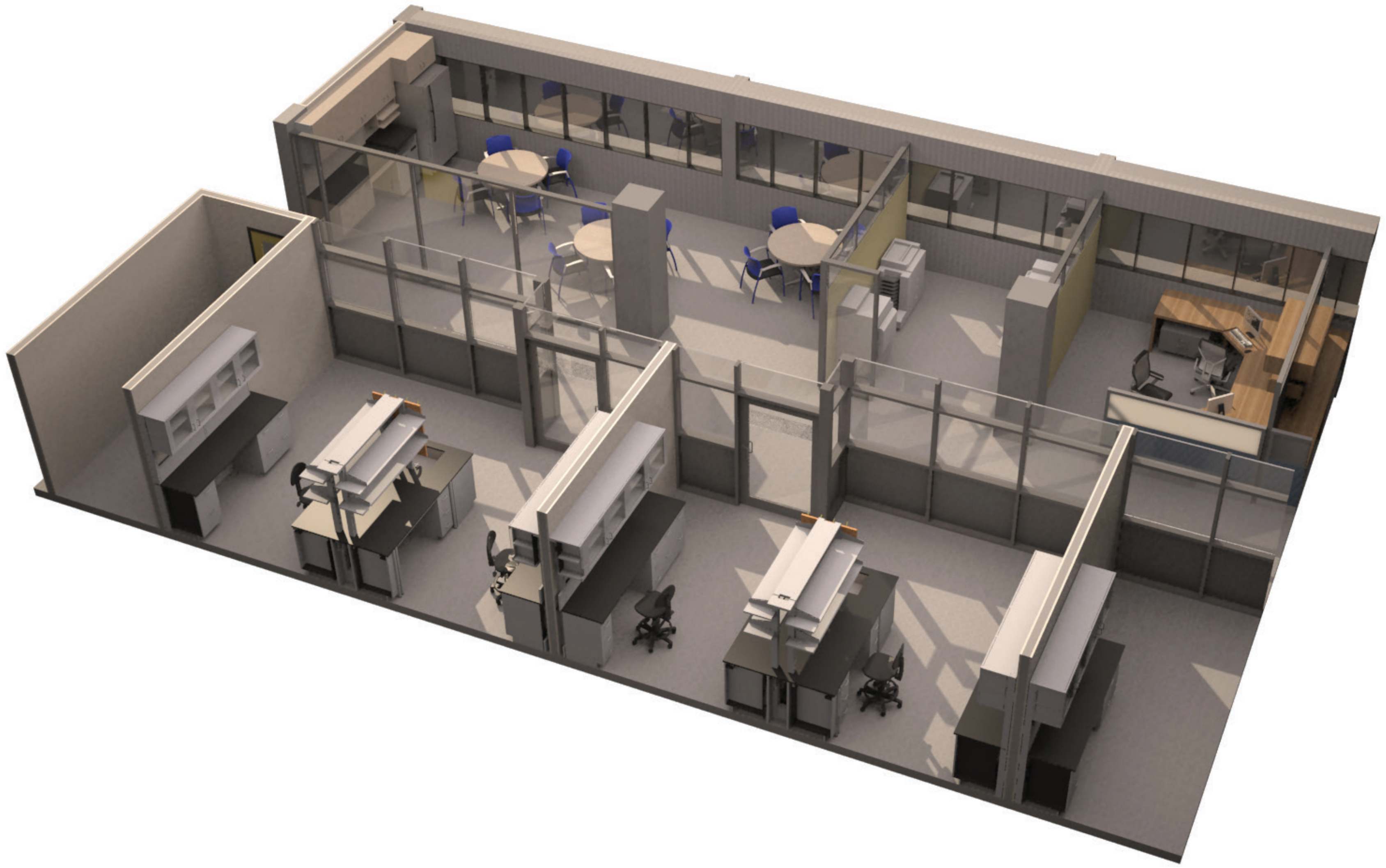
3.0m² Workstations

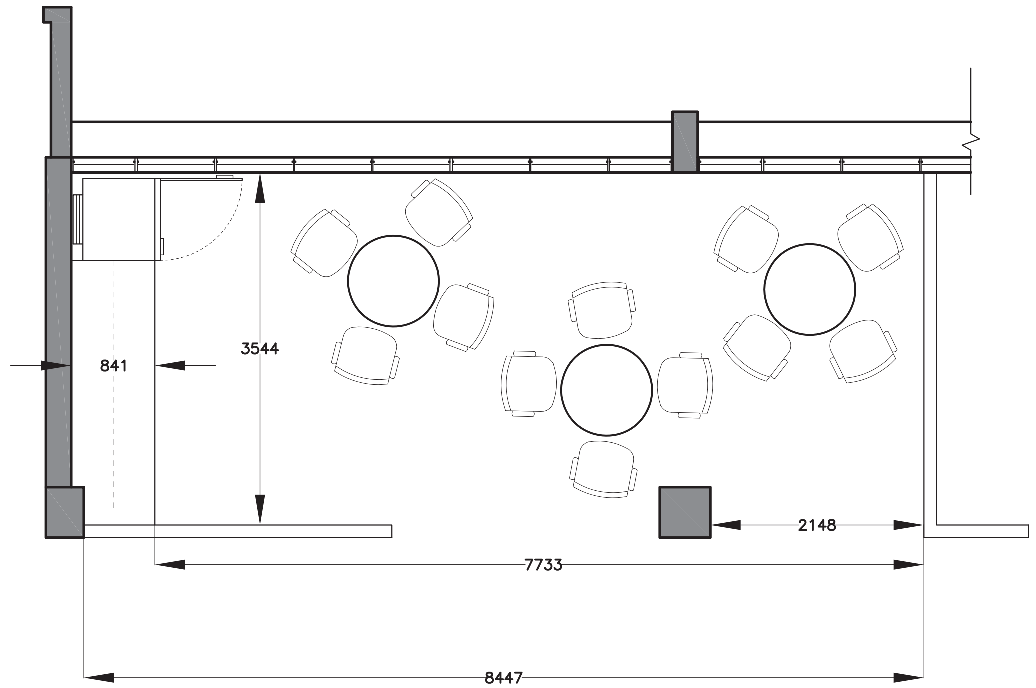




3.0 m² Workstations Rendering & Plan

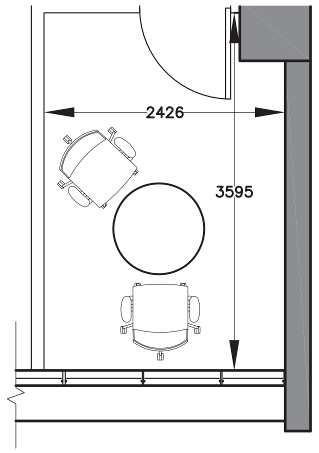
Kitchenettes



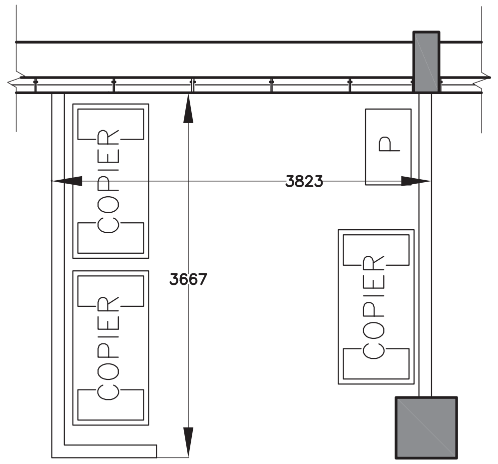


Typical kitchenette layout

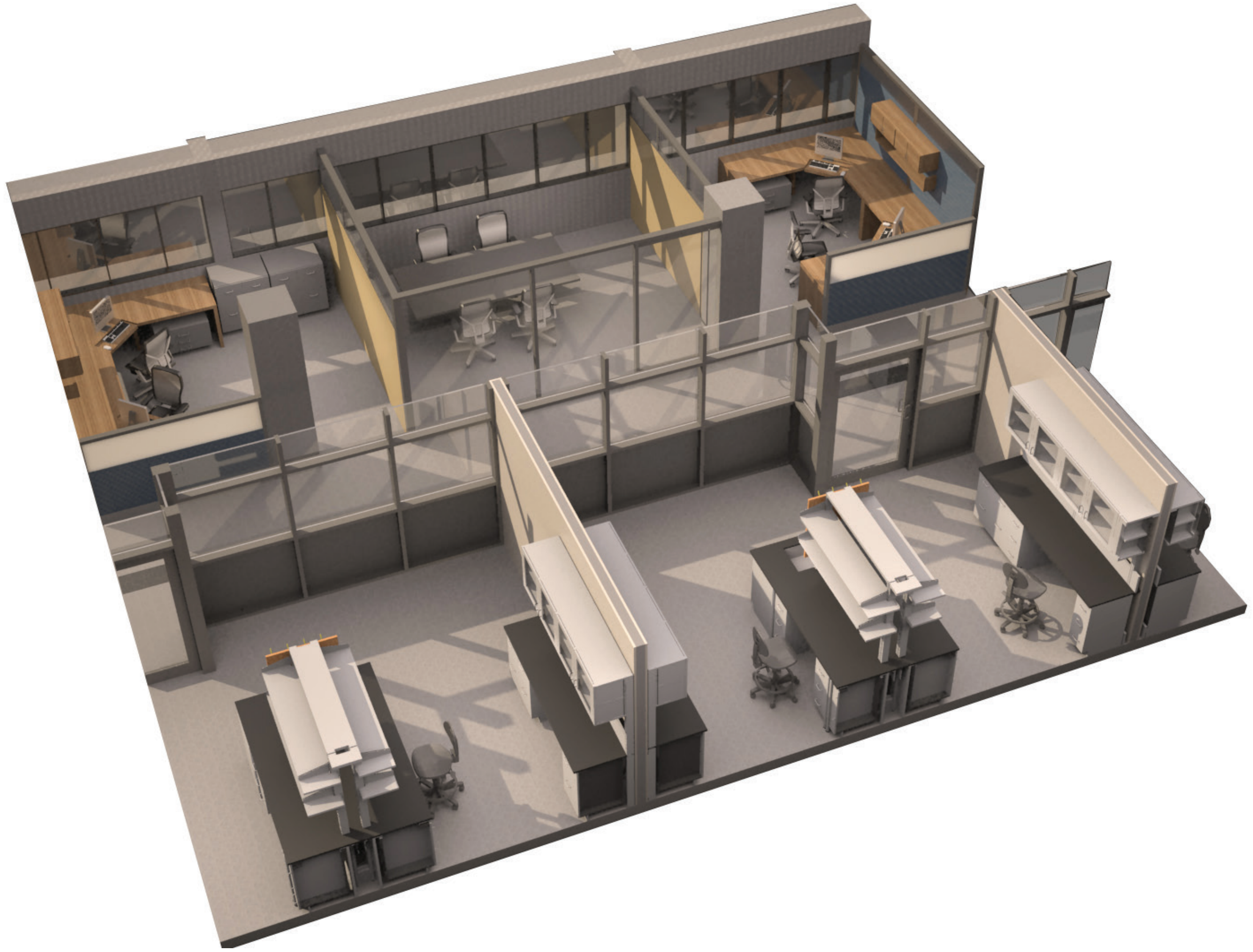
Enclosed Office Support

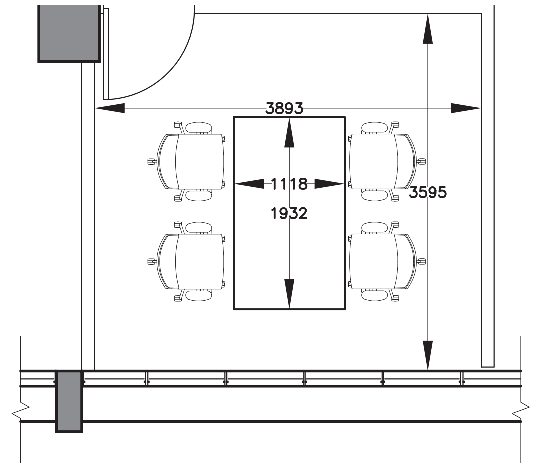


Quiet Room: 8m²

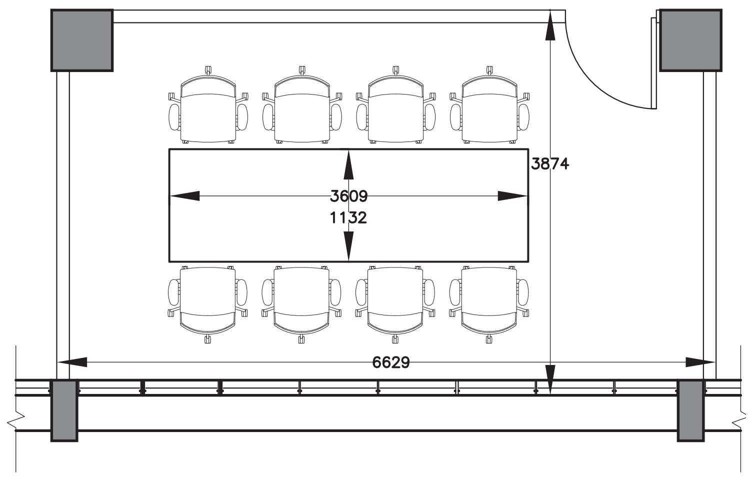


Shared Equipment Area: 14m²





Small Meeting Room: 14m²



Medium Meeting Room: 25.5m²

Typical Meeting Room / Quiet Room

3.5 Structural Design

Based on our review of the drawings and selected random design calculations, the floor slabs for levels 4 to 7 have a live load capacity slightly above the 4.8 kPa [100 psf] for the office and corridors, which are located around the perimeter, and 7.2 kPa [150 psf] for the laboratories, which are located in the interior core of the building. The loading for the exterior office and corridors is consistent with current codes, while the loading considered for the laboratories in the original design is greater than what is mandated by current codes.

Proposed options include for a reconfiguration of the lab area so that part of the lab extends to the exterior east and west portions of the building. Please note that the existing building exterior portions of the typical floor slab are designed for a live load of 4.8kPa. According to current NBCC 2010, minimum specified live load requirements for labs is 3.6kPa, and thus existing conditions will permit new lab floor arrangement. However, if the use of the labs requires a heavier live load, greater than 4.8kPa, then the concrete floor slabs and supporting concrete beams will need to be reinforced to accommodate the larger design love loads. The existing concrete elements can be reinforced using steel (in forms of plates, channels or beams) for added support, or alternately adding carbon fibre reinforcing plates. Either method of reinforcing the concrete members will need to be fire protected. It is important to note that re-purposing of the existing perimeter office space into lab with heavy equipment can only be accommodated for a very localized small footprint, because the existing exterior columns on gridlines '26' and '36' (east and west elevations respectively) are supported on 3.05m [10 ft] long concrete cantilever beams, which will be very difficult and not practical to reinforce.

FURTHER RECOMMENDATIONS

It is recommended that replacement of sealants on all vertical and horizontal surfaces continue to be replaced on a regular basis in order to reinstate the integrity of the building envelope and extend their effective service life. Continual monitoring and replacement of envelope sealants will extend the life of the structure.

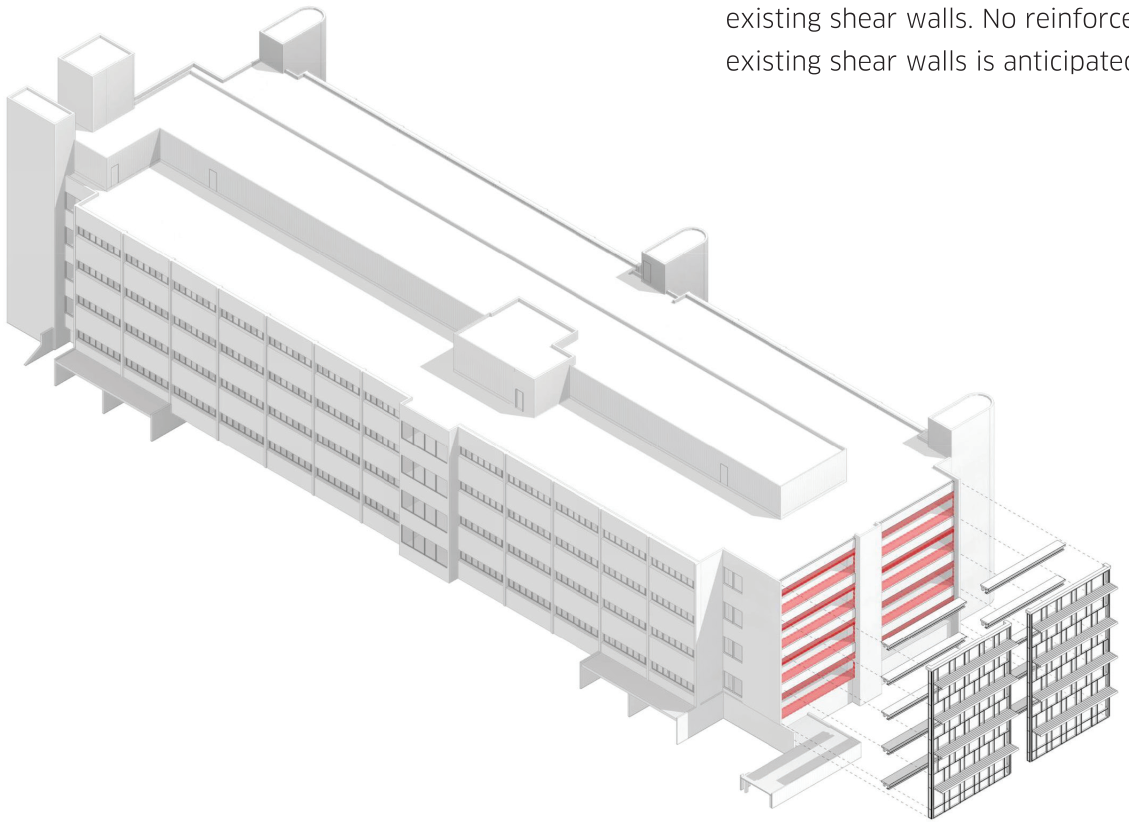
No leaks were observed at the Mechanical Penthouse / Roof level. It appears that leaks are addressed by the facility management team on an as-needed basis to help prevent premature deterioration of the roof structure and the interior structural and non-structural elements. It is recommended that replacement of roofing membranes and sealants continue to be part of the ongoing maintenance program in order to reinstate the integrity of the building. Other than normal maintenance (i.e. regular monitoring and minor repairs), no repair/replacement is anticipated for the superstructure.

The fire resistance ratings of the existing structure will require further studies and testing to determine the composition of the concrete mix, particularly the aggregates used in the concrete mix.

Although the Burlington location of this facility is considered a zone of low seismicity (and not located in a zone of moderate to high seismicity as defined by RPSC), an initial rapid seismic screening of this 45 year old building is strongly recommended for ranking this building in an inventory for later, more detailed seismic evaluations. The methodology for a rapid seismic screening is based on identifying the main features of the building affecting risk of seismic hazards, soil conditions, type of structure, irregularities of the structure and the importance of the building as determined by its use and occupancy.

SOUTH ELEVATION NEW CURTAIN WALL GLAZING

To provide more natural daylight into the laboratories on the 4th, 5th, 6th and 7th floors, a new curtain wall glazing facade is proposed to be installed on the south elevation. As shown on the structural cross-section, the existing perimeter 1.50m [5 ft] deep concrete beams will be cut to a depth of ±0.50m. A new W460 steel beam will be installed adjacent to the cut concrete perimeter beam to provide support to the existing concrete slab and new curtain wall cladding. The new steel beams will be supported at both ends onto the existing shear walls. No reinforcement of the existing shear walls is anticipated.



Exploded axonometric showing proposed south end extension

3.6 Mechanical Design

Sanitary and Acid Waste Drainage: The existing sanitary piping distribution shall be reworked to serve the new LMP renovation. Where plastic pipe penetrates fire rated assemblies the distribution be reviewed for compliance to fire separation requirements, and proper fire stopping be provided.

Domestic Potable Water: In efforts to mitigate cross contamination between potable water and non- potable water demands (ie. hand wash sinks vs lab sinks) it is recommend that a dedicated riser from level 3 to level 8 be provided to serve potable water (drinking water) sources. Two new potable water risers will be provide; serving the north and south wing. Each riser will consist of; 2-1/2” DCW, 1-1/2” DHW and a ¾” DHW re-circulation line, the recirculation line shall be extend back to the ground floor central mechanical room, complete with new recirc pump.

Due to the age of the existing plumbing risers, replacement of the existing risers shall be carried out. The risers shall be replaced to match existing sizes, and shall be phased to allow for continuous operation of existing building operations.

As part of any future renovations all new protective equipment (ie. emergency shower and eye wash stations) shall be piped from a potable water source as noted above and shall be complete with thermostatic mixing valves to comply with ANSI Z358.1. In addition all new handwash sinks shall be plumbed from the same source.

As part of an early works phase, the new potable water risers, and existing riser replacement shall be carried out. This will assure that the services are operation and ready for connection to new fixtures as the floor renovations commence.

Reverse Osmosis (RO) Water: The RO distribution is carried out via the existing distilled water piping supply, this piping dates back to the existing vintage of the building. It is difficult to maintain water quality within this system due its existing conditions. As part of any future renovations, it is recommended that the existing system be replaced in its entirety. Depending on water quality requirements the RO system may be paired up with a water polishing system to maintain improved water quality levels. The new RO distribution system will be recirculated to prevent standing water. In Labs where high quality is required it is recommended that local polishers (ie. Milli-Q) be installed, similar to some existing labs.

Lab Gases Recommendations: As part of any future renovations the existing compressed air distribution and gas piping system shall be modified to suit the new renovated areas.

The decentralized allocation of various gas cylinders requires to be rectified, gas cylinders shall be secured and hazardous gases shall be stored in ventilated rooms. It is recommended that gas storage be centralized on each floor inside a dedicated cylinder storage room, where appropriate ventilation and monitoring can be provided.

Life Safety: As part of any future renovations an automatic sprinkler system shall be added to serve the A&L building. A new sprinkler riser shall be added running inside the service corridor and supervisory valves shall be located on each floor.

As part of an early works phase, the new sprinkler risers shall be installed. This will assure that the services will be ready for connection and extension as the floor renovations commence.

Heating System: Based on the existing facility report dated 2009 the following systems were slated for replacement prior to 2014, and are recommended to be carried out:

- The cogen heat exchangers
- All condensate tanks.
- The existing humidifier systems shall be replaced with unfired steam to steam humidification units. The new humidification units shall utilize RO water as feed water for direct injection into the air stream. The RO generation unit shall be revised to accommodate the new demand.
- Due to the age of existing shell and tube heat exchangers it is recommended that existing units be replaced with plate and frame heat exchangers. During this replacement, existing distribution pumps where required shall be replaced as well.
- As part of any future renovations replacement of the existing induction units shall be considered. Facilities have noted that occupants complain about the temperature conditions in the offices served by these induction units.

Cooling System: Based on the existing facility report dated 2009 the following systems where slated for replacement prior to 2014, and are recommended to be carried out:

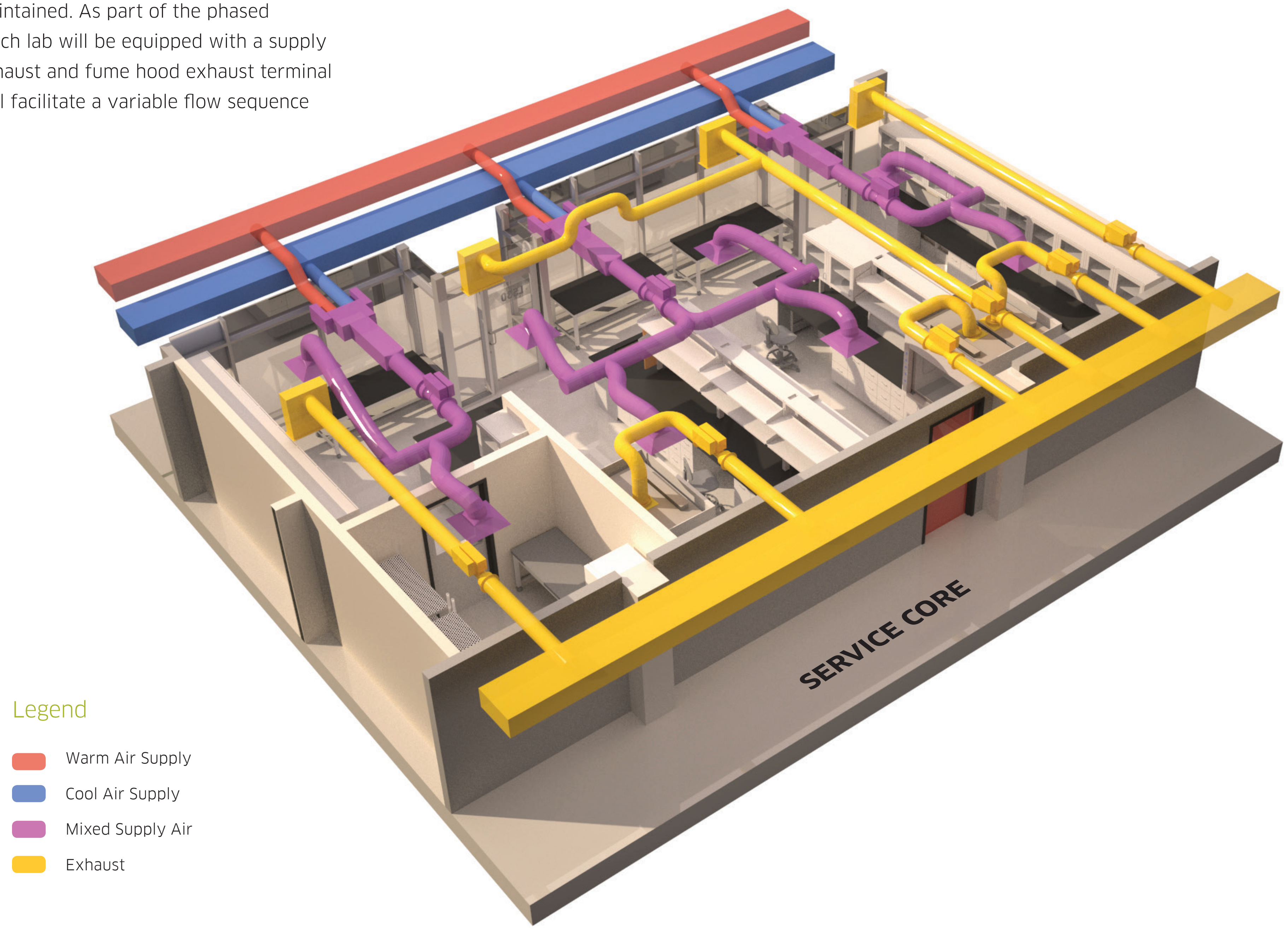
- Due to the previous use of bay water cooling, it is understood that the existing chiller condenser water tubes are in poor condition, resulting in reduction in efficiency. As the chillers are nearing the expected life expectancy of approximately 30 years and noting that the evaporator section is in poor quality, it is recommended that the replacement of the chiller system be considered. As part of any future chiller replacement, variable chilled water flow shall be considered.

Air Handlers: As part of any future renovations to the labs and office spaces it is recommend that a refurbishment of these units be carried out, this will reset the lifespan of the central air distribution system and provide another 30 to 40 years of continuous operation. The existing units date back to the original vintage of the building and are beyond their life expectancy; to our knowledge at the time of this report being published, there are no noted issues with the air handling units with the exception of no humidification capabilities. The refurbishment will take into account the required amount of supply and exhaust air for the connected spaces, and correct the issue of additional air being drawn in from the mechanical room.

Laboratory Exhaust: As part of any future renovation a centralized exhaust system shall be considered, the centralized system will consist of two central exhaust fan units installed on the roof of the mechanical penthouse. The central exhaust system will be tied into a central vertical exhaust shaft running from the 4th floor up to the roof; one serving the North Wing and another serving the South Wing. The new shafts will be constructed to comply with fume hood exhaust requirements; ductwork will be 316 stainless steel, fully welded and served by a redundant fan system tied into to emergency power. A combined fume hood and general exhaust approach will be considered to optimized shaft space utilization, and facilitate a phased lab redevelopment.

Office Terminal devices and Diffusers and Grille Recommendation: As part of any future renovations the current air distribution system should be reviewed, the existing system induction system shall by be modernized. New controls complete with new induction units shall be provided to serve the revised office layouts. The space shall be design to meet the Workplace 2.0 Fit-Up standards.

Lab Room Terminal devices and Diffuser and Grille Recommendation: As part of any future renovations the current air distribution system should be reviewed, the existing system is a dual duct variable volume system complete with constant volume return system shall be modernized as the system is currently set up for constant fume hood exhaust. Current lab design practices make use of quick response air dampers (terminal volume boxes) on the supply, general exhaust and fume hood exhaust ducts feeding each lab room. The implementation of quick response dampers will allow the system to operate in variable air flow and assure room pressure is maintained. As part of the phased renovations each lab will be equipped with a supply air, general exhaust and fume hood exhaust terminal valves, this will facilitate a variable flow sequence for each lab.



Typical laboratory exhaust design

3.7 Electrical Design

Large portions of the distribution system are quite dated. While the 600V switchboard twin switchboard in the main electrical room is relative new (dated 2009) and in good condition, it is one of the few exceptions. Many of aging distribution equipment does not directly affect the Labs on floors 4-7 but we recommend further investigation into the life cycle of these equipment.

The vast majority of laboratory panels are aging and near their end of life. Even newly renovated labs have re-used the aging electrical panels. In addition, the electrical penetrations into the service corridor block wall (for panels themselves as well as conduits) are not properly fire rated. As part of the Lab Modernization Project, we recommend removing these panel boards from the lab space and new panel boards should be installed within the service corridor where they are accessible only to maintenance personnel.

The majority of distribution dedicated to mechanical equipment are quite dated and we recommend replacing MCCs that have significant mechanical upgrades associated with them. Additionally, the Corridor panels on floors 4-7 serving the corridors and offices are aging and should be replaced. As part of office re-design to meet Workplace 2.0 guidelines, sound masking is highly recommended.

The generator and co-gen appear to be in good working condition. The majority of Critical Power Panels including the one feeding A&L are relatively new (dated 2009) and in good condition. Large portions of the Life Safety distribution system are quite dated. In order to accommodate the new central exhaust system, a new 200kW generator will be required. We recommend a packaged, fully-enclosed, outdoor unit to connect to the main 600V distribution switchgear.

PWGSC Lab Standards indicate the UPS power should be provided to accommodate essential systems. Depending on the quantity of specialized Lab equipment that requires UPS power, a UPS distribution system may need to be provided similar to the Critical Power System.

Lighting within existing laboratories is typically insufficient. We recommend a dual-prong approach to lighting design within the labs. A system of overhead lights should provide a minimum ambient level of light, approximately 300-400 lux. Another system of task lighting would then be used to supplement light levels at the work surface, up to 800 lux if needed. This setup allows for a reduced lighting power density, as the entire lab is not flooded with high intensity light but rather focused only where required.

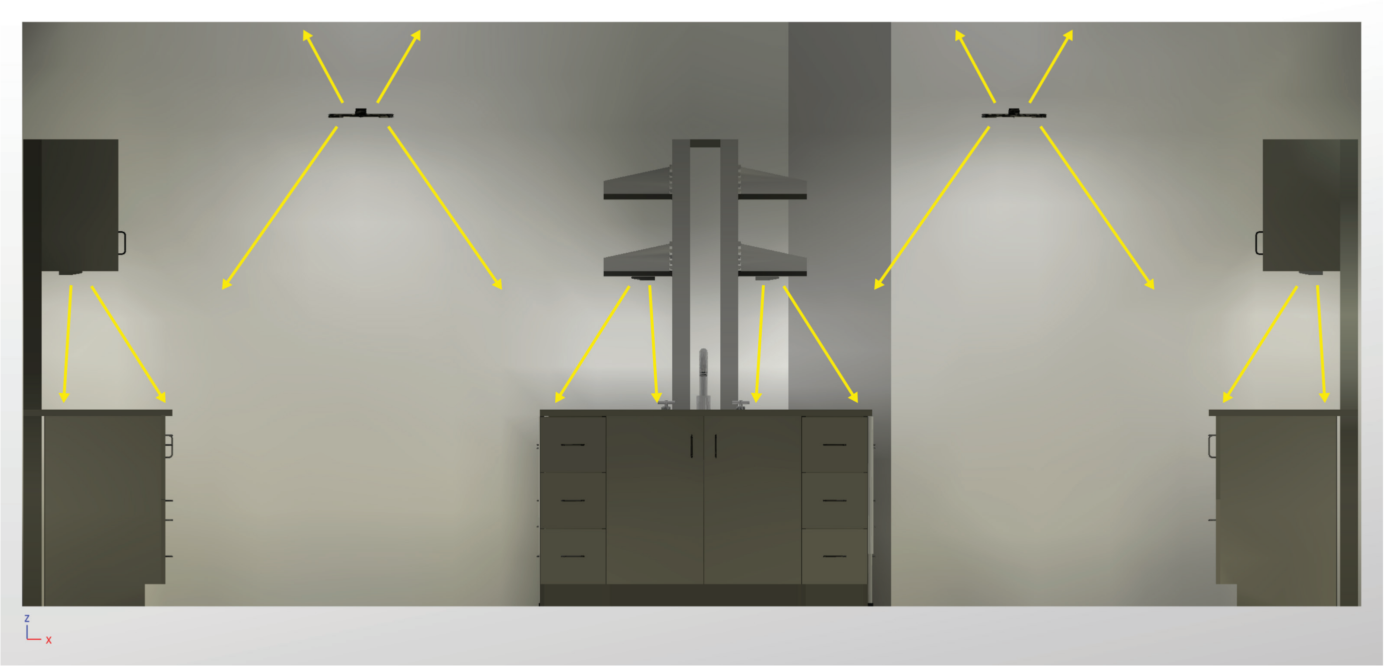
New lighting within corridors and offices should be controlled via occupancy sensors. Daylight sensors should be used for fixtures closest to the exterior glazing. Similar to the labs, overhead office lighting should be maintained at an ambient level to be supplemented with task lighting at the workstations. We recommend all new lighting fixtures to be LED type for improved efficiency and control options.

All exit lighting throughout the building is non-compliant with National Building Code 2010 and should be replaced with green running man style fixtures. Path of egress should be reviewed and exit signs provided to suit.

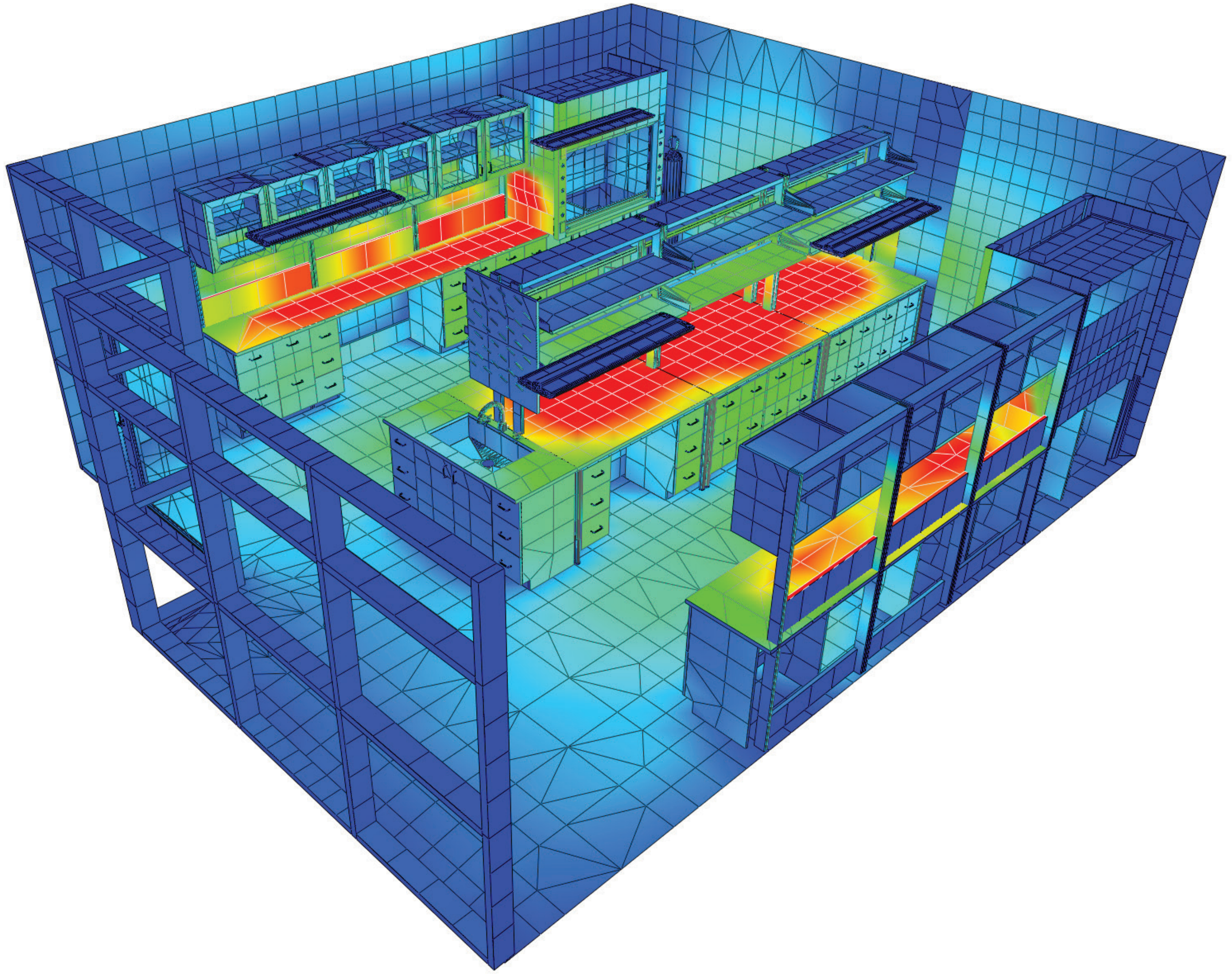
A review of the fire alarm system indicated that the Fire Alarm system was in good condition from an infrastructure perspective.

We recommend that as part of the Lab Modernization Project all LAN equipment in service corridors should be moved to a dedicated Communications closets in accordance with Shared Services Canada (SSC) requirements with a minimum of one per floor. This will allow a dedicated cooling system to provide temperature and humidity control, protect the equipment from dust/dirt, as well as increase security and improve maintenance of the IT equipment. We also recommend a cable tray infrastructure be added for the distribution of the cabling from each Communications closet to drops on the floor areas

We recommend that all labs doors be considered for upgrade to card access as per PWGSC Lab Standards. Security System requirements should be reviewed by CCIW in the context of the Lab Modernization Project.



Laboratory lighting strategy for LMP



Light Intensity Diagram of a Typical 2 Module Lab

3.8 Life Cycle Cost Analysis

As part of the Lab Modernization Process at the Canada Centre for Inland Waters DIALOG has performed energy modeling analysis and a Life Cycle Costing Analysis (LCCA).

Lifecycle Costing Analysis allows for the evaluation of multiple contemplated design options over the full service life of a project. Completing the LCCA allows the project team to choose the best project alternative, inclusive of initial costs and ongoing annual or non-annual costs.

In addition to cost savings and positive financial returns, building retrofits can provide many other benefits including better air quality, better acoustics, increased natural light, improved thermal comfort, better morale, and increased productivity. Building owners will frequently prioritize projects that result in an improved work environment to enjoy a return on their investment through a more productive work force.

A list of Energy Conservation Measures (ECMs) were selected for analysis based on their potential for saving energy consumption, operating costs and Greenhouse Gas emissions (GHGs). ECM's analyzed in the project included:

1. Central Exhaust System Upgrade: Convert the exhaust system to variable air volume with two central exhaust ducts.
2. Add Heat Recovery System: Addition of a glycol heat recovery loop to capture waste heat from the exhaust air stream.
3. Upgrade Lighting to High Efficiency LEDs: Lighting design on floors 4-7 will be revised to include high-efficiency LED fixtures.
4. Add lighting controls for occupancy and daylight: Add sensors for daylight level and occupancy to automatically control lighting.
5. Replace the existing windows: Remove the existing windows and frames and replace with a new thermally broken, high performance glazing system.
6. Add wall insulation: A 1" layer of continuous insulation will be added to improve the thermal performance for exterior walls.
7. Add VIEW dynamic glazing: Replace the high performance glass described in item # 5 with the VIEW dynamic glazing, which is electro-chromatically controlled to provide automatic shading and glare control.
8. Add air sampling system for Demand Control Ventilation in labs: Incorporate a dynamic air sampling system to monitor air quality and pollutant levels in labs. When air quality is high, baseline air change rates can be reduced to save on fan energy and heating costs.

Life cycle cost calculations were carried out using the US Department of Energy 'Building Life Cycle Cost' software BLCC 5.3. The program is developed by the National Institute of Standards and Technology (NIST) specifically to help federal government project teams assess the long term cost implications of contemplated capital projects.

Each proposed system was inputted into the software as a separate iteration to evaluate the impact on initial cost, operating costs and develop a comparative total life cycle cost.

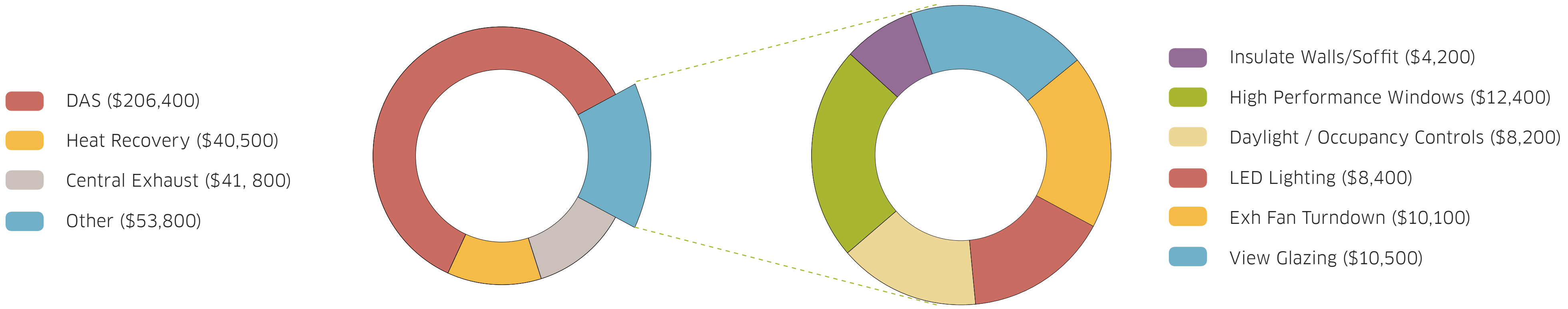
Based on the above rationale we are recommending a bundle of options including the Central Exhaust System upgrade, installation of the Heat Recovery System, high efficiency LED lighting, daylight and occupancy controls in select locations, replacement of the windows with a new high performance glazing system and installation of an air sampling system for reduced ventilation volume in labs.

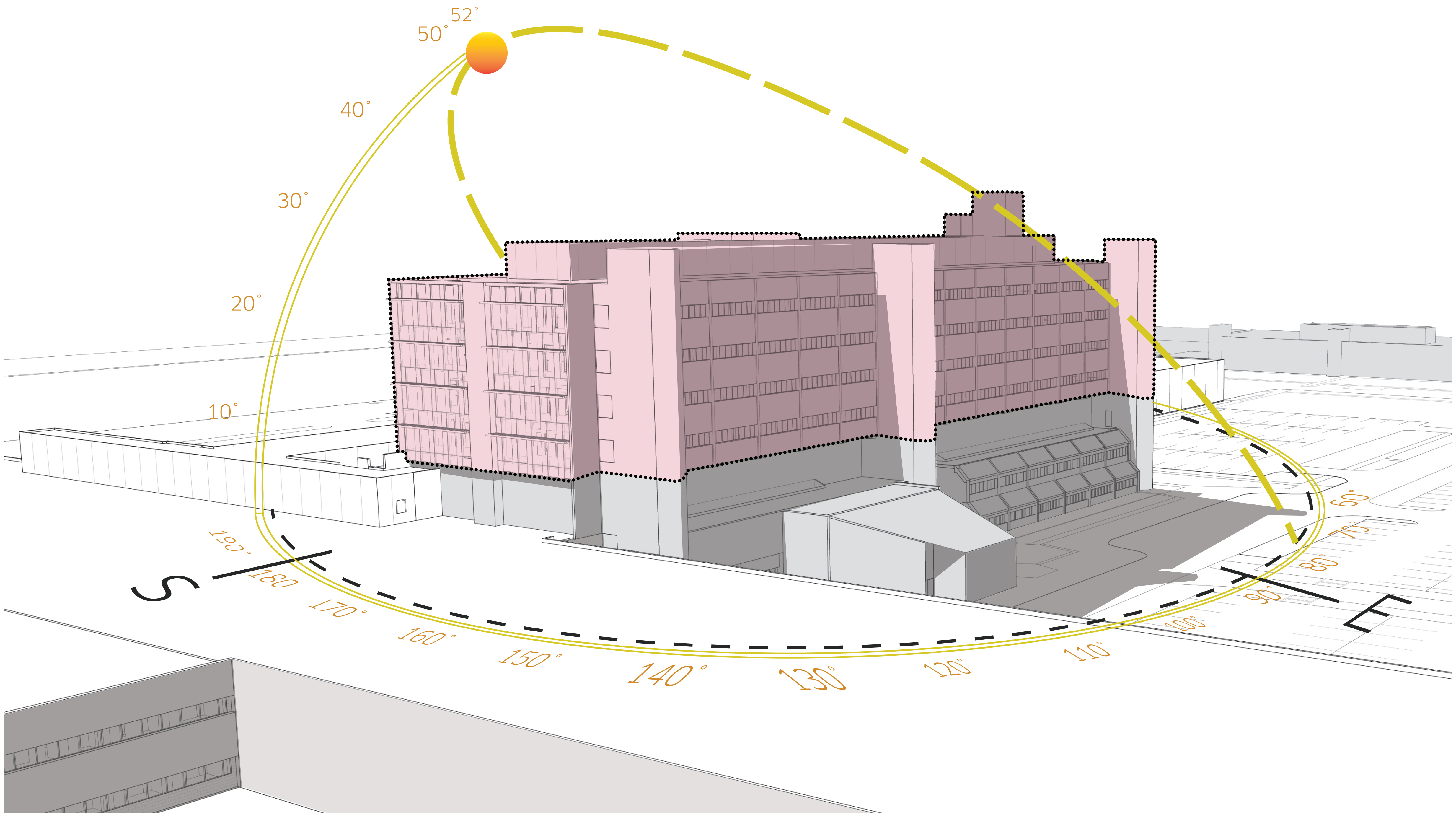
RECOMMENDATIONS

The recommended upgrades have a total initial capital cost of $4,553,295 and are predicted to generate an annual energy cost savings of $311,956 resulting in a total lifecycle cost savings of $4,339,605 with an SIR of 2.19. They are predicted to create an annual reduction of 975 tonnes of CO2 equivalent and will avoid approximately $19,500 annually in carbon emissions (assuming and offset cost of $20 per tonne).

Refer to Appendix for details of life cycle cost analysis.

Total Utility Cost Savings per ECM





CCIW with sun position diagram

3.9 Sustainability

Modernization of the CCIW Administration and Laboratory (A&L) building will be conducted with the next 40 years in mind, considering environmental and social impacts over time. The modernization of the space 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.

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.

Energy Efficiency and Greenhouse Gas Reduction

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. 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. A glycol heat recovery system is added to capture waste heat from the exhaust air. An air sampling system is planned for laboratory spaces to measure air quality and reduce Air Changes Per Hour (ACH) levels when appropriate to save on HVAC energy use.

Lighting systems are designed to appropriately balance environmental quality, safety and energy consumption. LED lighting fixtures are incorporated to further reduce lighting power and minimize lifecycle costs for replacements. Generally lighting power density targets will be 15-30% below the levels outlined in ASHRAE 90.1-2010.

The incorporation of energy efficient measures is expected to result in an annual energy cost reduction of $309,472 or 54% of the baseline energy use and create and annual GHG reduction of 968 tonnes of CO2e.

Materials and Lifecycle Impact

The LMP project be designed to maximize flexibility and adaptability in the space, configured with the next 40 years in mind. 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.

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. Contractor waste tracking will be required to ensure that a waste diversion rate of over 75% is achieved.

Materials selection will prioritize the use of products with Environmental Product Declarations (EPDs) and Health Product Declarations (HPDs) available, minimizing environmental and human impact.

Top – Reduced materials impact
Middle – Enhanced indoor environment
Bottom – Reduced water consumption

Indoor Environmental Quality

Healthy buildings contribute to occupant well-being 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.

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 (including SCAQMD, Green Seal, CRI, Green Guard, and BIFMA).

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.

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, providing water use savings for everyday use such as hand washing and food preparation.

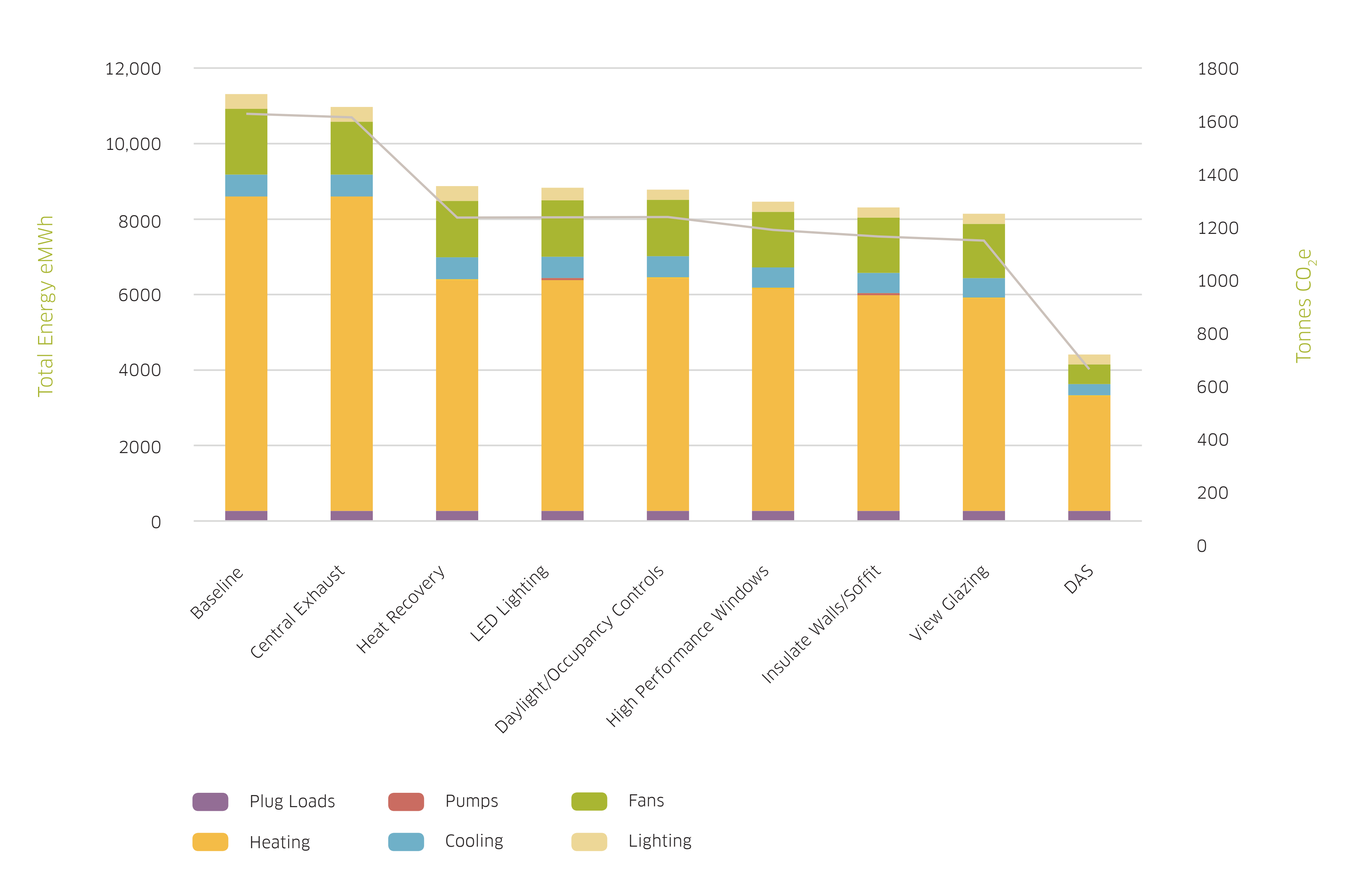
Water use measurement and reporting can be a useful method of reducing water consumption – similar to an energy reporting and occupant engagement program, communications of water consumption may stimulate savings based on user behaviour.

Based on these measures we predict a 40% annual savings in potable water use.

Rating Systems and Benchmarks

The LEED certification program (Leadership in Energy and Environmental Design) has gained widespread popularity for its marketing appeal and recognition amongst the general public.

The LMP project is eligible to achieve certification under LEED Canada for Commercial Interiors (LEED-CI) rating system with a certification level of LEED Silver or LEED Gold certification. LEED Platinum is possibly achievable however additional measures and/or additional costs may be required.



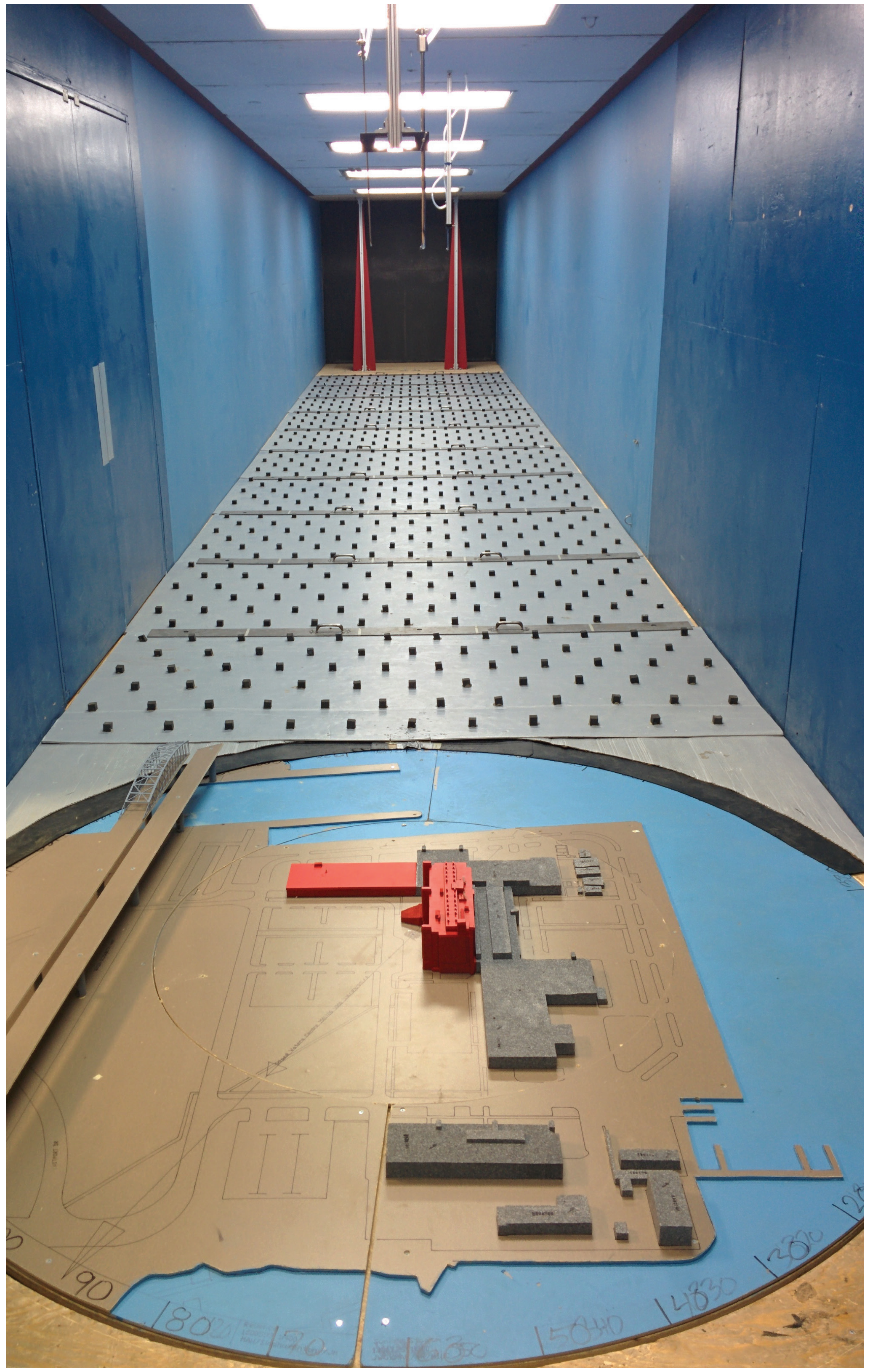
Energy and GHG reduction

3.10 Wind Tunnel Analysis

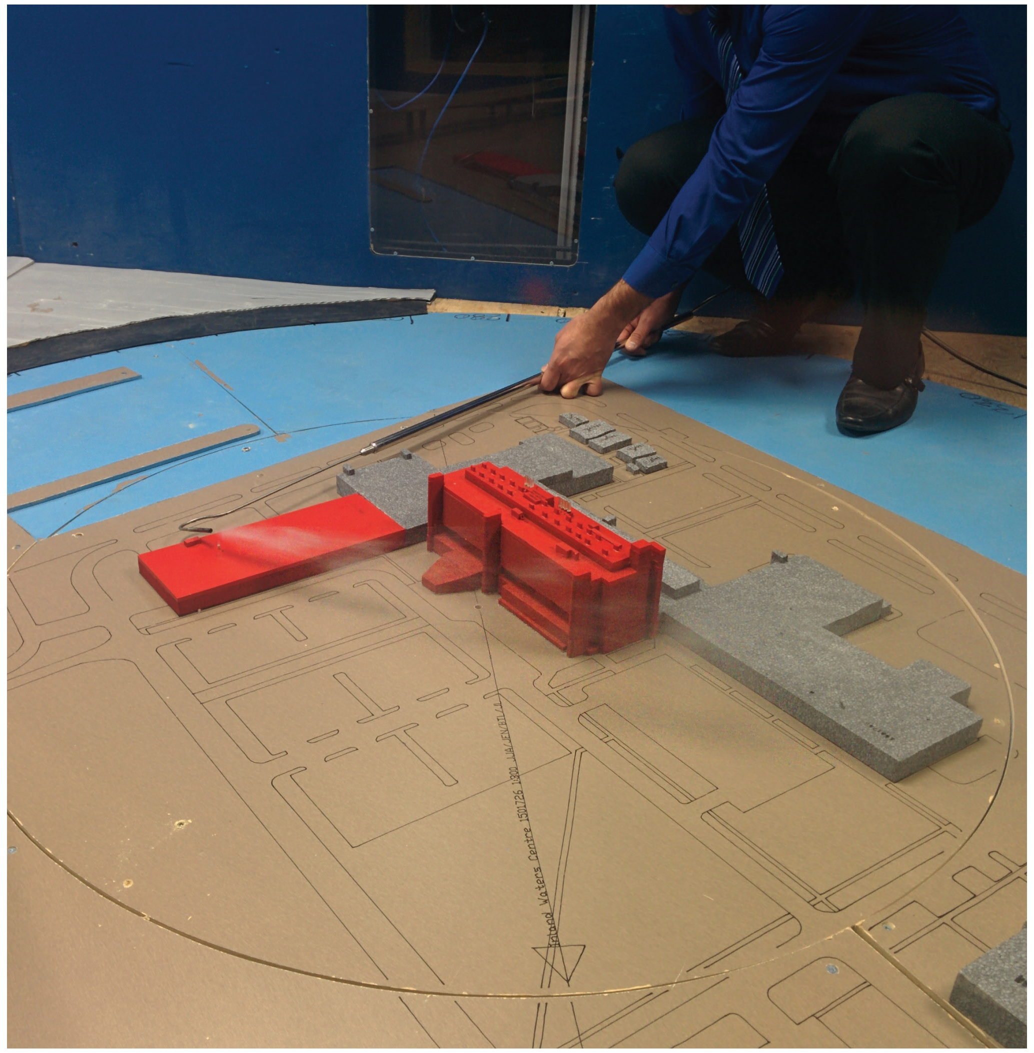
A wind tunnel exhaust dispersion study was performed for the proposed Canadian Centre for Inland Waters (CCIW) Laboratory Exhaust System Upgrade in Burlington, ON. Testing was completed on a 1:300 scale model of the site and surroundings in one of RWDI's boundary layer wind tunnels. Exhaust sources evaluated included the proposed north and south centralized manifolded laboratory fume hood exhausts on the Administration and Laboratory (A&L) Building. The objective of the study was to optimize the required discharge stack heights for the new central exhaust systems proposed as part of the LMP modernization project. The study focused on establishing the recommended discharge stack height to mitigate air entrainment back into the building intakes. Below is a summary of the findings.

- A&L North Centralized Laboratory Exhausts: The minimum recommended stack height for the
- desired turndown flow rate conditions (30% flow of the total fan flow) is 5 ft above the main
- penthouse roof.
- A&L South Centralized Laboratory Exhausts: The minimum recommended stack height for the
- desired turndown conditions of 30% flow is 6 ft above the main penthouse roof.

The study provides the optimal stack height configuration which results in reduction in operating system energy, given that calculations confirm the ability to turn down the system as low as 30% without the need for a supplemental fan booster to increase the stack discharge velocity under these reduced exhaust conditions.



RWDI model in wind tunnel



Refer to appendix for details of RWDI's exhaust entrainment analysis.

3.11 PHASING STRATEGY

Challenges & Strategies: Phasing & Accommodation

The most essential task in the planning process is to communicate with CCIW staff and users early on. This helps establish acceptance for the plan and lessen staff turmoil.

The Phasing & Accommodation Plan will try to undertake renovation in the largest area possible. In general, wherever possible the plan will take out as large an area as possible, including full floors or wings which can constitute a phase. This allows for a discrete boundary between occupied space and construction areas. Issues to be addressed include noise, dust, disruption of engineering system, maintaining of safe egress paths etc

The Phasing & Accommodation Plan will be set up with logical breaks in work areas, such as intersecting corridors, zones and solid walls, elevator cores, shear walls or fire partitions as opposed to more easily demolished partitions.

The goal of the Phasing & Accommodation Plan is to minimize the impact to adjacent areas and to localize and compartmentalize work so that other areas are not unexpectedly affected.

The ultimate phasing strategy will be to try and arrange the renovations so most users will only need to relocate once, although some users will likely have to move into temporary accommodation until sufficient new lab areas are completed, but this will be offset because they will be the first to be 3 accommodated in a new lab and should not have to move again during the LMP.

A phased renovation will add costs to a project but doesn't add any value to the end product so the goal is to minimize the 'throw-away' costs for the completed project. These costs come from extended General Conditions and from the cost of creating temporary measures to ensure life safety, access and continuity of services to the occupied areas. Swing space can be hard to find, so it is important that all users understand and be as flexible as possible during the renovations.

For the LMP project, the phasing is accomplished by constructing the new areas in Block A first. These new areas along with Block 5B are then occupied, making the vacated areas available for renovation, block by block. This process of construction, renovation, occupying and vacating is done until all areas are completed. This process creates "swing space" that allows for leap frogging from construction to occupied space.

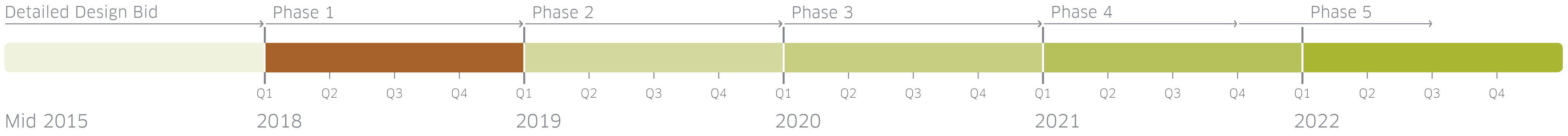
The LMP will use a modular approach to speed installation and reduce time on site. This approach is two-fold. First, using a modular layout for laboratory design as much as possible establishes economy and speeds fabrication time. Second, by prefabricating much of the work off site to a set modular dimension, the contractor's time on site can be reduced.

Work should be phased to minimize demobilizing and re-mobilizing trades. Work should be planned ahead so that when trades are established on site they can continue to work as delays are more likely to occur in bringing trades back to the site. The best case is if a swing space can be established for the duration of the project, which eliminates multiple setups and takedowns.

If the project is undertaken by a Construction Manager, consideration for ordering long lead items during the early stages of the project should be considered allowing materials and equipment to be on order and available when required

The Phasing & Accommodation Plan will try to accommodate existing lab users wherever possible by consolidating functions on floors 4 to 7, utilize existing spaces without renovating, adjusting work patterns or time of work to reduce space needs, find available space in other areas of the CCIW, and lastly, generate swing space on-site by commissioning temporary laboratory space.

The Phasing & Accommodation Plan will try and facilitate the LMP phasing by reducing the amount of local swing space required to host the labs within the LMP scope. This may be achieved by identifying laboratories that are under-utilized and those which can be amalgamated within other lab space without detrimentally impacting either's workflow patterns. Some laboratories have areas area devoted to storage usages, which suggest they are under-utilized and may be able to be amalgamated with other laboratories during the LMP. Laboratories with critical functions such as accredited analytical laboratories or Bio Safety must be accommodated with similar facilities during the LMP.



Start of Phase 1 - Floors 4, 5, 6, 7

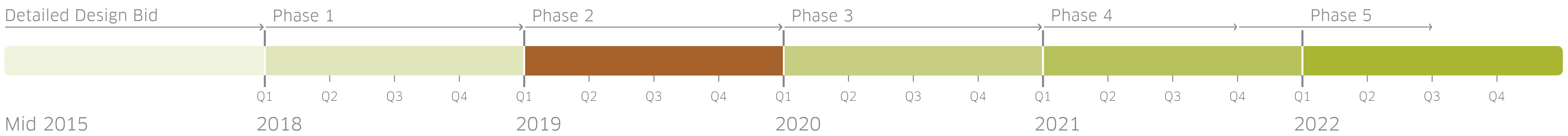
End of Phase 1 - Floors 4, 5, 6, 7

Phase 1

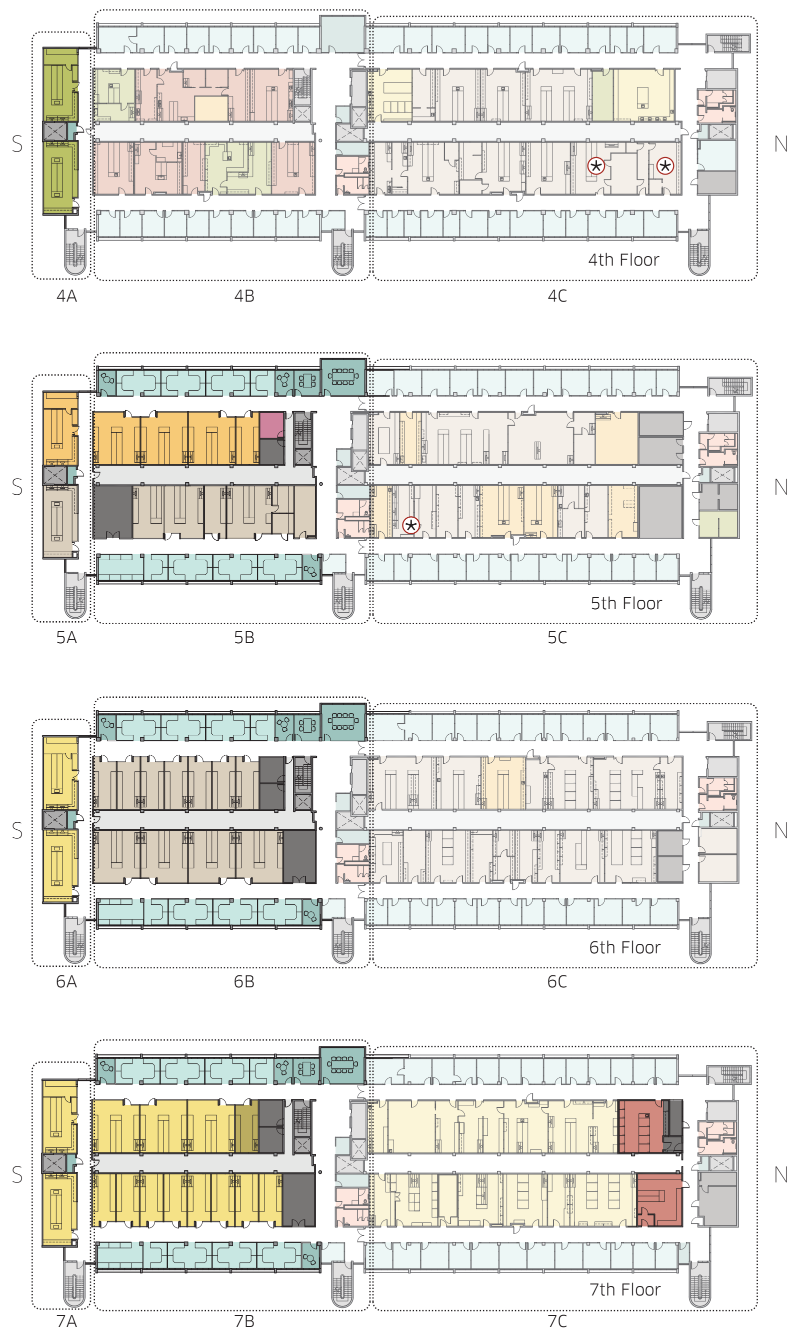
START Q1 2018 to end Q4 2018. Vacate south end offices on floors 4 to 7-Blocks 4A, 5A, 6A & 7A, provide temporary labs in A&L Existing, Warehouse, WTC and Hydraulics (require approximately 300m² of swing space in existing facilities). When swing space is available, vacate Block 5B (ACRD, WQMS, WHERD - approximately 400m² of existing labs); 380m² + 460m² of new lab space will be available at start of Phase 2.

Legend

(*) Denotes certified Biosafety/ Laboratories (BSL or CALA) that will require additional coordination for inclusion in phasing



Start of Phase 2 - Floors 4, 5, 6, 7



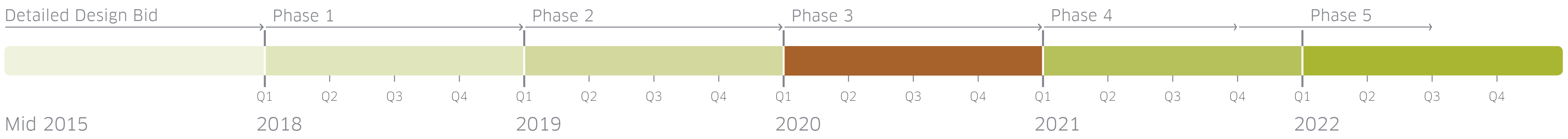
End of Phase 2 - Floors 4, 5, 6, 7

Phase 2

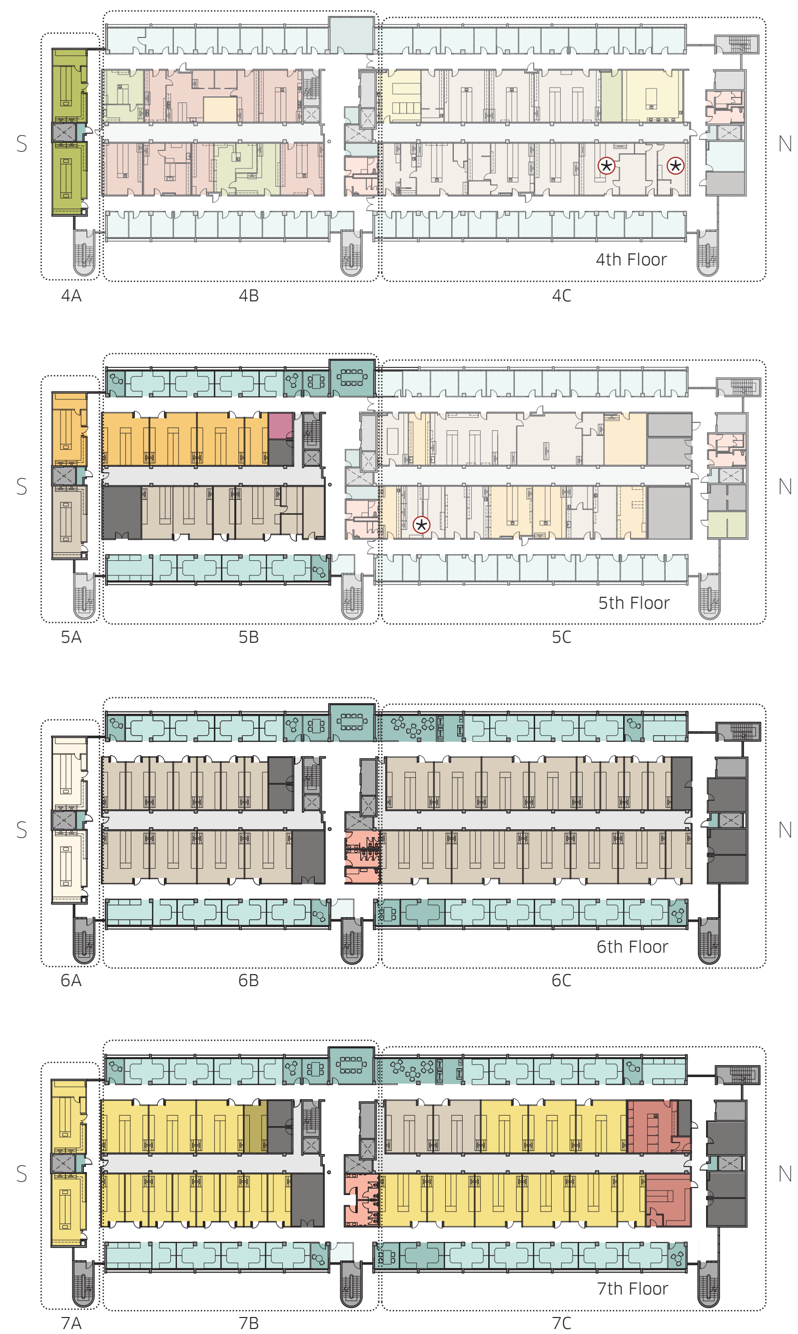
START Q1 2019 to end Q4 2019. Block 6B (WHERB) moves to Block 5B; EOALRS occupies 6th & 7th floor new South Lab Block 6A and 7A; WHERD occupies 5th floor South Lab Block 5A; ACRD occupies 4th floor South Lab Block 4A in 2017 Q4. Block 6B and Block 7B are vacated and demolished; Block 6B (WHERD) has moved to Block 5B and Block 7B. (EOALRS) occupies new South Labs Block 6A & 7A and modulars, Warehouse or Hydraulics as required; 840m² + 920m² of lab space will be available at start of Phase 3.

Legend

⊛ Denotes certified Biosafety/ Laboratories (BSL or CALA) that will require additional coordination for inclusion in phasing.



Start of Phase 3 - Floors 4, 5, 6, 7



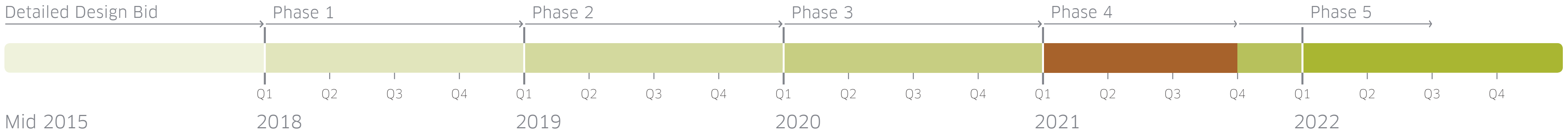
End of Phase 3 - Floors 4, 5, 6, 7

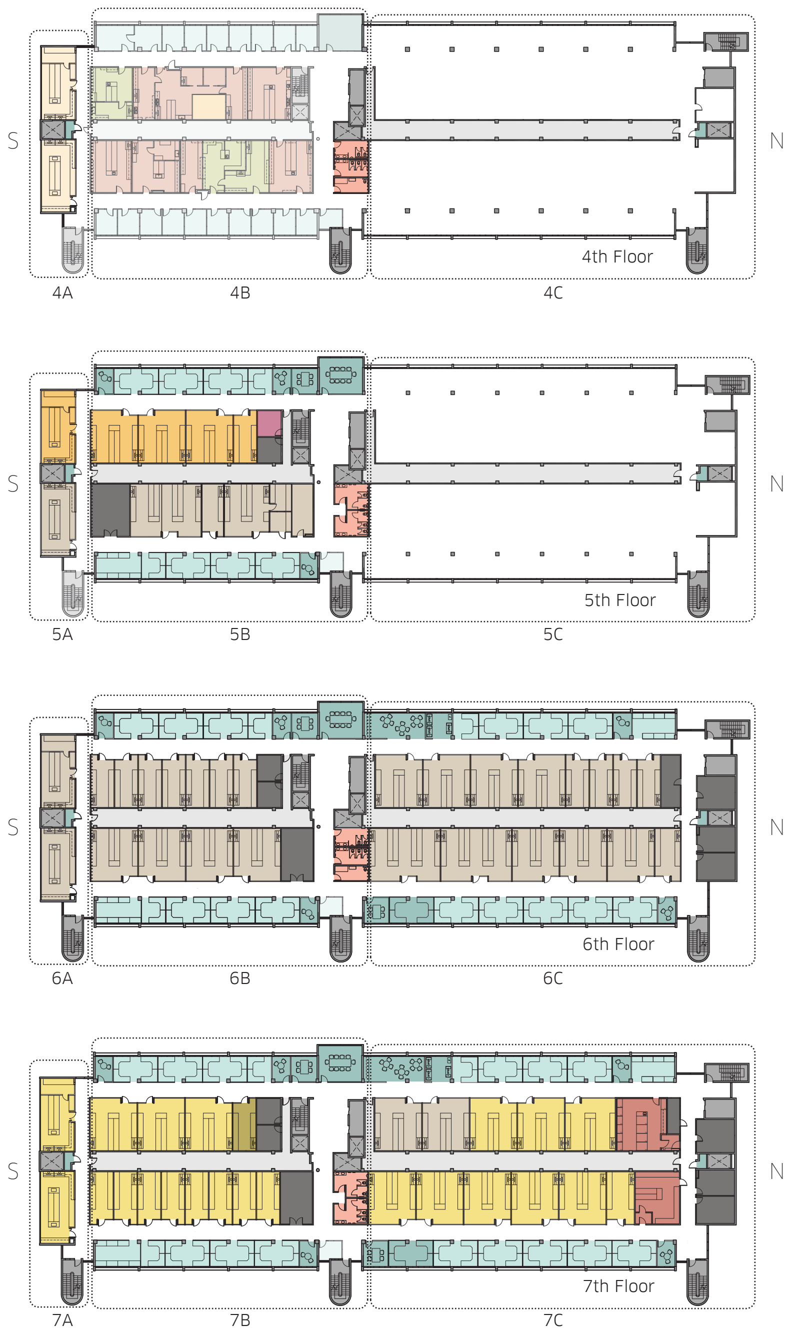
Phase 3

START Q1 2020 to end Q4 2020. Block 6C (ACRD) moves from north end to Block 6B; Block 7C (EOALRS) moves from north end to Block 7B; when Block 6B and 7B are occupied, demolish Block 6C and Block 7C and start North Central Exhaust System; start renovations of Block 6C for ACRD move from Block 5C and backfill of Block 7C EOALRS from Block 4C and swing space; 1760m² + 1200m² of lab space will be available at start of Phase 4.

Legend

⊛ Denotes certified Biosafety/ Laboratories (BSL or CALA) that will require additional coordination for inclusion in phasing





Start of Phase 4 - Floors 4, 5, 6, 7

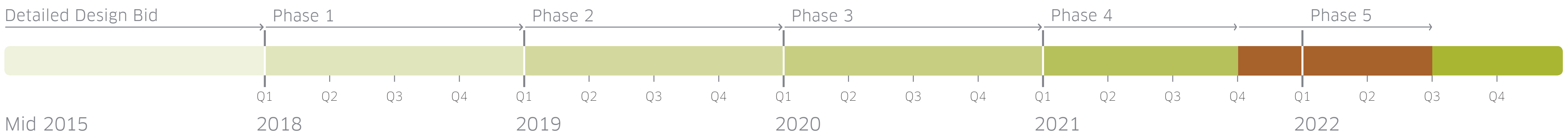
End of Phase 4 - Floors 4, 5, 6, 7

Phase 4

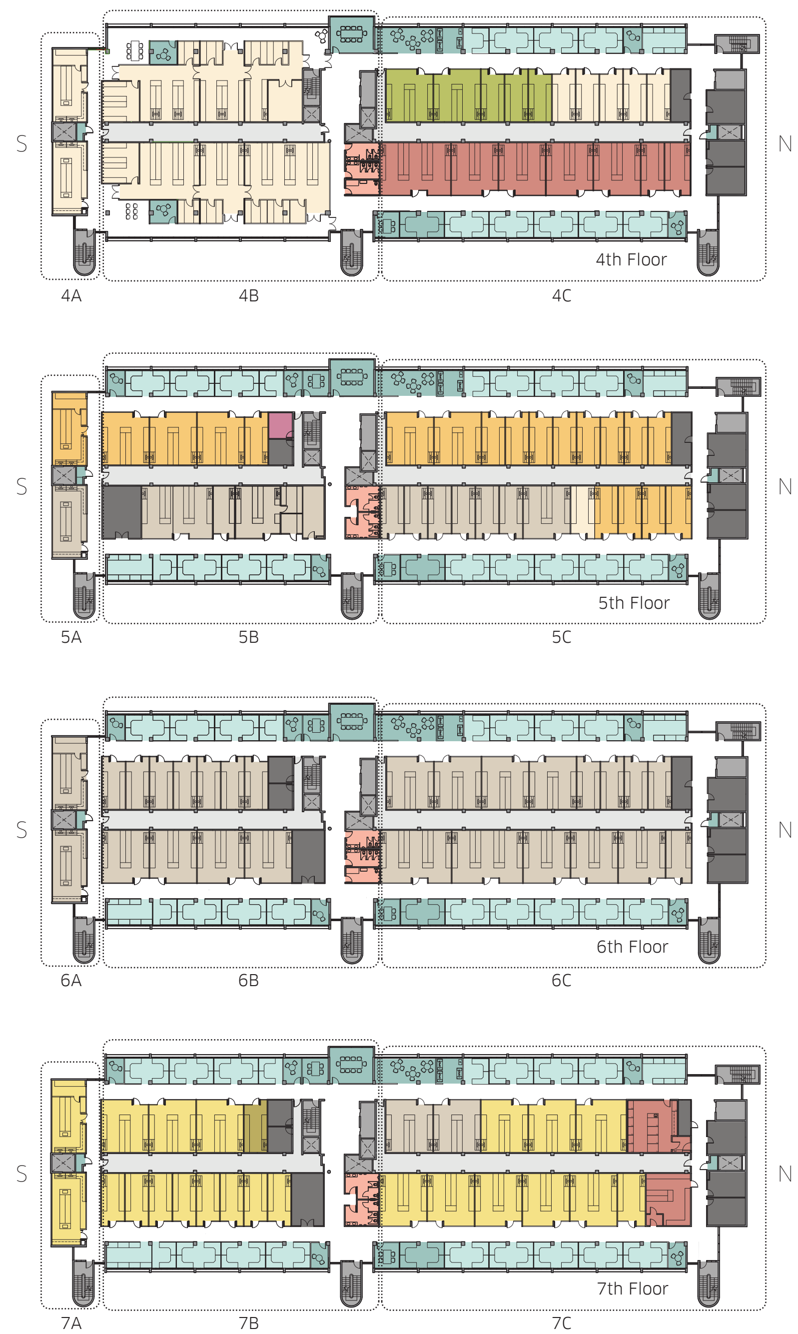
START Q1 2021 to end Q3 2021. Block 6C (ACRD) is filled with Block 5B (ACRD); Block 7C (EOALRS) is filled from Block 4C and swing space labs throughout CCIW (EOALRS moves complete at Q4 2019); when Block 6C and Block 7C are occupied, demolish Block 4C and Block 5C. Start renovations Block 4C for DFO & WQMS and Block 5C for ACRD and WHERD; 2960m² + 1200m² of lab space will be available at start of Phase 5.

Legend

Denotes certified Biosafety/ Laboratories (BSL or CALA) that will require additional coordination for inclusion in phasing



Start of Phase 5 - Floors 4, 5, 6, 7

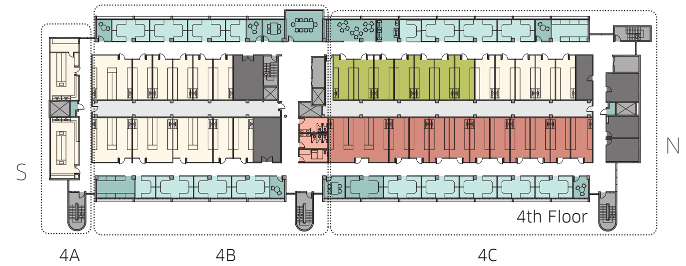


End of Phase 5 - Floors 4, 5, 6, 7

Phase 5 (Option 1)

START Q4 2021 to end Q2 2022. Block 4C is filled from Block 4B (DFO & WQMS) and Block 5C is filled with ACRD from Block 4C; when Block 4B is vacant demolish and complete new Laboratory Suite start of Q2 2022 to end Q4 2022. At the end of Phase 5 4,160m² + 450m² of lab space will be available. Refer to appendix for full analysis of Phasing Strategy.

Phase 5 (Option 2)



The phasing for Option 2 and Option 1 are identical, apart from the implemented design of the south half of floor 4. The above plan depicts the 4th floor layout of Option 2.

Phase 5 (Option 3)

The phasing strategy for Option 3 would generally follow the plan depicted here, however the many existing labs that are noted to remain would add an additional level of complexity. As such, Option 3's Phasing Strategy would require a more thorough review in the detailed design stage.

Legend

⊛ Denotes certified Biosafety/ Laboratories (BSL or CALA) that will require additional coordination for inclusion in phasing.

4th floor laboratory suite rendering (from corridor)

3.12 Construction Cost Estimates

The Construction Cost Estimate for the Design Concept has been developed by Hanscomb Ltd. and is intended to provide an assessment of the total project costs associated with the Laboratory Modernization Plan of the Canada Centre for Inland Waters in Burlington, Ontario as illustrated in the Design Concept Report. Accordingly, this Cost Estimate should only be considered within the full context of the above noted documentation. The Cost Estimate is based on the work required to undertake the modernization of the laboratories, office and common areas on floors 4 to 7, as well as limited upgrades to the existing mechanical and electrical systems serving these floors. The cost estimate are not intended to accommodate other work which is beyond the scope indicated in the Design Concept plans and reviews.

Methodology

Generally, the areas of work projected by the Design Concept are estimated using parametric quantities and unit rates considered appropriate for a project of this scope and nature. Costs reported in these estimates provide for all building construction and include related exterior work, allowances for Furnishings & Equipment and Professional Fees & Expenses. Provision has also been made where appropriate for such things as building demolition, site access, mobilization and staging areas.

Construction Phasing

Allowances have been made to cover premiums for phased construction and decanting of staff including reasonable provision of temporary swing space during the renovations in accordance with the Phasing Strategy of five distinct phases indicated in Section 3.10. It should be noted that this element of planning has not yet been completely developed and will be contingent upon more detailed design of laboratories and the phasing strategy which is ultimately agreed to. An extended phasing strategy would likely incur additional general conditions while more compressed phasing would incur additional costs to provide suitable swing space for laboratories and offices and the resultant throw away costs.

Cost Considerations

The cost estimates are based on a Construction Management approach with competitive bids for sub-trade contractors and suppliers being received amd negotiated. Pricing shown reflects probable costs obtainable in the Hamilton area on the effective date of this report and is therefore a determination of fair market value for the construction of the work and not a prediction of the final costs.

Option 1

1. **Total Construction Cost (2015):** $ 31,800,000
2. **Post Contract Cost:** $1,590,000
3. **Ancilliaries:** $6,360,000
4. **Furniture, Fixture & Equip/IT:** $2,400,000
5. **Current Project:** $42,150,000
6. **Escalation:** $4,400,600
7. **Escalated Project:** $46,550,000

Option 2

1. **Total Construction Cost (2015):** $ 32,600,000
2. **Post Contract Cost:** $1,630,000
3. **Ancilliaries:** $6,520,00
4. **Furniture, Fixture & Equip/IT:** $2,400,000
5. **Current Project:** $43,150,000
6. **Escalation:** $4,500,000
7. **Escalated Project:** $47,650,000

Option 3

1. **Total Construction Cost (2015):** $ 31,200,000
2. **Post Contract Cost:** $1,560,000
3. **Ancilliaries:** $6,600,300
4. **Furniture, Fixture & Equip/IT:** $2,400,000
5. **Current Project:** $41,760,000
6. **Escalation:** $4,350,000
7. **Escalated Project:** $46,110,000

3.13 Procurement Strategy

The Laboratory Modernization Plan for the CCIW A&L Building is expected to be a multi-year project which is contingent on long term capital funding. The timing of the program will be determined based on how the project is ultimately funded. At the present time it is unknown what the proposed funding horizon would be and whether a long term budget will be established or whether the modernization will be funded on a year to year basis. 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 may 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 LMP will 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 the Feasibility Study Phase for the LMP a number of design and costing options were developed so that the client would be in a position to determine how to proceed with the LMP and over what timeline based on funding. The options were reviewed and the pros and cons of each were considered. Some of the factors which were considered in order to develop the proposed procurement strategy include:

- Maintenance of on-going operations
- Ability to meet Environment Canada Strategic Plan 2014-2019
- 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

Of the options considered it was determined that a PWGSC Managed - Construction Management procurement strategy would provide the most benefits to the client. 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 construction manager 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 Fire Protection or Central Exhaust System. This type of procurement would allow for the most interaction between the existing laboratory users and the design team and provide planning horizons for researchers which have to be accommodated in temporary or finished laboratories as they are completed. The factors which were considered to develop this strategy include:

Pros

- LMP project could be fast-tracked
- CM firms provides coordination & flexibility in contracting and procurement
- Transparency of bid process and selection of qualified sub-contractors
- 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 LMP progress would be dependent on experience and skill of the CM and PWGSC oversight

A key to the successful delivery of the LMP is selecting experienced design and construction teammates committed to an integrated partnership. The design and construction teams must have dedicated, "hands-on" personnel in order to provide real-time feedback on design, cost and schedule issues as the project progresses. The project team should be able to identify the key issues such as decanting existing laboratories to temporary or new spaces, develop a range of potential solutions and quickly make decisions allowing progress to continue unimpeded. On complex lab projects, the procurement will be successful through a well-integrated team.

In order to meet the goals of the LMP, it is essential that the construction manager develops an extremely detailed schedule very early in the design process based on experience on similar projects.

Another key component of a successful procurement strategy will be material and equipment selection to expedite the procurement of long lead items such as laboratory casework and mechanical equipment and to identify in the schedule a plan for phasing of separate bid and permitting packages early and commitments to meet this plan.

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