DIALOG®

Canada Centre for Inland Waters Administration and Laboratory Building Laboratory Modernization Plan (LMP)

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Environment Canada

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Investigation and Report

Public Works and Government Services Canada

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Contents

1 Executive Summary

Report Purpose: The purpose of this Investigation and Report is to undertake a thorough review of the Administration & Laboratory Building of the CCIW as part of a Laboratory Modernization Plan (LMP). The investigation is intended to examine all components of the building, including laboratory equipment, building structure, building envelope, interior finishes, mechanical and electrical systems and conduct a building code review. The investigation and subsequent report was restricted to Floors 4 to 7, although other areas were reviewed in order to gain an understanding of how the systems worked. The report includes a general Building Condition Assessment which can be used as the basis of a recapitalization plan for the Laboratory components on the Levels 4 to 7 of the building.

Background: The CCIW, as one of 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 facilities have undergone some upgrades in the past as Environment Canada.

The Investigation Phase was undertaken by an evaluation team, including structural, architectural, mechanical and electrical disciplines. During the field work for the investigation of Nov. 4th and 5th the evaluation team was able to visit all areas of the A&L Building including laboratories and mechanical spaces.

The Investigation determined that while the existing facilities have been maintained in an acceptable manner considering the age and use of the facilities, there are a number of areas which should be addressed on an on-going basis and as part of a LMP. In accordance with the Investigation mandate, many of these relate specifically to Floors 4 to 7, but there are other areas outside the immediate scope of work for this project that should be considered. The items which are more critical include a number of life safety and accessibility issues which are illustrated in Section 4 under Building Code Review and Section 5 under Barrier Free Accessibility. A number of mechanical an environmental issues have been indicated under Section 3.4 and electrical conditions under Section 3.5. Recommendations are indicated at the end of each section.

2 Introduction and Assignment

2.1 Introduction

DIALOG was engaged by Public Works and Government Services Canada (PWGSC) on behalf of Environment Canada (EC), to undertake an investigation and prepare a report for the building condition assessment as part of the Laboratory Modernization Plan (LMP) and recapitalization of the Administration and Laboratory Building (A&L) of the Canada Centre for Inland Waters (CCIW).

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.

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

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

1. **Administration & Laboratory (A&L)** – A seven storey building housing the main facility entrance, administrative offices, cafeteria, kitchen, auditorium, library, offices, laboratories. The majority of the laboratories are located on floors 4 to 7 with approximately 3,000 m^2 on each floor (Labs at 1,400m^2 and Office and Common Areas at 1,600m^2). These floors are generally arranged with the laboratories backing on a central service core with staff offices located on the building exterior. The Service Core which contains the plumbing, piping, drainage, and fume hood exhaust risers to the penthouse are centrally located on each floor and back on to the laboratories. The Mechanical Room serving the A&L is located on the 3rd floor and the fume hood exhaust fans and stacks are housed in the Penthouse located above Floor 7.
2. **Research & Development (R&D)** – A two storey building housing offices, 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.

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.

2.2 Site Investigation Methodology

Site review of the existing A&L Building conditions was conducted during the period of November 4 and 5, 2014. The site reviews were undertaken by all members of the evaluation team, including structural, architectural, mechanical and electrical disciplines. During the site investigation of Nov. 4th and 5th the evaluation team was accompanied by Mr. David Dautovich, P. Eng., Project Leader for Environment Canada who provided access to laboratory and common spaces on floors 4 to 7; the Ground Floor Mechanical and Electrical Rooms, the Third Floor Mechanical Rooms as well as the Rooftop Mechanical Penthouse. There were four laboratories (L451, L551, L662 & L684) that were not accessible due either to operational requirements or different keying.

Representatives from DIALOG who participated:

- Kelly Menier, Architectural Technologist
- Raza Tanveer, P Eng. Electrical Engineer
- Daria Khachi, P Eng Structural Engineer
- Raul Dominguez, P Eng. Mechanical Engineer
- Andre O'Neill, EIT, Mechanical
- Robert Northcott, Architect and Project Manager

All assessments and comments are based on visual inspection of observable building elements. No cutting or testing was conducted. 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 visual 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 investigation team's assessment is limited to those elements exposed to view within the portions of the building reviewed.

2.3 Background Documentation

The following documents have been made available to the Investigation Team by PWGSC and were reviewed in preparation of this report:

a) Existing 'As-Built' Constructions Documents dated 1970 prepared for the original construction. (Approximately 200 drawings).
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 prepared by Federal Fire Commissioner, dated March 2011
f) Fire Protection Report prepared by Leber/Rubes Inc., dated November 15, 2013
g) Building Condition Report prepared by PWGSC, dated September 2009
h) Administration & Laboratory Central Exhaust System Study, Filer Engineering Ltd, July 2013.

The investigation compared the "As-Built" Construction drawings with the existing conditions and updated the current floor plans attached to this Report to reflect these conditions. In general, it is understood that with the exception of renovations to approximately 15-20% of the laboratories, most of the rest of the areas in question remain generally as originally constructed. There have been renovations to some washrooms on each floor in effort to make a reasonable accommodation for accessibility. Some offices and corridors have received cosmetic upgrades, new floor finishes and ceiling tiles. In addition, as will be noted in the Mechanical and Electrical reviews to follow, there have been some upgrades or renovations of existing climate control as well as lighting. The plans attached to Appendix 2 of this report indicate the current layouts of the Floors 4 to 7 as well as the locations of laboratories that have undergone renovations from the original construction.

2.4 Mandate and Objectives

The purpose of this 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. The investigation and subsequent report is generally restricted to Floors 4 to 7, although members of the evaluation team also reviewed the Ground, Third Floor and Rooftop Mechanical Penthouses to gain an understanding of how the systems worked. 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, with permission from the departmental representative, 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 items are not part of the scope of work for the LMP although they will be taken into account in the phases to follow:

a) Study and Planning for air handling units, roofing, and building envelop
b) Sprinkler Study
c) Study and Planning for Central Exhaust Systems, however, review of Filer Engineer Ltd.'s report is required
d) Life Cycle Cost Analysis

It should be noted that while the Scope of Work for the Laboratory Modernization Plan of the A&L Building is restricted to Floors 4 to 7, the understanding and recommendations contained in this report will take into account other areas that are peripheral to and associated with the laboratories where they would have an impact on the long term modernization and operation of the A&L.

2.5 Other Related Projects

It is understood that a number of other projects, studies and investigations are currently underway or have been completed in the A&L Building or on the CCIW Campus. These projects may have an impact on the current Investigation and subsequent Report and Concept Design Phase to follow. The following information has been provided by PWGSC:

a) Fire Protection Studies in Planning – procurement of consultant
b) Laboratory Exhaust System Upgrade in Planning Phase - RFP
c) Lab L760 (Ultra Trace Lab with a new rooftop AHU) in Design Phase with construction to be completed in Oct 2015.
d) Library on 2nd floor in Construction Phase – PWGSC project; 90% complete; furniture delay
e) AHUs inventory – currently being reviewed and summarized by Filer Engineering, to be completed by the end of December 2014
f) Emergency Power Study – to be finished by the end of December 2014
g) Replacement of System 3 Switchgear – Construction will begin in April 2015 and finish in May 2015.

Where required, this Report and subsequent Feasibility Study and Concept Design will reference and acknowledge the impact of these studies as part of the Laboratory Modernization Plan and make recommendations which could impact the plan.

3 Building Assessment

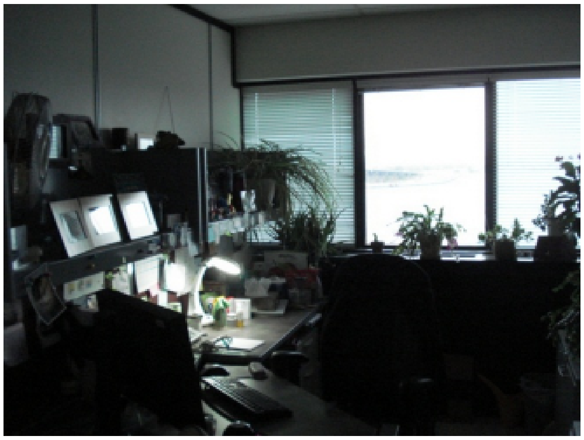
3.1 Architectural

3.1.1 Functionality of Building Layout

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 freight elevator. The first and second floors house the main building entrance and security desk, administrative offices, cafeteria/kitchen, auditorium and 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 standard design of the era with perimeter offices and interior laboratories which back on to service cores. A corridor extends around the perimeter of each floor and separates the offices from the laboratories. Each of the laboratory floors are divided into a North and South wing and serviced by the five Stairs and 3 Elevators. (Refer to Appendix 2). In addition to the laboratories for the A&L Building there are additional labs and research areas located on the 1st and 2nd floors of the Research & Development (R&D) as well as the Hydraulics Lab. These are connected to the A&L by the closed 2-storey area, referred to as the Mall which interconnects the A&L, R&D, Hydraulics Lab and Warehouse structures at the 1st and 2nd floor levels via 5 open circulation stairs. The footprint of this structure (A&L/Mall) is approximately 3247 m^2.

The floors 4 to 7 labs occupy approximately 1,400m^2 per floor with office and common areas occupying approximately 1,600m^2. There are approximately 115 designated laboratories on the 4 floors and are fairly evenly distributed and range from 25 to 31 labs per floor, although it is understood that a number of these are only being utilized 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. These floors are generally arranged with the laboratories backing on a central service core with staff offices located on the building exterior.

A-Figure 1 Typical Lab



A-Figure 2 Typical Office

A-Figure 3 Typical Service core

A-Figure 4 Typical Corridor

The offices which are located separately from the Research and Analytical Labs on each floor are located on the building perimeter. The offices and other support spaces are typically configured in a 1 or 2 per 6.3m bay size to correspond to the structural grid with demising walls located on a column or window mullion. It is apparent from a review of the original construction drawings that a number of the current offices have been demised and sub-divided from larger offices. The depth of the offices is typically 3.2m from the corridor demising wall to the face of the exterior glazing. The area of a typical office would be approximately 11.2m^2, although these vary from 8m^2 to 15m^2. It is understood that while many offices are located in reasonable proximity to related laboratories, a number have been assigned based on availability. The size and locations of offices and special support spaces will be reviewed against the Workplace 2.0 Standards in the Functional Programming and Concept design Phases to follow. It is understood from discussions with Environment Canada and DFO staff that the existing high-walled offices are strongly favoured and this will be a topic of discussion during the subsequent phases.

The laboratory section also includes support spaces such as `Wash Up & Sterilization Rooms, Cold Rooms, Technician Support Areas and Bottle Wash Areas. The laboratories use a standard 7.3m depth from the corridor demising wall to the service core walls with exhaust and fume hoods generally located on this service core wall. All access to the labs is from the corridor side with the exception of a single door on each of the North and South service cores into an adjacent lab. These have been provided to eliminate a dead end corridor at this location. Access to the North and South service cores on each floor is from the each corridor on the north and south ends of the building. (Refer to plans Appendix 2)

A-Figure 5 Cold Rooms located along corridor

A-Figure 6 Service Core exit door through Lab

The typical structural bay sizes are 6.30m in the north-south direction x 3.65m in the east-west direction (the 3.65m span covers the perimeter offices and the corridors between offices and labs). The next east-west structural bay spans 10.18m across the laboratory. These bay sizes are mirrored across the 2.43m wide Service Core between two adjacent laboratories. Floor to floor heights for floors 4 to 7 is 3.96m. Large enclosed duct shafts are located at the south end of the building and adjacent to the main passenger elevators near the center core. These are used to provide ducts from the third floor Mechanical Room and the rooftop Penthouse Mechanical Room. The floors are serviced by a Freight Elevator on the north end of the building and by 2 Passenger Elevators in the center core. The center core elevator shaft was designed to accommodate three elevators although only two are installed in the shaft. The cast in place concrete elevator cores, stair and some exterior walls are used as shear walls to restrict lateral movements of the building frame.

The labs do not have a standard width 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. There do not seem to be any laboratories that have a dedicated office within the suite with all researchers offices located on the perimeter of the building.

A-Figure 7 Shear Wall

A-Figure 8 Typical Floor framing from Service Core

A-Figure 9 Typical Floor framing from Lab

It is understood that approximately 15-20% 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 are located on the 7th floor including L719/L721 Liquid Chromatography-Mass Spectrometry and L724/l725 Mass Chromatography & Gas Chromatography Labs which adhere to the Canadian Association of Laboratory Accreditation (CALA) standards.

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. It is understood that another Ultra-Trace Laboratory is to be constructed on this floor in the area currently designated as L760.

3.1.2 Condition of Building Interiors

Interior Construction

The interior construction of each of floors 4 to 7 is similar in most respects with the exception of some upgrades or renovations which have occurred over the years. A synopsis of the condition of each laboratory, office and common area is included in Appendix 2, but in general the condition of the interior components would be considered acceptable for the current use.

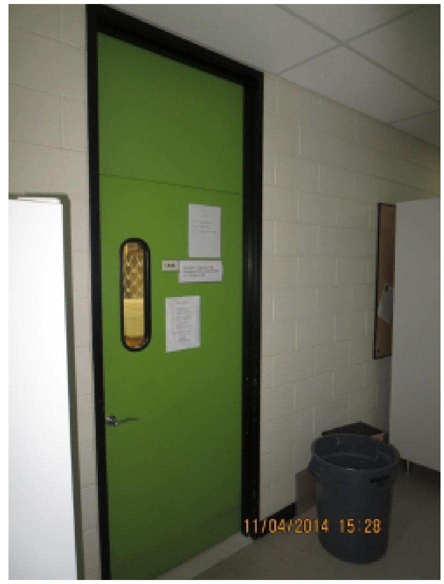
Interior Demising Walls: The demising walls between laboratories, corridors and service cores are typically a painted 140mm concrete block wall, full height to the underside of the concrete structure above. There is no indication on any of the as-built drawings whether they have any vertical or horizontal reinforcing. In addition, there is no apparent lateral anchorage at the underside of the structure above. Under current codes, these walls would be reinforced with horizontal wire reinforcing and be laterally restrained at the top of the wall. A number of other demising walls including Washrooms, Janitors Rooms, Freezer/Cold Rooms and vertical duct shafts are also constructed of 140mm concrete block. This type of 140mm concrete block typically provides a one hour fire resistance rating when constructed in accordance with applicable testing agencies.

The existing concrete block demising walls are generally in good condition with the exception of several cracks evident on corridor demising walls north of the cast in place concrete elevator core. These would be considered minor in nature. The other are of concern is the concrete block wall separating the laboratories from the service cores. There are several instances where existing fume hood exhaust ducts have been removed and the opening has not been sealed to maintain the same fire separation. This is noted under the Building Code Review in Section 4.

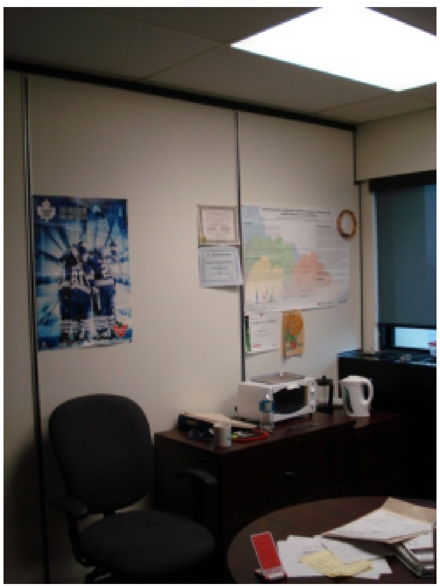
It should be noted that with few exceptions, none of the laboratories on floors 4 to 7 have any access to natural daylighting with the exception of a small vision window in each door. L662 Instrument Lab which is located on the north end of the building on the outside perimeter zone of offices has an interior window which opens on to the corridor, and L520 Monitoring and Surveys which is a renovated Clean Room also has a larger viewing window in the door which users seem to appreciate as it allows outside light into the space. This is an exception but was noted as a feature by the users in the 2009 survey. The current *'Health Laboratory Design Standards'* prepared by Health Canada encourages natural daylighting unless it conflicts with the functional requirement of any laboratories and it is recommended that interior viewing windows be considered for any new renovations and for the LMP.

A-Figure 10 Left side: typical Lab 6" Concrete wall;

Right side: typical office demountable partition



A-Figure 11 Typical Lab 6" Concrete wall and door



A-Figure 12 Typical office demountable partition

A-Figure 13 Atypical Lab gypsum board partition

The other predominate interior partition used throughout the laboratory floors is a demountable wall system using metal stud framing finished with gypsum board panels and an exposed metal batten covered seam. These systems are typically used as demising walls between laboratories or as partitions within labs. This system is also used as the demising wall between the offices and corridor and between offices. All demountable type walls go to the underside of the existing ceiling system. These walls are finished with a variety of materials including wall coverings, cork and paint. There is no indication from any existing documentation that these walls would have any insulation within the walls. The *'Health Laboratory Design Standards'* and good practice suggest that laboratory walls be full height to reduce sound transmission between laboratories. In addition it is recommended that the laboratory zones be separated from the administrative zones and designed as a containment barrier. It is recommended that all interior demising walls between laboratories should be full height walls to reduce noise and separate the laboratories from adjacent laboratories and administrative areas.

The interior walls in the L719 Liquid Chromatography-Mass Spectrometry or L725 Mass Spectrometry & Gas Chromatography Lab has been covered in a foam acoustic material to reduce noise and acoustic vibrations which interfere with the laboratory instrumentation. The *'Health Laboratory Design Standards'* and good practice suggest a Noise Criteria (NC) 45 rating as a background noise level in laboratory environments. This rating takes into account air handling, fume hoods and other equipment. It is recommended that a NC 45 rating be maintained for all future laboratory renovations.

A-Figure 14 Foam acoustic material

A-Figure 15 Foam acoustic material

Concrete walls which form the structural system for stairs, elevators and other vertical support or lateral resisting elements is left exposed in many areas. A rough board finish is found in the main elevator lobby area and exit stairs and unfinished in service areas. Where concrete is located within offices it is typically covered with cork or some other wall covering.

A number of areas have painted hollow metal frames systems with plain or wired glass. These are typically found in the conference room located on each floor as well as the three feature exit stairs on the south side of the building. A variety of finishes are employed throughout this facility, including paint as the predominant wall finish, vinyl wall coverings at various offices and meeting rooms and ceramic tile located at drinking fountain alcoves and in washrooms.

A-Figure 16 Exposed concrete and hollow metal board room framing

The interior partitions and their finishes would be considered to be in fair overall condition, free of damage and with no visible wear outside of normal wear patterns, except in some high-traffic location where localized damage has occurred. Demising partitions between laboratories, in areas such as L527 & L530 are in worse condition and the choice of a demountable partition system without acoustic insulation that does not go full height would be unusual in today's laboratory environment. The Health Canada *Laboratory Space Standards & Design Guidelines* suggest that wall's for laboratories and lab support spaces should be highly durable, cleanable, water resistant, easy to maintain and have good anti-microbial properties. Overall, given the current condition the interior walls could be expected to remain usable for a considerable period of time with general maintenance and upkeep. It is recommended that as part of any future renovations and the LMP, that all interior demising walls between laboratories should be ….to minimize maintenance and flexibility within the laboratory areas.

Ceilings: The ceiling systems used throughout Floors 4 to 7 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 ceiling tiles are typically a 610mm x 1220mm tile with a standard finish and most of the ceilings appear to date from the original construction of the facility in the early 1970's. It is understood that a number of areas throughout the floors have been replaced as part of various minor addition and renovation projects over the life of the facility. The Health Canada *Laboratory Space Standards & Design Guidelines and standard practice* suggest that laboratories lab support spaces should have ceilings that are cleanable and easy to maintain. In addition, they should provide a NC45 rating to minimize background noise in the work areas.

Gypsum board ceilings have been used in the L461 Biosafety Laboratory and in some other areas such as autoclave rooms and glassware washing rooms. Where CL2 + labs are required, ceilings should be easy to sterilize with a high durability epoxy paint finish. It is recommended that as part of any future renovations and the LMP, all laboratory ceilings should be an acoustic, washable lay in tile (mylar finish or similar) to minimize maintenance and flexibility within the laboratory areas. Where gypsum board ceilings are required for BSL or Clean Room purposes, the ceilings should be a gypsum board with a high durability paint finish.

Several areas of each floor such as elevator Lobbies have feature ceilings consisting of stained cedar slats on suspended metal furring and washrooms are painted gypsum board. With the exception of water stained or damaged tiles which should be replaced as part of on-going maintenance to reduce the risk of possible health issues associated with moisture leakage these ceilings can likely be expected to perform for a reasonably long period.

A-Figure 17 Stained cedar slat ceiling

A-Figure 18 Typical Lab acoustic tile ceiling in poor condition

A-Figure 19 Atypical lab ceiling with plastic finishes

A-Figure 20 Typical Lab acoustic tile ceiling in good condition

Flooring: The floor finishes used throughout Floors 4 to 7 are predominately vinyl tile in the laboratories with carpet used in many offices. Some of the upgraded laboratories such as L428 have sheet vinyl and a seamless sheet epoxy is used in Lab L752 on the 7th floor. Ceramic tile is used typically in the washrooms with exposed concrete in service cores and enclosed exit stairs.

The 300mm x 300mm vinyl tile which is used throughout most of the building was identified as Vinyl Asbestos Tile (VAT) in the Asbestos Report prepared by Pinchin Environmental in 2009 for CCIW. This report indicated that the tile is non-friable and in good condition. The mastic used to adhere the tiles was tested and deemed to have no asbestos. There are many localized areas of repair and replacement of vinyl tile that have been undertaken using mismatched vinyl tile. As the original VAT contains asbestos it is no longer available to replace areas that have been damaged. There are at least three distinct tile colours and patterns used. This newer vinyl tile does not appear to be holding up to wear and tear traffic as well as the original tile.

A sheet vinyl flooring is used in several 4th floor laboratories, L411, L413 and L414 as well as L730 on the 7th floor. This flooring has a slip resistant finish and is showing some evidence of wear. Epoxy is used in the 7th floor lab L752 Ultra-Trace Laboratory and appears to be standing up satisfactorily. The flooring (vinyl tile and sheet vinyl) dates from various times over the life of the facility, however, the majority is from the original construction in the early 1970's. The original laboratory flooring materials are nearing the end of their effective service life and should be considered for replacement.

The majority of offices located throughout all four floors are finished with the original vinyl tile with carpet installed in approximately 50% of the offices. (Refer to Lab Condition Appendix 1). It is expected that the carpet is loose laid or installed over the existing vinyl asbestos tile and this would have to be taken into account in any future renovation to the office areas. The carpet floorings will continue to require replacement on an ongoing basis.

The staff washrooms on each floor, including the original and upgraded accessible washrooms are finished with ceramic tile and the janitors rooms are painted concrete floors. All landings and stairs for all five exit stairs which serve each floor are finished with exposed concrete.

With the exception of aesthetics of mismatched vinyl tiles and localized repairs required in some areas, the vinyl flooring is generally acceptable for the current use. Some areas of the carpet installation in offices show wrinkles and wear but these are considered maintenance issues. Carpet tile which is typically specified today and is part of the *Workplace 2.0 Guidelines* would be a preferred flooring material where carpet is desired.

The Health Canada *Laboratory Space Standards & Design Guidelines* suggest that laboratories and lab support spaces should have flooring that is hard, resilient, impervious to chemicals, cleanable, non-slip and seamless. Base materials should be compatible with flooring, coved and integral with the floor to facilitate cleaning. It is recommended that as part of any future renovations and the LMP that all laboratory flooring should be a seamless, slip resistant flooring. Options include Stonehard "Stonetec' which is a multi-component epoxy based system which provides a seamless floor application with integral cove but requires mechanical surface preparation. This is an extremely durable product that requires a lot of surface preparation and would be more suitable for a new or major laboratory renovation. This system would be applicable where a waterproof flooring with a high chemical resistance is required. Where chemical resistance is not as critical such as in dry labs or support spaces or where there is limited access, a system such as Armstrong 'Accolade' 2mm sheet flooring with integral cove base would be suitable. This system requires minimal preparation and would provide a reasonable return on investment.

A-Figure 21 12”x12” Vinyl composite tile with new patches

A-Figure 22 Vinyl Sheet Flooring

A-Figure 23 Epoxy Coated floor

Interior Doors: Several different door types are used throughout floors 4 to 7 to serve the laboratories, offices and other support spaces. The typical laboratory doors which are from the original construction, are solid core wood with a plastic laminate finish with a hollow metal door frame set in the concrete block walls. The laboratory doors swing into the labs and are typically 914mm x 2130mm with 5 to 6 labs per floor having a 200mm wide inactive leaf. All doors appear to date from the 1970’s and are located in the same locations where they were originally constructed. All doors have a plain or wired glass vision lite in the door while the frames to most offices have a glazed sidelite. Doors to service cores, exit stairs as well as other service rooms are painted hollow metal with pressed steel frames. Door hardware is a mixture of exit devices, push/pull hardware, and both lever and knob type latch sets and lock sets. Most laboratories have lever handles and a number have been equipped with supplementary access control by means of card readers or push button code. No doors to laboratories, service cores, janitor and store rooms or exit stairs are labeled for fire resistance ratings. This will be reviewed in more detail in the Building Code Review Section 4 which follows.

In general, the interior doors are considered to be in an acceptable condition, with no obvious signs of damage or deterioration outside of normal wear. With the exception of fire resistance ratings and accessibility in some areas the doors are suitable for the intended purposes.

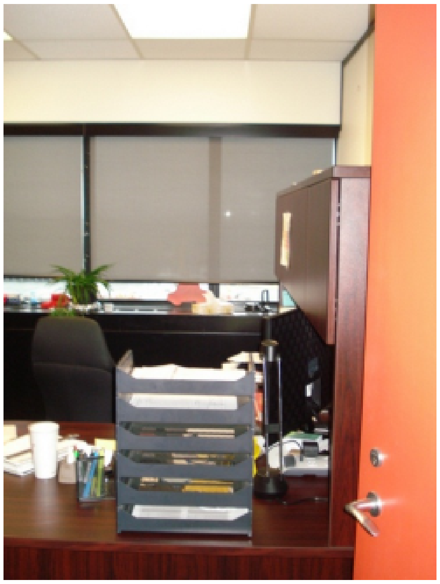
Health Canada *Laboratory Space Standards & Design Guidelines* and current design suggest that laboratory and lab support spaces should have higher doors or doors with removable transoms for movement of laboratory equipment with a minimum size of 1067mm x 2134mm. Where space permits, laboratory doors should swing in the direction of egress and card access or security hardware should be provided on doors to laboratory and suites, designated labs and lab zones. Where anterooms are required for Biosafety Level 2 or 2+ Containment, such as in L461 and L465A, doors should be interlocked to ensure doors cannot be opened simultaneously. It is recommended that as part of any future renovations and the LMP that all laboratory doors should be increased in size to facilitate the movement of larger equipment and that all doors should have an access control system with supervised locks.

A-Figure 24 Typical interconnected Lab door; Refer to A-Figure 11 for a typical Lab entry door

A-Figure 25 Sliding door to Chemical Storage Room

Window Coverings: There are a variety window covering types employed throughout the Office areas of Floors 4 to 7. These include fabric curtains, PVC vertical louvre blinds, vinyl/fabric roller blinds, and metal horizontal louvre blinds. In some instances window blinds have been removed and not replaced. This is understood to be an occupants' choice and more prevalent on the west side facing the water.

The ad hoc replacement of the window coverings within individual office spaces has resulted in reduced aesthetics of the exterior views, owing to the variety of window coverings employed throughout. The window coverings likely date from various times over the life of the building, with the fabric curtains dating from the original construction of the facility in the early 1970's, the PVC vertical louvre blinds being older replacements, and the vinyl/fabric roller blinds and metal horizontal louvre blinds being newer replacements. Other than the aesthetics of a variety of window coverings this would not be considered a significant issue and depending on the LMP, replacement of all coverings could be considered as part of the future plans for these floors.



A-Figure 26 New top down window shades; Refer to A-Figure 2 for typical office horizontal shade

A-Figure 27 Vertical window shade

3.1.3 Condition of Laboratories and Furnishings

The laboratories for the A&L Building are generally located on the 4th to 7th floors with some additional labs and research areas located in the R&D and Hydraulics sections on the 1st and 2nd floors. The laboratories floors 4 to 7 occupy approximately 1,400m^2 per floor with support spaces, offices and common areas occupying approximately 1,600m^2. The service core which contains the plumbing, piping, drainage, and fume hood exhaust risers to the Penthouse on the 8th Floor are centrally located on each floor and back on to the laboratories. Floors 4 to 7 also includes support spaces such as Wash Up & Sterilization Rooms, Cold Rooms, Technician Support Areas and Bottle Wash Areas. The north and south service cores only have one access door as illustrated in the plans in Appendix 2. There are secondary doors at the far end of each service core which appear to be a means to eliminate a *dead end corridor* situation, but in each instance this door exits into an adjoining laboratory rather than a *means of egress* as defined under the building code.

The 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 fume hood and exhaust canopies from each laboratory are ducted horizontally to the service core and then exhausted vertically to the exhaust units on the rooftop Mechanical Penthouse and then to the roof above. All access to the labs is from doors swinging into the labs and with few exceptions such as L730 Trace Organic Contaminant which has an Ante Room or airlock, the laboratories open directly to the corridor. There is no access to the service core directly from any laboratories with the exception of the emergency egress doors noted above.

A-Figure 28 Typical Lab

A-Figure 29 Typical Lab partially renovated

A-Figure 30 Typical Equipment Lab

A-Figure 31 New Clean Lab

The labs do not have a standard module or width 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 demising walls to an adjacent laboratory. There are no laboratories with a dedicated office or separated write up area within the suite and all researcher's offices are located on the perimeter of the building.

It is understood that approximately 15-20% 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. (Refer to Appendix 2 Plans). It was also noted that many of the analytical laboratories are located on the 7th Floor under the Emergencies, Operational Analytical Laboratories and Research Support (EOALRS) with other research and analytical laboratories located on floors 4 to 6. The analytical labs include the L719/L721 Liquid Chromatography-Mass Spectrometry and L724/L725 Mass Chromatography & Gas Chromatography Labs which adhere to the Canadian Association of Laboratory Accreditation (CALA) standards. A number of the original laboratory spaces such as L565 are now being used for storage of equipment and surplus items. A new L752 Ultra-Trace Laboratory has been recently completed with its own air-handling system, up to date equipment and fume hood with separate strobic exhaust system. A new L760 Ultra-Trace Laboratory is to be constructed on the 7th floor in an existing laboratory space that has been demolished.

Included within the laboratory structure of the A&L are some Biosafety Level (BSL) 2 Laboratories as well as Radioisotopes, Liquid Chromatography-Mass Spectrometry, Mass Spectrometry & Gas Chromatography and Ultra-Trace Labs. L461 and L465A Environmental Microbiology and related labs are BSL 2 and meets Canada Health *Biosafety Guidelines* and the Canada Health Agency's *Containment Standards for Veterinary Facilities*. It is understood that the lack of BSL 2 containment does not allow for culturing, incubation, or storage of pathogens in a number of labs where it would be beneficial to the analysis or research. Many of the Branches located on Floors 4 to 7 have associated laboratories located in other parts of the CCIW including the R&D and Hydraulics Lab on the ground floor.

The condition and capacity of the existing laboratories condition is noted in the Appendix 1: Building and Laboratory Checklist as well as the mechanical and electrical systems reports in the following sections.

The following table is taken from the 2009 *CCIW Lab Report* from the individual lab questionnaires, along with the data collected from each of the individual lab audits, a list of common positive and negative aspects of each lab was created. Among the findings was the following:

Most Common Positive Aspects of CCIW Labs		Most Common Negative Aspects of CCIW Labs	
Description	Percentage	Description	Percentage
Open / Spacious Layout	28.6%	Poor Casework Condition	44.6%
Large Lab Area (+50m^2)	27.7%	Poor Flooring Condition	29.5%
Ample Storage Space	25.9%	Poor Sink Condition	25.9%
Ample Counter Top Space	21.4%	Poor Fume Hood Condition	22.3%
Large Lab Area (40-50m^2)	20.5%	Poor Countertop Condition	20.5%

Significant issues that have been identified include:

- Strong draft in some labs which can make using the balances difficult,
- Lack of Biosafety Level 2 standard Labs for pathogen research,
- Lack of acoustic privacy between labs,
- Lack of write-up areas or locations for desk top computer stations in old casework,
- Lack of storage space for samples, bottles,
- Insufficient countertop space and storage,
- Lack of communication, telephones and security services,
- The reverse osmosis system has lots of air in it when initially turned on,
- Inadequate temperature control; too hot in winter and too cold in summer with no user control,
- Supplemental A/C units have been installed in some labs to maintain correct temperature,
- Abandoned walk in coolers and freezers being used for storage,
- Lack of hot water for running glassware washing equipment,
- Excessive noise from equipment such as Gas Chromatograph-Mass Spectrometer's require sound attenuation in labs,
- Locating bulk tanks such as Argon in labs rather than outside is an issue,
- Use of metal finishes in the Trace Metals Labs is an issue.

Laboratory Benching & Countertops:

As with many areas of the A&L Building, the laboratory benching and countertops are varied in their condition and suitability to current standards. Approximately 15-20% of the laboratories have been upgraded over the years, but even among these are a number that do not suit the purpose. Significant issues that have been identified include:

- Poor quality of existing countertops including spalling of surfaces lack of write-up areas or locations for desk top computer stations in old casework,
- Concern about countertop surfaces constructed of Bakelite, an asbestos containing materials (ACM) – See also Section 6,
- Metal cabinets used for acid storage,
- Inadequate depth (560mm) does not allow newer instrumentation on countertops,
- Raised centre islands inhibits locations for equipment and instrumentation,
- Lack of mobility of benchtops (wheels would allow movement).

The *Health Canada Laboratory Space Standards & Design Guidelines* suggest that laboratories and lab support spaces have the following:

- Lower casework should be flexible and moveable to allow for easy reconfiguration of lab work areas.
- Materials should be highly durable (preferably metal) with corrosion resistant finishes except for acid storage,
- Lab bench tops must be highly durable with a corrosion resistant finish,
- Components (drawers, cupboards, etc,) should be plug and play type units that are interchangeable to provide ease of reconfiguration,
- Upper casework should be ceiling suspended if possible to allow for maximum efficient use of lower case surface area,

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. The final decision on whether the cabinets are wood, polypropylene or metal would have to be based on the particular usage of individual laboratories although the metal casework is the most popular and cost-effective choice. All benchtops should be a non-absorptive, seamless one-piece design such as stainless steel, epoxy or wood. As with the benching, the decision on materials would have to be determined based on the particular usage of the laboratory.

A-Figure 32 Typical Lab Wood and Laminate Millwork

A-Figure 33 Clean Room Polypropylene Millwork

A-Figure 34 New Metal and Laminate Millwork

A-Figure 35 New Stainless Steel Millwork

Laboratory Fume Hoods:

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. It is understood that the make-up air to the by-pass type fumes hoods has been disconnected and this feature is no longer in operation.

L525 is set up as a divided fume hood room which would be an advantage for some activities but the poor condition of the fume hoods make it unusable. It is understood that this Laboratory is to be demolished and a new laboratory set up in this location. The CESS Report included the following findings:

- Individual fume hood exhaust risers are made of transite, stainless steel, plastic or galvanized steel material and terminate in the penthouse with approximately 149 individual exhaust fans.
- There are no fire dampers in the exhaust air risers as required under NFPA-45, 2012.
- Exhaust air risers vary in diameter and some have numerous offsets enroute to the penthouse fans.
- A total of 104 existing fume hoods in 64 laboratories are currently in use. Of the 104 existing fume hoods, 67 are of the original auxiliary air type fume hoods with the auxiliary air supply system removed and the original fume hoods remain. These hoods have no sash air foil or overhead baffles to control room air flow into the fume hood..
- A total of 175 constant volume exhaust points in 52 rooms have bench tops, exhaust canopies or exhaust arms. It was recommended that the number of these should be reduced where possible for locations with only heat generating devices or non-toxic fume generating devices. Equipment or processes requiring exhaust should be located within fume hoods.
- Eighteen rooms have no fume hoods or constant exhaust points and use slow acting general exhaust air dampers to match the supply air flow damper response speed. It was recommended that fume hood labs should have fast acting general exhaust dampers to match the fast acting fume hood exhaust dampers response speed to face velocity changes.

Among the commonly cited and observed problems for the fume hoods and laboratory ventilation are the following:

- Rusting and deterioration of fume hood cabinets and linings;
- Fume hoods being used permanently to ventilate gases from carcinogenic gases;
- Fume hoods go into alarm mode too often, in many instance when there are windy conditions outside suggesting issues with the exhausts;
- Older fume hood cabinets are lined with asbestos containing materials (ACM);
- Fume hoods out of order;
- Lack of fume hoods in some laboratories that now require them;
- Limited control of fume hood exhaust in some labs;
- Non-vented storage cabinets which contain chemicals is an issue;
- Prefer corrosive resistant finishes rather than metal for fume hoods due to amount of chemicals in use.

The *Central Exhaust System Study* by Filer Engineering Ltd. makes a number of recommendations regarding changes to the fume hood exhaust system. This report will be coordinated with the LMP project to provide fume hood and other related laboratory exhaust systems in keeping with current standards including the *Health Canada Laboratory Space Standards & Design Guidelines.* The CESS Report included the following recommendations:

- It was recommended that the 67 of the original auxiliary air type fume hoods with the auxiliary air supply system which was removed be replaced with new variable flow style fume hoods;
- The speed of the control action for the fume exhaust, general exhaust and the supply air flows must be similar in order to avoid over or under pressurization;
- The general exhaust for the laboratories should be connected into a new fume exhaust system and connected into the existing fume exhaust ductwork if the velocities and pressure drops allow;
- New roof top high plume fume exhaust fans should be installed at the Penthouse level with four identical fans providing standby protection in case of fan failure. The fans would be suction pressure controlled in order to provide a constant pressure for the individual laboratory exhaust valves or dampers to modulate against;
- Individual laboratory fume hoods and general exhausts to have control dampers or valves to modulate to correct for changes in fume hood face velocities and /or lab pressure and volumetric flow offsets;

- Labs to have VAV control with fast acting damper actuators calibrated venturis or cross flow sensors to measure air flows and to modulate quickly in response to fume hoods sash position changes or room temperature changes;
- Add heat recovery coil at each system and the supply air fan systems be equipped with a heat recovery coil and glycol loop to exchange exhaust heat to the outdoor air stream;
- Current laboratory wing return fans would no longer be required to act as return/exhaust units;
- If a manifold system is developed, at least one of the exhaust fans should be on emergency power where exhaust system function must be maintained as per MD 15128 item 3.9.4;
- Existing auxiliary air ductwork risers should be utilized for laboratory general exhaust conveyance to the penthouse.

A-Figure 36 Typical Fume Hood

A-Figure 37 New Fume Hood

A-Figure 38 Corroded sink in acid contamination unit

A-Figure 39 Gooseneck Fume Hood

A-Figure 40 Biological containment unit

A-Figure 41 Direct Exhaust Fume Hood

Laboratory Fixed Equipment:

In addition to the typical complement of fixed equipment such as fume hoods found in the labs, there are other significant equipment used throughout the A&L which include:

- Cold Rooms (L460, L627, L771);
- Large Refrigerators and Freezers to -86^{o} C in L742;
- Large Furnaces and Drying Ovens in a number of laboratories;
- Autoclaves;
- Radioisotope Fridges;
- Gas Chromatograph-Mass Selective Detectors;
- Liquid Chromatograph-Photodiode Array Detectors;
- Gas Chromatograph-Coupled Plasma Mass Spectrometers;
- Uninterrupted Power Supplies (UPS);
- Sediment Blender.

These types of equipment generally require specialized mechanical and electrical service or structural and architectural considerations such as acoustic wall treatments for Gas Chromatograph and Mass Spectrometer units which have high background noise levels.

A-Figure 42 Fridge/freezer

A-Figure 43 Gas Chromatograph

A-Figure 44 Cold Room

A-Figure 45 Fridge/freezer

A number of gases are present inside laboratories or in the Service Cores including:

- Helium;
- Argon;
- Oxygen;
- Nitrogen.

In keeping with current practice, it is recommended that these be relocated to a central tank farm or isolated locations within floor areas and piped by a gas manifold to individual laboratories as required.

A-Figure 46 Argon tanks

A-Figure 47 Helium tanks

3.1.4 Recommendations

Biosafety for Health Science Laboratories: The majority of health science labs are dedicated to work involving low risk or inactive agents. It is recommended that the determination of how many laboratories that require Containment Level 2 standards as defined in the most current edition of the *Canadian Biosafety Standards and Guidelines (CBSG)* be undertaken as part of the Programming Phase to follow. It is recommended that where BSL are required that the following should be implemented:

a) Laboratory areas should be separated from public areas such as corridors by a locked door and controlled via card access.
b) Access to specific lab suites within the lab area should be through lockable doors and controlled via card access.
c) Although not required for CL2 requirements, office areas should be located outside of the containment laboratory zone.
d) Directional inward airflow should be provided such that air will flow towards (not away from) laboratory.
e) Primary containment should be achieved through the use of biosafety cabinets and fume hoods.
f) Hand-wash sinks should be provided in all rooms and laboratories where there is a possibility of handling an infectious substance.
g) Walls separating the laboratory zones from administrative zones are considered as a containment barrier. As such, these walls should extend from floor to underside of structure and be free of openings.
h) All laboratories should have observation windows to an adjoining corridor.
i) All laboratories should have intercom stations or some other easy method of connecting to security desk for safety and security reasons.

3.2 Building Envelope

3.2.1 Condition of Exterior Walls

Exterior Walls: 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 as well as on the 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 a cast in place beam at the slab edge above and concrete block below. Continuous aluminum windows infill the space between the precast panels. The construction of the exterior precast panels acts as a rainscreen and a vapour barrier and 38mm of rigid insulation is noted on the 'as-built' drawings. 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. From the initial investigation, an aging of the insulation, it would appear that the overall insulation value of the exterior wall would be approximately 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). 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.

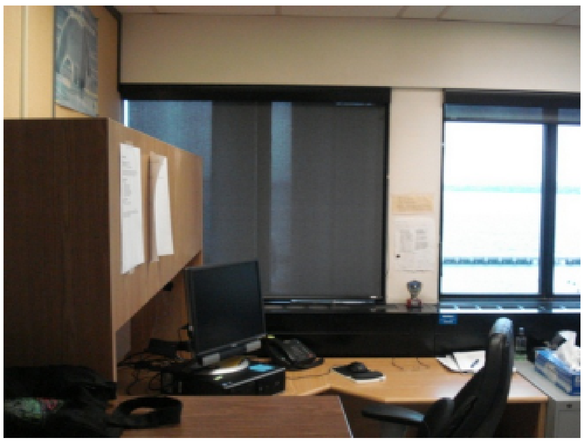
There is some evidence of localized rust staining, cracking and spalling of some cast-in-place concrete or the cementitious coatings, but it is likely that these are not a significant issue and is just surface cracking that is telegraphing through the surface materials. There is a small risk of water 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.

3.2.2 Condition of Windows

Windows: 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 strip windows between columns on the four building elevations with several single units adjacent to stairs or corridors. The windows extend from approximately 914mm above finished floor to approximately 2,134mm 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.



A-Figure 48 Exterior windows at offices

3.2.3 Recommendations

It is recommended that an allowance be made for maintenance of the precast concrete panel walls (including replacement of sealants, area repairs at exposed rebar locations, and cleaning of stained surfaces) in order to maintain the integrity of the building envelope, extend their effective service life by correcting deteriorative conditions, as well as facilitating monitoring and restoring some of the facility's aesthetic value.

It is recommended that if a major upgrade to the laboratory floors is undertaken that a study of the exterior cladding, insulation and performance of the building envelope be undertaken to increase the overall thermal performance value of the building. In addition, it is recommended that if the LMP and recapitalization of the A&L is considered that a new high performance window system be included a required component of the project.

3.3 Structural

3.3.1 Description of Existing Structural System

'As-Built' structural drawings S1 to S29 prepared by Reid, Crowther and Partners Limited, dated December 1972 were used as a reference. Drawing S19 (High Roof Framing Plan) was missing from the set and was not available for our review at this time. No specifications were provided for our assessment as part of this review.

The plan dimensions of the Administration and Laboratory 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 Administration and Laboratory 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 floor design live load is 7.18kPa for the laboratory areas and 4.79kPa for the perimeter corridors and offices.

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. The floor design live load is 7.18kPa for the laboratory areas and 4.79kPa for the perimeter corridor and offices. 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.

The roof structure is similar to 7th floor framing with 115mm thick one way concrete slabs spanning 2.13m and supported onto 460mm wide x 460mm deep concrete beams. The concrete roof structure has been designed for a design live load of 5.98kPa adjacent to the high roof over the mechanical penthouse (along the east and west sides). Concrete beams and slabs which are affected by snow drift (according to the 2010 NBCC) have sufficient capacity to resist the current snow load plus accumulate snow piling and meet the 2010 NBCC requirements.

High roof framing above the mechanical room is framed using a steel structure of beams and columns supporting a metal roof deck.

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. Two hundred millimeter reinforced concrete stair walls and 250mm thick reinforced concrete shear walls provide lateral stability to the structure. The foundation supporting all columns and walls consists of pilings and pile caps supporting concrete grade beams and walls.

3.3.2 Structural Condition

References

The following reference materials have been used in this report and preparation of recommendations:

- National Building Code of Canada (NBC), 2010
- Ontario Building Code (OBC) 2012
- 'As-Built' structural drawings S1 to S29 prepared by Reid, Crowther and Partners Limited, dated December 1972 was used as a reference.
- Condition Report prepared by Maintenance Management Services PWGSC/RPB/PTP, dated September 2009.

We have reviewed the structural framing and the as-built structural drawings of the 4th floor to the roof level. Although the Administration and Laboratory facility was constructed in the early 1970's, there is no mention of the building codes and standards used for the structural design.

A review of a 2009 Condition Report concluded that no deficiencies or recent repairs or modifications have been carried out on the foundations and the substructure.

Average Useful Life

The following list of structural systems and average useful life years (extracted from PWGSC's 'Capital Asset Planning System (CAPS)' is based on regular preventive maintenance properly performed at prescribed frequencies. Many factors can affect the average useful life, however, this list serves as a basis for future planning:

Cast-in Place Concrete Walls …………………	50 years
Masonry Block Walls ……………………………	35 years
Footings & Foundations ………………………	110 years
Basement Concrete Walls ………………………	110 years
Concrete superstructure (slabs and beams)..	110 years
Steel framed superstructure ……………………	110 years
Concrete floor Slab on Grade …………………	110 years
Roof structure Steel Joist & Steel Deck …….	75 years

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. Also refer to S-Figure 1.

The floor slabs on the north and south sides of the expansion joint were reviewed at each level and found to be level with no visible signs of distress except on the 7th level where a slight slope in the floor slab was observed south of the expansion joint in the corridor. The concrete slab south of the expansion joint bears on a ledge beam with a sliding Teflon pad in between the slab and supporting concrete beam. This sliding bearing detail is a typical detail on all levels and the floor slabs appear to be horizontal with no visible deflections on all other levels. We therefore suspect that the excessive deflection in the floor slab south of the expansion joint on the 7th floor corridor is likely due to the early removal of the temporary shoring below the floor slab during construction. Also refer to S-Figure 2.

S-Figure 1. Typical low strength concrete slabs within the service corridors accommodating Pipe penetrations above (shown on the left) and below each level (shown on the right)
.

S-Figure 2. View on the 7th floor looking east along (gridline Dy) expansion joint.

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. Also refer to S-Figure 3.

S-Figure 3. Pipe penetrations above the service corridors at the Mechanical Penthouse level

The roof framing above the Mechanical Penthouse service link is framed with structural steel beams and steel columns supporting a metal roof deck. The structural framing appears to be in good overall condition with no visible signs of water leaks that would cause premature deterioration of the roof structure and interior structural components.

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. All stairwells have an exposed concrete surface with a rough board finish cast integrally with the building structure (see also S-Figure 4 and S-Figure 5). The interior and exterior walls are considered to be in good overall condition with no visible signs of cracks or distress.

S-Figure 4. Typical curved stair walls along interior stairwell the east side of building

S-Figure 5. Typical stair walls at south of the expansion joint.

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.

Effective Remaining Life

The superstructure dates from the original construction of the facility in the early 1970's. Given its current condition, the super-structure can likely be expected to perform for another 50+ years with continued regular review and preventive maintenance

3.3.3 Floor Slab Fire Separation Performance

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.

The change in concrete properties due to high temperature depends on the type of coarse aggregate used in the concrete mix. Aggregate used in concrete can be classified into three types: siliceous, carbonate and lightweight. Siliceous aggregates include materials consisting of silica, granite and sandstone. Carbonate aggregates include limestone and dolomite. Lightweight aggregates are usually manufactured by heating shale, slate, or clay. The fire resistance in concrete structures will vary in relation to the type of aggregate used. Table S-1 shows a summary of the minimum floor and roof slab thickness requirements for the different types of aggregates used in the concrete mix and for different fire resistance ratings. Although the as-built drawings specify 115mm and 150mm thick floor and roof slabs, the composition of the concrete mix (particularly the aggregates used) are unknown. Based on the values shown on Table S-1 below, the minimum concrete slab thickness required to achieve a 2 hour fire resistance rating could vary between 91mm to 127mm depending on the aggregates used in the concrete mix. Hence it will be difficult to determine for certain the fire resistance rating of the existing floor and roof slabs without further testing.

	Fire Resistance Rating (hours)				
Concrete Type	**1 hr.**	**1.5 hr.**	**2 hr.**	**3 hr.**	**4 hr.**
Siliceous aggregate	3.5″	4.3″	5.0″	6.2″	7.0″
Carbonate aggregate	3.2″	4.0″	4.6″	5.7″	6.6″
Sand-lightweight	2.7″	3.3″	3.8″	4.6″	5.4″
Lightweight	2.5″	3.1″	3.6″	4.4″	5.1″

Table S-1. Minimum thickness (inches) for cast-in-place floor and roof slabs

Another factor to be considered in complying with fire-resistive requirements is the minimum thickness of concrete cover below the steel reinforcement in concrete slabs and beams. The concrete protection specified in CAN/CSA A23.1 for cast-in-place concrete will generally equal or exceed the minimum cover requirements for fire resistance ratings, but there are a few exceptions at the higher fire ratings.

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

3.3.4 Floor and Roof Loading

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 4.79kPa for the office and corridors and 7.18kPa for the laboratories which is consistent with office and laboratory use.

A multitude of floor openings have not hindered the ability of the slab to carry the full design live loads, as these openings are placed in sacrificial areas between adjacent concrete beams with a thin floor slab inlay.

The concrete roof structure has been designed for a design live load of 5.98kPa adjacent to (along the east and west sides) the high roof over the mechanical penthouse. Concrete beams and slabs which are affected by snow drift (according to the 2010 NBCC) have sufficient capacity to resist the current snow load plus accumulate snow piling and meet the 2010 NBCC requirements.

3.3.5 Current Building Code and Seismic Capacity

National Building Code

The National Building Code of Canada prescribes requirements for new building construction and provides no consistent requirement for dealing with older existing buildings that may not meet the today’s stricter requirements.

The NBCC is not intended to be enforced retroactively to an existing building unless the building is undergoing major renovations, there is a change of use, or a specific hazard is identified with the building or a portion thereof. As such, care and judgement is required when applying NBCC requirements to an existing building.

The NBCC is not intended to be a design guide, but rather a minimum set of requirements intended to provide for the safety of building occupants, emergency responders and surrounding properties.

Commentary L – Application of NBC Part 4 of Division B for the Structural Evaluation and Upgrading of Existing Buildings of the NBCC states that when existing buildings are being analyzed for load capacity, Loads, Load Factors and Material Standards should be used. It is also acceptable to use Code Standards that applied "when built", unless there is a change of use or occupancy loads or a design upgrade.

Real Property Services Policy – Seismic Resistance of PWGSC Buildings

The structural system of any building provides the backbone upon which all other services rely. From the sub-grade to the foundations, through the floors to the roof joists, all structural components are required to work as a cohesive system and to integrate with the other building systems for the life of the structure.

Structures designed decades ago may not be able to meet the demands placed on them by current occupancies; allowable deflections in 1970 may cause current architectural finishes or electrical services to bend or break. Floor and roof loading that was acceptable in 1970's may be inadequate for today's server rooms, and seismic requirements have become much more rigorous.

Deteriorating structural components will also reduce the long term capacity of the structural system. Over time, with exposure to weathering elements, excessive loading and repeated loading cycles, structural elements will deteriorate.

For these reasons, it is essential to determine the current condition of the structural system in this asset.

There is a growing push to address the seismic resistance of older existing buildings that may not meet the stricter requirements of current building codes for seismic loading. While the National Building Code of Canada does not apply retroactively to older buildings, there is a clear need for a suitable approach. It was with this in mind that the 1998 draft of this policy was created and issued by Real Property Support Corporation (RPSC) in October 1998 as a Guideline.

This Guideline was developed with the objective to provide a consistent risk management approach nationally, and this was subsequently adopted as a Policy on Seismic Resistance of Existing Buildings in 2001. This policy applies to crown-owned buildings currently in or to be added to the custody of PWGSC.

The Policy requirement begins with a seismic screening of existing buildings located in zones of *moderate to high* seismicity.

A seismic screening or investigation of this building has not been undertaken as this is beyond the scope of this work. 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. A numerical scoring system is used which is related to the earthquake requirements of the National Building Code of Canada. It must be emphasized that this method is not an evaluation for seismic adequacy, but merely a screening procedure to rank buildings to find those that should be evaluated in more detail.

The Real Property Services Policy generally states the following: Where the results of a building's Seismic Screening result in a Structural Priority Index (SPI) greater than 30, the building can be considered potentially hazardous and a detailed seismic assessment must be carried out.

The results of the detailed seismic assessment are generally to be implemented as follows:

i. Seismic requirements are to be in full compliance with current local by-laws and provincial building codes, where such requirements exist.

ii. Seismic upgrading in zones of moderate to high seismicity:
   a) Seismic upgrading of the building structure is not mandatory if the building structure's seismic resistance meets or exceeds 60% of the seismic load requirement for new building construction as specified by the current NBCC.
   b) If the main building structure's seismic resistance does not meet 60% of the NBCC requirements, seismic upgrading of the main structure is required to achieve a seismic resistance of at least 60% of the NBCC requirements. Consideration shall be given to upgrade the building to NBCC requirements or higher. The optimal level of upgrade shall be selected based on financial, functional, operational, security and client requirements as usually documented in an Investment Analysis Report (IAR).
   c) If the cost differential between meeting 60% and 100% of the NBCC requirements is negligible, consider meeting 100% of the requirements.

3.3.6 Recommendations

The floors 4 to 7 of the building appear to have been constructed in general accordance with the structural drawings. The building appear to be in good condition with no evidence of excessive deformation or other signs of distress that would indicate any existing underlying problems. No significant signs of structural deficiencies or deterioration were found.

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.

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 4.79kPa for the office and corridors and 7.18kPa for the laboratories which is consistent with office and laboratory use. If there is a possibility of relocating some of the laboratories towards the exterior of the typical floor plate, the concrete floor slabs and supporting concrete beams will need to be reinforced to accommodate the larger design love loads. This can be achieved by reinforcing the existing concrete 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.

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. 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.

3.4 Mechanical Systems

3.4.1 Plumbing

3.4.1.1 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.

The acid drainage piping system appears to be in good working order, however some small leaks were reported and have been patched with new acid resistant plastic piping.

The main sanitary service for the building exits on the West side. This connects to the main 8"Ø drainage pipe outside to the pumping station.

Sanitary and Acid Waste Drainage Recommendation: It is recommended that where plastic pipe penetrates fire rated assemblies the distribution be reviewed for compliance to fire separation requirements. The conditions of the acid neutralization tanks could not be inspected during the site visit, however as noted by facility staff and as observed from the neutralizer controller, it is understood that the tanks are no longer operational and have not been maintained in some time. Based on this understanding it is recommended that the existing tanks be inspected. Further review is required with user groups to confirm what the internal process is to prevent intentional and unintentional disposal of chemicals to drain.

M-Figure 1 Acid resistant piping

M-Figure 2 Plastic pipe serving laboratory sink

M-Figure 3 Neutralization Tank

M-Figure 4 Neutralization Tank

3.4.1.2 Storm Water Drainage: Roof drainage is from the original construction of the building, no conditions where noted as part of this report.

3.4.1.3 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.

Domestic Potable Water Recommendation: As part of any future renovations, a strategy to separate potable water from lab water should be considered. In efforts to mitigate cross contamination between potable water and non- potable water demands (ie. hand wash sinks and lab sinks) it is recommend that a dedicated risers be provided to serve potable water (drinking water) sources and a backflow prevention be added to any services extended to non-potable demands (ie. lab sinks and lab equipment).

In addition, as part of any future renovations any existing risers to be re-used shall be inspected further; the existing risers date back to the original vintage of the building and as such are reaching 40+ years. It is recommend that some destructive testing be carried out on a sample basis to verify existing pipe wall thickness. Test should be carried out at the bottom of the riser around the existing elbows.

3.4.1.4 Domestic Hot Water: The primary source of heat is from the Cogen plant via a heat exchanger, back up to the Cogen domestic system is low pressure steam to hot water converter located in the mezzanine floor, a third stage of domestic hot water is available via heat recovery from condensate tank vent system. Hot water is stored in a storage tank, the storage tank dates back to 1970's.

A 100mmØ domestic hot water service is extended from the ground floor up to the third floor where the service is divided into two pressure zones each sized for 63mm"Ø; floors 3-5 and floors 6 to 8. A pair of variable speed booster pumps boost the pressure of the hot water service up to floors 6 to 8. Pressure in these zones is controlled with PRV stations. No back flow prevention was visible on the hot water risers feeding the labs.

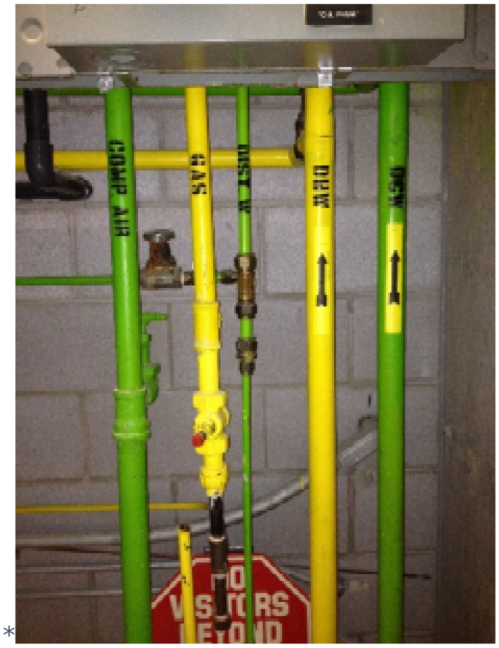
The domestic hot water system is served by five (5) thermostatic solenoid valves assemblies which maintain the domestic hot water loop temperature at 140°F by opening up a solenoid and dumping domestic hot water to drain when the loop temperature drops below 130°F.

Domestic Hot Water Recommendation: As part of any future renovations, a strategy to separate domestic hot water from lab water should be considered. In efforts to mitigate cross contamination between domestic hot water and non- potable hot water demands (ie. hand wash sinks and lab sinks) it is recommend that a dedicated risers be provided to serve potable water (drinking water) sources and a backflow prevention be added to any services extended to non-potable demands (ie. lab sinks and lab equipment).

The system does not currently have a closed hot water recirculation loop; it utilizes solenoid valves to maintain the loop temperature as described above. In efforts to mitigate water consumption and to comply with current energy standards and guidelines it is recommended that as part of any future renovations the existing loop temperature control be replaced with a close circuit recirculation loop complete with recirculation pumps. In addition as part of any future renovations a study of the actual DHW consumption shall be carried out, the study shall be used to verify and optimize the size of the domestic hot water storage tank.

As part of any future renovations any existing risers to be re-used shall be inspected further; the existing risers date back to the original vintage of the building and as such are reaching 40+ years. It is recommend that some destructive testing be carried out on a sample basis to verify existing pipe wall thickness. Test should be carried out at the bottom of the riser around the existing elbows.

As part of any future renovations all existing protective equipment (ie. emergency shower and eye wash station) 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.



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M-Figure 5 Typical plumbing risers

M-Figure 6 Emergency eye wash

3.4.1.5 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.

RO Water Recommendation: 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, if RO water is required in the labs 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.

M-Figure 7 RO tank


M-Figure 8 Milli-Q water purifier

3.4.1.6 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 unisons to maintain compressed air system pressure; each compressor generates approximately 109scfm up to 150psi. The compressed air system is complete with a refrigerant dryer and a large receiver for storage.

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. Refer to Appendix A for a room by room summary of the types of gasses currently present in the lab areas.

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.

It is understood that the existing air compressors are in acceptable condition and the need to replace any component on the central distribution system will be monitored and tracked by facilities as part of ongoing infrastructure upgrades.

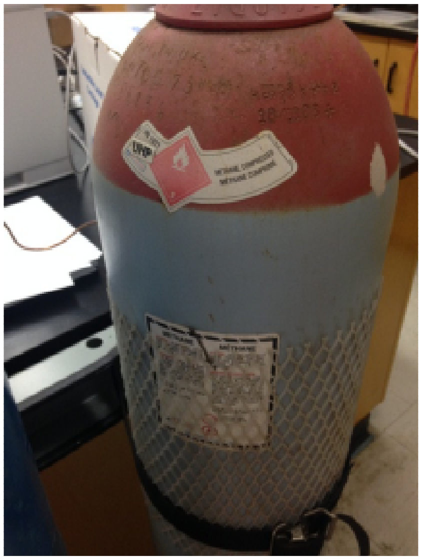
The decentralized allocation of various gas cylinders requires to be rectified, gas cylinders shall be secured and hazardous gases shall be stored in ventilated rooms. It is recommended that gas storage be centralized on each floor inside a dedicated cylinder storage room, where appropriate ventilation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

M-Figure 9 Air compressors and receiver

M-Figure 10 Air dryer

M-Figure 11 O2 Bottle

M-Figure 12 Hydrogen



M-Figure 13 Methane Bottle

M-Figure 14 Gas Manifold

3.4.1.7 Plumbing Fixtures: There is a wide variety of plumbing fixtures throughout the facility with varying vintages. Existing fixtures and lavatories did not appear to be low flow type. Water closets and urinals were wall mounted manual flush valve type. Lavatories were observed to be counter mounted type with manual dual levers with goose neck faucets.

All lab fixtures appeared to date back to the original vintage of the building in typical labs. Typical existing fixtures are made out of stainless steel; many of these fixtures have corroded likely due to the exposure to corrosive lab supplies such as acids. Typical lab fixtures include: sinks, emergency eye washes, small cup sinks and gas outlets. Recent retrofits of many labs have included the installation of the "*Milli-Q"* to provide labs with a source of purified water for process work

Emergency showers are located in each wing, in both main corridors serving the lab spaces.

Over the years there have been several renovations through-out the facility, it is anticipated that approximately 15-20% of the spaces on floors 4-7 have undergone full renovation and the existing plumbing fixtures are in reasonable condition. Refer to Appendix A for general condition summary on a room by room basis.

Plumbing Fixture Recommendation: As part of the modernization plan it is recommended to replace all washroom fixtures with low flow type to conserve water and comply with current codes and standards. Furthermore, it is recommended that all lab fixtures in poor conditions be replaced.

M-Figure 15 Washroom water closet

M-Figure 16 Washroom lavatory

M-Figure 17 Laboratory stainless steel sink and eye wash in poor condition

M-Figure 18 Polypropylene faucet (renovated lab)

M-Figure 19 Stainless steel faucet (renovated lab)

3.4.1.8 Fire Protection: Levels 4 through 7 are currently not sprinklered and are only served by fire hose cabinets. It is understood that a separate fire protection study is currently underway, and as such this has not been covered within this report. Any future renovation to the facility shall consider the addition of an automatic sprinkler system to the building. Currently only areas of the ground floor is sprinklered

3.4.2 Heating and Cooling Systems

3.4.2.1 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.

The Co-generator system consist of a water loop circulated through the co-generator engine and three heat exchangers reclaiming and distributing hot water and glycol to main mechanical rooms. The Cogen can produce approximately 600Kw of heat when the unit is running at full capacity. As confirmed with facilities, the Cogen heat exchangers have been replaced between 2011 and 2013.

The waste heat steam boiler consist of a high pressure steam boiler generating steam from the cogen flue. It is understood that the boiler will generate up to 32 boiler horse power (BPH). It is understood that this boiler runs all year round. As confirmed with facilities, the boiler was replaced in 2011.

It is our understanding that the direct contact hot water heating boiler (Sofame) is not operational, this was installed in 2007.

The steam boilers consist of three high efficiency low NOx burners, installed in 2007. Each unit is rated for approximately 250BHP. As confirmed with facilities, it is understood that the steam boiler operate from April to early October.

Treated water for the boilers is provided via the RO treatment system.

Low pressure steam services the building steam unit heaters, the steam to hot water heat exchangers, the steam to glycol heat exchangers, and the decommissioned direct steam spray humidification systems installed inside the air handling units. It is understood that the existing humidification system was decommissioned due to concerns with volatile chemical steam treatment and its dispersion into the air stream of occupied areas.

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 don the heating water pumps to improve system efficiency.

The existing components on the hydronic heating systems are a combination of new and original vintage dating back to 1970's. The perimeter offices on floors 4 through 7 are served by hydronic induction units along the perimeter. The induction units and controls date back to the original vintage of the building

Heating Recommendations: 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.

M-Figure 20 Steam boiler

M-Figure 21 Steam boiler

M-Figure 22 Steam boiler operator's station

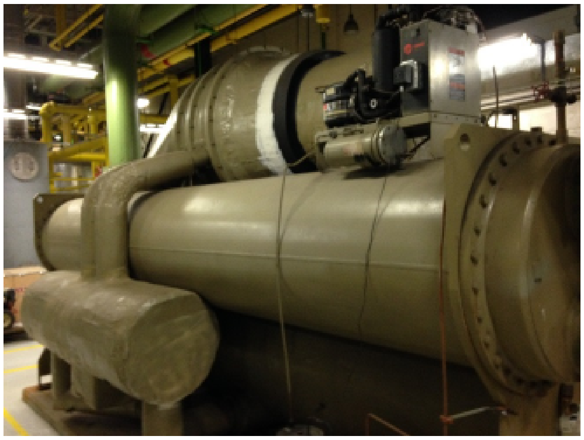
M-Figure 23 Direct contact hot water heating boiler (Sofame)

M-Figure 24 Direct contact hot water heating boiler (Sofame)

3.4.2.2 Cooling System: The primary cooling system for the complex consist of two 700Ton centrifugal chillers replaced in 1990. The chillers are located in the boiler/chiller room on the ground floor. The chillers operate only in the summer and the refrigerant was converted from CFC-11 to HCFC-123 in 2000, during this change the chiller have been de-rated to approximately 600Tons each. The chillers are equipped with a purge alarm, pressure relief valve piped to the exterior and a refrigerant monitoring and emergency exhaust system. The chillers are paired up with two variable speed fan closed circuit fluid coolers on grade, they previously relied on bay water to cool the condenser sections. 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.

Cooling Recommendations: 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.



M-Figure 25 Chiller

M-Figure 26 Condensing water pumps

M-Figure 27 Condensing water pumps

M-Figure 28 Cooling tower

3.4.3 Air Handling Systems – General

3.4.3.1 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. The units date back to the original vintage of the building.

Air handling system 27 is approximately 47,000CFM, 125HP fan. The fan is variable speed and as confirmed by facilities it is due for replacement. The unit feeds the south laboratory area from floors 4 to 7. The unit is equipped with a pumped preheat coil and a decommissioned humidification section and a heating coil in the hot deck and a chilled water coil on the cold deck. It is understood that the supply fan has been retrofitted with a VFD drive and two supply air pressure sensors. It is understood that the existing return air fans have been converted to exhaust air and the supply fan draw the balance of air from the mechanical room, total outdoor air quantity supplied by the unit is unknown at this time.

Air handling system 28 is approximately 67,360CFM, 150HP fan. The fan is variable speed and as confirmed by facilities it is due for replacement. The unit feeds the north laboratory area from floors 4 to 7. The unit is equipped with a pumped preheat coil and a decommissioned humidification section and a heating coil in the hot deck and a chilled water coil on the cold deck. It is understood that the supply fan has been retrofitted with a VFD drive and two supply air pressure sensors. It is understood that the existing return air fans have been converted to exhaust air and the supply fan draw the balance of air from the mechanical room, total outdoor air quantity supplied by the unit is unknown at this time.

Systems 29 & 30 originally handled laboratory fume hood make up air duties, but have since been decommissioned and removed. The supply ductwork risers serving the mechanical corridors on floors 4 through 7 still remains, but is capped at each floor.

M-Figure 29 Systems 29 and 30 capped make up air duct distribution to exhaust hoods

Air handling system 31 is approximately 24,000CFM, 50HP supply fan and 7.5HP exhaust fan. Both supply and exhaust fans are served by VFDs. The unit feeds the building perimeter induction units from floors 4 to 7. The unit is 100% outdoor air. The unit is equipped with a heating and cooling coil and a decommissioned humidification section. The unit is divided into three zones each complete with duct mounted heating coils (south, east and west zone). It is understood that the supply fan has been retrofitted with a VFD drive and two supply air pressure sensors.

Air Handlers Recommendation: It is recommended that the existing air handling systems 27, 28, and 31 be assessed via air balancing test to measure the current system capacity with all the terminal boxes in maximum setting. Focus should be provided on how much outside air the units are drawing and what is the supply air (discharge air) temperature and humidity conditions are in both heating and cooling seasons.

As part of any future renovations to the labs and office spaces it is recommend that a refurbishment or replacement 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 listed above 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/replacement shall account for adjustments in the system external static pressures to assure variable volume can be achieved on both the supply and general exhaust distribution systems.

All new supply air system shall be designed to conform to Health Science Laboratory Standards as published on March 17, 2014 and other applicable codes and standards, at a minimum the following shall be adhered to.

Laboratories:

1. Ventilation systems should be designed to address worst of the following requirements:
    a. Hood or special exhaust requirements,
    b. Thermal load requirements, or
    c. As a minimum, if requirements for a and b above are not defined, design for 10 air changes per hour of supply air with the ability to set back to 6 air changes for un-occupied mode. Based on the air handling system airflows mentioned above, Systems 27 and 28 appear to be capable of maintaining 10 air changes per hour in the current lab areas.
2. If allowable, a Demand Air Supply (DAS) system should be considered to reduce the minimum number of air changes per hour.
    a. A DAS system samples the concept of an air monitoring system to detect unsafe or unhealthy conditions in a lab and automatically initiate the emergency ventilation system to flush exhaust the lab and return it to safe conditions while the problem is being identified and resolved.
    b. The effective use of a DAS system is dependent on the substances and materials being used in the lab, as some hazardous substances may not be detectable by the monitoring system.

Lab Support Areas:

1. Ventilation design should be based on worst case of the following:
    a. Special exhaust requirements,
    b. Thermal loads, or
    c. A minimum of 6 air changes per hour of supply air, unless a DAS system is being used.

Office Areas:

a. 9.4 L/s·person (20 cf/m·person) of outside air, will be provided from the main building 100% outside air system.

Washrooms:

a. 35.4 L/s (75 cf/m) per water closet or urinal, or minimum of 21.5 L/s ·m² (2 cf/m·ft²).

Corridors:

a. 0.55 L/s ·m² (0.05 cf/m·ft²)

Storage Rooms (Hazardous Material):

a. 10.7 L/s ·m² (1 cf/m·ft²).

M-Figure 30 System 27 supply side

M-Figure 31 System 27 return side

M-Figure 32 System 31

M-Figure 33 System 28 supply side

M-Figure 34 System 28 return side

3.4.3.2 Terminal Devices and Diffuser and Grille Conditions: Dual duct terminal devices and supply air diffusers and return air grilles are all ducted to their respective duct system. Terminal devices and diffusers throughout the facility are in varying conditions ranging from original vintage to new. Diffusers in the corridors serving the laboratory and office spaces have been rearranged since original construction. On floors 4 and 5 where dual duct terminal box replacement has occurred, new diffusers have been installed throughout the corridors, while the remaining floors have original diffusers that have been relocated.

Typical laboratory spaces have three levels of refurbishment: original, some renovations and complete renovations. Laboratories that are original contain all original diffusers and grilles that are in poor to fair condition. Laboratories that have had some renovations done to them typically have had their diffusers and grilles replaced; diffuser and grille conditions are fair. Laboratories that have had complete renovations have all new diffusers and grilles that are in good condition. Refer to room detail matrix for room by room description.

Since original construction, many offices have been renovated or retrofitted to suit new use requirements. The HVAC systems do not appear to have been upgraded along with these retrofits. Many offices have no return air as a result of these renovations.

Insufficient cooling appears to be a common issue as noted by staff complaints and evident of supplemental cooling systems added to certain rooms. The types of supplemental cooling systems range from split direct-expansion systems to residential grade packaged cooling units.

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. 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. Once variable flow is achievable on the supply, general exhaust and fume hood exhaust; a variable flow sequence can be implement to each lab, this modification and sequence of operation will complement the CCIW Administration Laboratory *Central Exhaust System Study* prepared by Filer Engineering Dated July 11, 2013, refer to Appendix C.

As part of future renovation, rooms with large equipment loads should be addressed by providing additional supply air and general exhaust to comply with the expected heat dissipation in the space. Where this air is extensive, the implementation of spot cooling unit shall be considered so that the central air system is not taxed with increased outdoor air requirements.

The offices along the perimeter are served by induction units, building occupants in the perimeter offices often complain about being too hot or too cold. As confirmed by facilities, the control valves in the induction units date back to the original vintage of the building and are both cumbersome and expensive to replace. Replacing the induction systems with an alternate system should be considered as part of any future renovation project.

M-Figure 35 Original and new diffusers located side by side

M-Figure 36 Packaged air conditioning unit

M-Figure 37 Split air conditioning indoor unit

3.4.4 Air Handling Systems – Laboratory Exhaust

3.4.4.1 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 corridor, then rise within the corridor. Exhaust fans in the penthouse are of unknown vintage, and maintenance has been carried out on some units such as motor and belt replacements. In accordance with the Filer Engineering *Central Exhaust System Study (CESS)* study shall be referred to for further details on the existing fume hood system and proposed upgrades that should be considered as part of any future renovations to the facility.

M-Figure 38 Laboratory exhaust ducts and fans in mechanical penthouse

Fume hoods within laboratories exist in varying conditions – some are original and some have been recently updated. All fume hoods have had their supply air connection removed. Original fume hoods have a constant exhaust rate while the recently replaced fume hoods have a variable exhaust rates based on the sash position. Fume hoods are typically tagged with the tag of their accompanying exhaust fan, however some of the newer units are not tagged.

Many laboratories are equipped with exhaust snorkels of varying vintage. These snorkels are also served by one exhaust fan per laboratory, snorkels are typically tagged with the exhaust fan that serves them. Some snorkels have been removed, often leaving the rough-in exposed in the T-bar ceiling. Some rough-ins were observed to be capped with aluminum foil and some were left exposed. Refer to appendix A for further details on a room by room basis.

Laboratory Exhaust Recommendation: Refer to recommendations as summarized in the Filer Engineering report. In summary, below is a recap of the recommend modifications:

1. The speed of the control action for the fume exhaust, general exhaust and the supply air flow must be similar to avoid pressurization fluctuations.
2. The general exhaust for the labs shall be connected to a new dedicated general exhaust fan.
3. New central fume hood exhaust fan system complete with heat recovery.
4. Each fume hood and general exhaust duct is required to have a control damper or valve to modulate the correct air flow requirement.
5. All original fume hoods should be replaced with variable air flow type hoods.

Furthermore, should additional general exhaust be required to accommodate future renovations, the use of the abandoned exhaust hood make up air duct should be considered.

Any new work shall comply with the following requirements:

- Low flow fume hoods to be considered in lab designs.
- The criteria is based on a Containment Level 2 Lab, where room supply and general exhaust airflow modulates proportionally to maintain negative room pressure and hood exhausts can modulate to maintain a constant air volume. As such, any future design considerations to include a Containment Level 2 Lab should have the functions noted above.
- The general heating and cooling should be provided by an air handling unit with local reheat for each lab terminal unit. The existing heating and cooling system is provided by a central air handling system via dual duct system and mixing terminal box. As such, the existing system is capable of modulating heating and cooling.

- Laboratory drainage is to be treated at a neutralization system. The existing drainage system has a neutralization tank that appears to be of original vintage and not operational as observed on site. As per section 3.4.1.1, further investigation is required.
- Laboratory gas cylinders should be stored securely, with brackets, in close proximity to the laboratory but not within the lab itself. The existing gas cylinders were observed to be located within labs and not properly secured. As required, the lab modernization plan should incorporate a dedicated area for gas storage.
- Laboratory liquids locations for purified water and liquid nitrogen are stipulated as part of this criteria. As part of the modernization plan, locations of where laboratory liquid is required must be provided to the plumbing system designer.

M-Figure 39 Laboratory snorkel

M-Figure 40 Snorkel rough-in uncapped

M-Figure 41 Poorly capped snorkel rough-in

M-Figure 42 Poorly capped snorkel rough-in

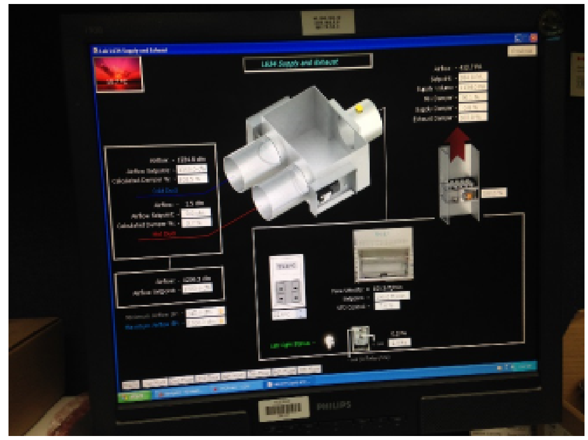
3.4.5 HVAC Controls

3.4.5.1 Controls: Thermostats are located in typical laboratories located on the wall near the door. The existing control system is a Delta Controls System. Thermostats were a mixture of digital in renovated areas and pneumatic in non-renovated areas. In general, floors 4 and 5 have been upgraded, floors 6 and 7 have only been upgraded in specific labs, refer to appendix A for further details. As part of these recent renovations, the existing dual duct boxes have been replaced. Existing thermostats are monitored at the BAS.

Existing air handling units systems 27, 28 and 31 are not connected to the building automation system.

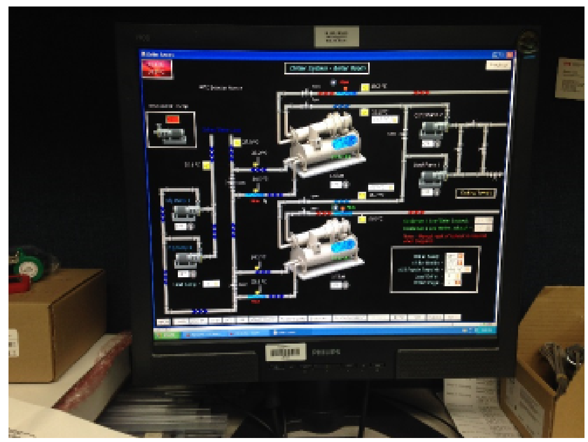
Controls Recommendations: The BAS infrastructure shall allow lab areas to have the ability to operate independently, controllers to be electronic and on emergency power, and uninterruptible power supply. All new terminal devices as noted above shall be picked up by the existing BAS system. The existing air handling units are not tied in to the BAS, as part of any future project the existing controls system and controls graphic shall be updated to pick up all the new and refurbished air handling systems. Lastly, pressure monitoring shall be carried out in all CL-2 labs.

M-Figure 43 BAS operator work station, user interface

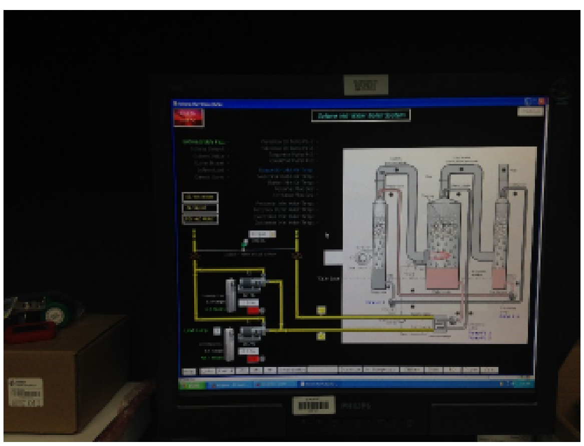


M-Figure 44 Laboratory BAS graphics

M-Figure 45 Lab supply fan graphics



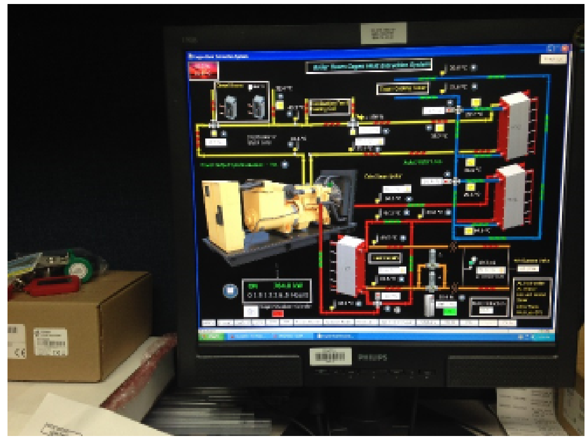
M-Figure 46 Chilled water system graphics



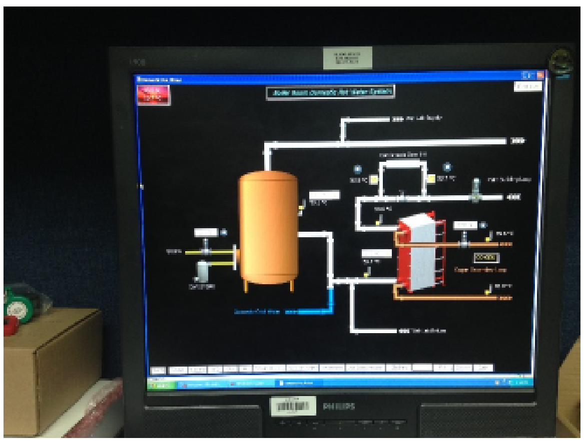
M-Figure 47 Sofame hot water boiler system graphics

M-Figure 48 Steam boiler system graphics

M-Figure 49 Air compressor system graphics



M-Figure 50 Cogen system graphics



M-Figure 51 Domestic hot water boiler system graphics

3.4.6 Recommendations

Sanitary and Acid Waste Drainage Recommendation: It is recommended that where plastic pipe penetrates fire rated assemblies the distribution be reviewed for compliance to fire separation requirements. The conditions of the acid neutralization tanks could not be inspected during the site visit, however as noted by facility staff and as observed from the neutralizer controller, it is understood that the tanks are no longer operational and have not been maintained in some time. Based on this understanding it is recommended that the existing tanks be inspected. Further review is required with user groups to confirm what the internal process is to prevent intentional and unintentional disposal of chemicals to drain.

Domestic Potable Water Recommendation: As part of any future renovations, a strategy to separate potable water from lab water should be considered. In efforts to mitigate cross contamination between potable water and non- potable water demands (ie. hand wash sinks and lab sinks) it is recommend that a dedicated risers be provided to serve potable water (drinking water) sources and a backflow prevention be added to any services extended to non-potable demands (ie. lab sinks and lab equipment).

In addition, as part of any future renovations any existing risers to be re-used shall be inspected further; the existing risers date back to the original vintage of the building and as such are reaching 40+ years. It is recommend that some destructive testing be carried out on a sample basis to verify existing pipe wall thickness. Test should be carried out at the bottom of the riser around the existing elbows.

Domestic Hot Water Recommendation: As part of any future renovations, a strategy to separate domestic hot water from lab water should be considered. In efforts to mitigate cross contamination between domestic hot water and non- potable hot water demands (ie. hand wash sinks and lab sinks) it is recommend that a dedicated risers be provided to serve potable water (drinking water) sources and a backflow prevention be added to any services extended to non-potable demands (ie. lab sinks and lab equipment).

The system does not currently have a closed hot water recirculation loop; it utilizes solenoid valves to maintain the loop temperature as described above. In efforts to mitigate water consumption and to comply with current energy standards and guidelines it is recommended that as part of any future renovations the existing loop temperature control be replaced with a close circuit recirculation loop complete with recirculation pumps. In addition as part of any future renovations a study of the actual DHW consumption shall be carried out, the study shall be used to verify and optimize the size of the domestic hot water storage tank.

As part of any future renovations any existing risers to be re-used shall be inspected further; the existing risers date back to the original vintage of the building and as such are reaching 40+ years. It is recommend that some destructive testing be carried out on a sample basis to verify existing pipe wall thickness. Test should be carried out at the bottom of the riser around the existing elbows.

As part of any future renovations all existing protective equipment (ie. emergency shower and eye wash station) 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.

RO Water Recommendation: 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, if RO water is required in the labs 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.

It is understood that the existing air compressors are in acceptable condition and the need to replace any component on the central distribution system will be monitored and tracked by facilities as part of ongoing infrastructure upgrades.

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.

Plumbing Fixture Recommendation: As part of the modernization plan it is recommended to replace all washroom fixtures with low flow type to conserve water and comply with current codes and standards. Furthermore, it is recommended that all lab fixtures in poor conditions be replaced.

Heating Recommendations: 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 Recommendations: 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 Recommendation: It is recommended that the existing air handling systems 27, 28, and 31 be assessed via air balancing test to measure the current system capacity with all the terminal boxes in maximum setting. Focus should be provided on how much outside air the units are drawing and what is the supply air (discharge air) temperature and humidity conditions are in both heating and cooling seasons.

- As part of any future renovations to the labs and office spaces it is recommend that a refurbishment or replacement 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 listed above 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/replacement shall account for adjustments in the system external static pressures to assure variable volume can be achieved on both the supply and general exhaust distribution systems.
- All new supply air system shall be designed to conform to Health Science Laboratory Standards as published on March 17, 2014 and other applicable codes and standards, at a minimum the following shall be adhered to.

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. 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. Once variable flow is achievable on the supply, general exhaust and fume hood exhaust; a variable flow sequence can be implement to each lab, this modification and sequence of operation will complement the CCIW Administration Laboratory Central Exhaust System Study prepared by Filer Engineering Dated July 11, 2013, refer to Appendix C.

- As part of future renovation, rooms with large equipment loads should be addressed by providing additional supply air and general exhaust to comply with the expected heat dissipation in the space. Where this air is extensive, the implementation of spot cooling unit shall be considered so that the central air system is not taxed with increased outdoor air requirements.

- The offices along the perimeter are served by induction units, building occupants in the perimeter offices often complain about being too hot or too cold. As confirmed by facilities, the control valves in the induction units date back to the original vintage of the building and are both cumbersome and expensive to replace. Replacing the induction systems with an alternate system should be considered as part of any future renovation project.

Laboratory Exhaust Recommendation: Refer to recommendations as summarized in the Filler Engineering report. In summary, below is a recap of the recommend modifications:

- The speed of the control action for the fume exhaust, general exhaust and the supply air flow must be similar to avoid pressurization fluctuations.
- The general exhaust for the labs shall be connected to a new dedicated general exhaust fan.
- New central fume hood exhaust fan system complete with heat recovery.
- Each fume hood and general exhaust duct is required to have a control damper or valve to modulate the correct air flow requirement.
- All original fume hoods should be replaced with variable air flow type hoods.
- Furthermore, should additional general exhaust be required to accommodate future renovations, the use of the abandoned exhaust hood make up air duct should be considered.

Any new work shall comply with the following requirements:

- Low flow fume hoods to be considered in lab designs.
- The criteria is based on a Containment Level 2 Lab, where room supply and general exhaust airflow modulates proportionally to maintain negative room pressure and hood exhausts can modulate to maintain a constant air volume. As such, any future design considerations to include a Containment Level 2 Lab should have the functions noted above.
- The general heating and cooling should be provided by an air handling unit with local reheat for each lab terminal unit. The existing heating and cooling system is provided by a central air handling system via dual duct system and mixing terminal box. As such, the existing system is capable of modulating heating and cooling.
- Laboratory drainage is to be treated at a neutralization system. The existing drainage system has a neutralization tank that appears to be of original vintage and not operational as observed on site. As per section 3.4.1.1, further investigation is required.
- Laboratory gas cylinders should be stored securely, with brackets, in close proximity to the laboratory but not within the lab itself. The existing gas cylinders were observed to be located within labs and not properly secured. As required, the lab modernization plan should incorporate a dedicated area for gas storage.
- Laboratory liquids locations for purified water and liquid nitrogen are stipulated as part of this criteria. As part of the modernization plan, locations of where laboratory liquid is required must be provided to the plumbing system designer.

Controls Recommendations: The BAS infrastructure shall allow lab areas to have the ability to operate independently, controllers to be electronic and on emergency power, and uninterruptible power supply. All new terminal devices as noted above shall be picked up by the existing BAS system. The existing air handling units are not tied in to the BAS, as part of any future project the existing controls system and controls graphic shall be updated to pick up all the new and refurbished air handling systems. Lastly, pressure monitoring shall be carried out in all CL-2 labs.

3.5 Electrical Systems

3.5.1 Service Entrance and Distribution

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. The main service feeds a 600A, 27.6kV outdoor switchgear with three (3) 600A load break switches. Each load break switch supplies power to 3MVA outdoor transformer. Secondary cables from these three outdoor transformers provide power to the switchboard within the main Electrical room via parallel runs of TECK cable. Two of the three transformers terminate into a 600V, 4000A twin switchboard forming a single lineup. The third transformer feeds a 5kV, 2200A switchboard which supplies power to the WTC building via feeders in the crawl space and tunnels.

E-Figure 1 Incoming 27.6kV Switchgear

E-Figure 2 Outdoor Service Transformers

The 600V distribution within the main 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. A key interlock system allows selectivity from the redundant 600V sources. This report focuses on the Admin & Lab (A&L) portion of the distribution system.

E-Figure 3 Main 600V Twin Switchboard

E-Figure 4 5kV Switchboard, Aging

E-Figure 5 Misc Aging Distribution Equipment

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 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.

It was observed that the distribution equipment had Arc Flash Hazard labels dated from 2011 indicating appropriate PPE requirements as per Ontario Electrical Code and CSA Z462 requirements.

Recommendations:

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 outside of this scope; the main 5kV switchboard feeding WTC building is an especially dated unit.

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 are aging and should be replaced.

One of the main problems with dated distribution equipment arises in the event of component failures as replacement parts can be difficult if not impossible to procure in a timely manner.

3.5.2 Emergency Power System

The Emergency Power System has recently been separated into 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. Through a 1000A automatic transfer switch, power is supplied to a 1200A, 600V life safety power distribution panel LSP-1, which in turns feeds LSP-4, a life safety distribution panel dedicated to the A&L area. From this distribution panel, a single 150kVA transformer feeds one life safety 120/208V panelboard on each floor.

The separate Critical Power System feeds building mechanical equipment, select lab equipment, UPS systems, and other equipment. The critical power system additionally has the ability to connect to a portable backup generator through a manual transfer procedure.

E-Figure 6 Main Critical Power Panel, New

E-Figure 7 Main Life Safety Panel

E-Figure 8 Example of Aging Emergency Distribution Equipment

In addition to the two generators noted above, an 810 kW, 600V, Co-Generator unit is also located in the Boiler Room area. The Co-Gen unit currently supplies power back to the main 600V distribution board located within the Main Electrical Room.

It was observed that there is limited UPS power via standalone local UPS units as well as in newer labs (e.g. L727 has a 50kVA UPS).

Recommendations:

The generators and co-gen appear to be in good working condition, although details of maintenance and testing are not known at this time. The emergency power distribution is comprised of a mix of aging and newer distribution equipment. Much of the newer distribution equipment is related to the recent Life Safety and Critical Power disambiguation work.

The majority of Critical Power Panels including the one feeding A&L (CPP-4) are relatively new (dated 2009) and in good condition.

Large portions of the life safety distribution system are quite dated. Many of aging life safety distribution equipment does not directly affect the Labs on floors 4-7 but we recommend further investigation outside of this scope. As part of the LMP scope, we recommend replacing Main Life Safety Panel LSP-1 and A&L Life Safety Panel LSP-4.

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.

3.5.3 Laboratory Power Systems

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 4^{th} floor horizontal bus duct via 70A/2P or 100A/2P bus plugs.

Laboratory panelboard loads typically include some combination of fume hoods, wall/bench receptacles, air conditioners, refrigerators, and freezers.

E-Figure 9 Typical Lab Panel, Front

E-Figure 10 Typical Lab Panel, rear

Recommendations:

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 new laboratory renovations include in their scope the relocation of panelboards to the front of the room where they are easily accessible while maintaining adequate clearances.

3.5.4 Lighting

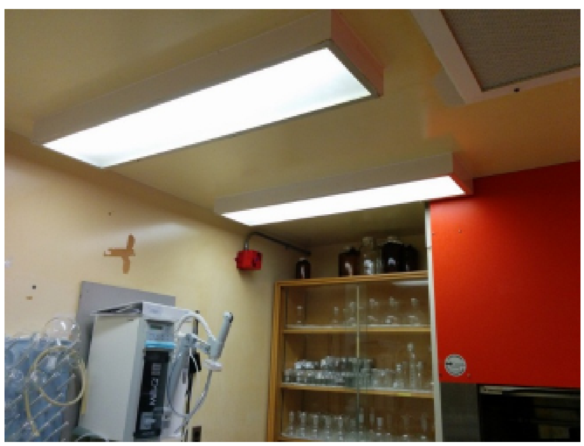
Interior lighting in the A&L Building is provided from a variety of fluorescent fixtures, both recessed and surface mount, containing T8 lamps. The laboratory lighting and corridor lighting on the lab floors are typically fed from the corridor panels and are scheduled via building automation.

On the 7^{th} floor corridors are single lamp T8 1’x4’ surface mounted fixtures. There is also deprecated cove lighting along the 7^{th} floor corridors. The ceilings on the 4^{th}, 5^{th}, and 6^{th} corridors appear to have been renovated and the corridor lighting consists of recessed 2 lamp 1’x4’ fluorescent fixtures. Office areas are typically lit with 2x4’ recessed fluorescent fixtures, occasionally supplemented by task lighting.

In Laboratory areas there are a variety of fluorescent fixtures, both recessed and surface mount. Some storage areas contain explosion proof fixtures and fittings with incandescent style lamps, and controlled by local wall switches. The stairwells have varying types of fluorescent fixtures, suspended and surface mount.

E-Figure 11 Deprecated Cove Lighting on 7th Floor

E-Figure 12 Recessed Lab Lighting, Inconsistent Light Levels



E-Figure 13 Surface Mounted Lab Lighting

Recommendations:

The 7th floor corridors are not as well lit as other floors, although lighting tests were not conducted. Upgrades to lighting are recommended if any ceiling work is planned on the 7th floor.

Lighting within existing laboratories appears to be inconsistent. Except for special considerations for particular labs, recommended lighting levels for labs is generally around 500 lx. Specialty labs based on user requirements may require higher lighting levels for the performance of tasks of low contrast and small size. In these areas, we recommend supplemental task lighting be installed to address these situations. Task lighting should also be considered under upper cabinets.

There does not appear to be any LED lighting in the new labs. We recommend any new lab renovations as part of the Lab Modernization Project are LED type for improved efficiency and control options. Notwithstanding upgrades to aging distribution equipment noted in other parts of this report, upgrading to LED lighting should allow for increased and consistent illuminance levels to be achieved while remaining within the existing capacity of the distribution system.

3.5.5 Emergency Lighting/Exit Lighting

The emergency lighting is provided from emergency panels on each floor. The emergency 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.

E-Figure 14 Typical Corridor Exit Sign

E-Figure 15 Variety of Exit Sign Types

Recommendations:

Notwithstanding upgrades to aging distribution equipment noted in other parts of this report, there exists sufficient infrastructure capacity for life safety and emergency lighting throughout the building. Further review of the emergency lighting on each floor should be undertaken to determine if lighting levels reach minimum lux required for safe egress.

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.

3.5.6 Receptacles and Branch Wiring

Branch wiring consists of two different systems. For lighting, the wiring is fed from panel boards, with conduit home runs to junction boxes and then from fixture to fixture with armoured cable in the ceiling space or EMT conduits for surface applications. For receptacles, armoured cable drops are run through walls to flush mounted devices and EMT conduits are used for exposed applications. PAC poles are used to service modular furniture.

E-Figure 16 Surface Mounted Conduit

E-Figure 17 Power Bars Being Used Where Insufficient Receptacles Of The Required Type

Recommendations:

The condition of existing branch wiring and conduit seems to be fair and does not require any work in near future. However, for all new renovations we recommend wire in conduit shall be utilized as much as possible for wall and ceiling devices. Uses of BX should be kept to a minimum, with maximum recommended length of 3.5m. It was also noted that outlets near sinks were not always GFCI type. This safety hazard can be exasperated by the use of power bars.

Lack of sufficient receptacles is a common problem in the labs, which can lead to unsafe conditions such as extension cords, power bars, and overloaded breakers. Any renovated labs should have numerous receptacles along the counters/millwork/benches/etc. Outlets and wiring should be installed in a lab-safe raceway with multiple channels for data, normal power, and emergency power where needed. Where required for island furniture, vertical raceway should be used to provide services to the work area.

Some equipment within labs may need to be moved to the emergency/critical power system (fridges, freezers, some specialty lab equipment, etc).

3.5.7 Fire Alarm System

The A&L Building is equipped with an Edwards, two stage, multi-zone fire alarm main panel which monitors heat and smoke detectors, manual pull stations, sprinkler flow, anti-tamper devices on control valves, and fire suppression systems located in special areas. The main control is provided by a fire alarm control computer and software package rack mounted in a separate cabinet located within the Maintenance Control Room at the front entrance of the facility. The main fire alarm system incorporates a voice communication system that consists of speakers installed throughout floor spaces.

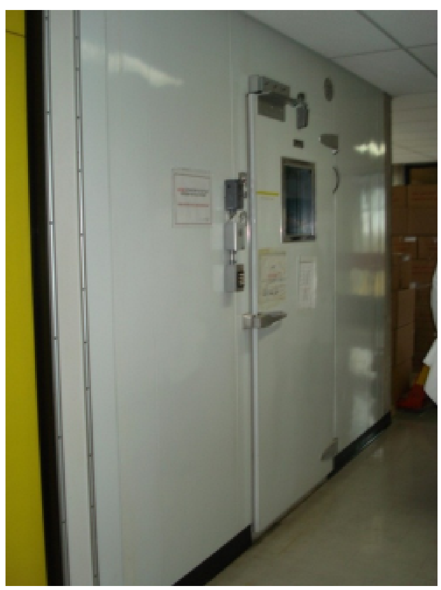
On the 4th-7th floor, heat detectors are installed in the ceiling of all labs. No fire detection devices were observed at the corridors. Notification in these corridors was through ceiling speakers. Fire fighters handsets were observed at stairwell entrances. Smoke detectors were observed at doors with hold open devices.

Recommendations:

A review of the fire alarm system indicated that the Fire Alarm system was in good condition from an infrastructure perspective. A device level review of the fire alarm system was not conducted as part of this investigation and report. We recommend a further investigation to confirm that all magnetic locking devices and hold open devices are connected to the fire alarm system, as well as a review of pull station locations.

E-Figure 18 Pull station and Fighters Handset at Stairwell Entrances

E-Figure 19 Smoke Detector for Hold Open Doors



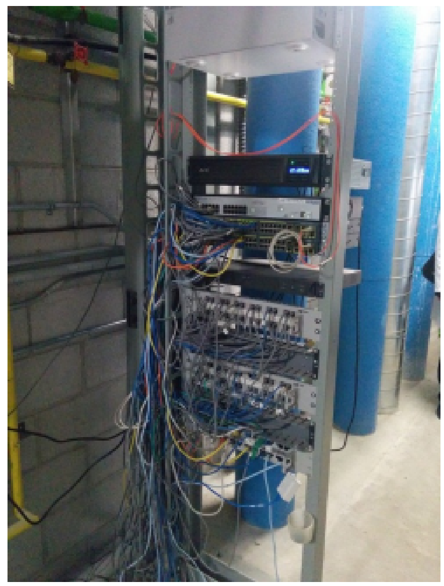
E-Figure 20 Maglock Door

3.5.8 Telecommunication Systems

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. The front end equipment is a Nortel Networks System with distribution by a multi-line BIX board type installation for phone lines and fibre optic cables to the main computer room areas. 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. The majority of communications for the facility is connected to this location. LAN towers and rack mounted computer equipment located within the Main Computer Room provide communications to all floors via conduit risers and fibre optic trunk lines to local LAN racks installed at each level. All of the observed racks were in the service corridors. The LAN equipment in the service corridors were generally not fed from emergency power.

E-Figure 21 Telephone Closet, Typical



E-Figure 22 LAN Rack in Service Corridor, Typical

Recommendations:

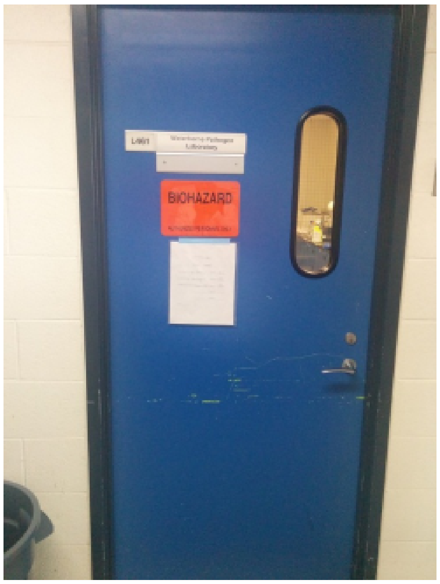
We recommend that as part of the Lab Modernization Project all LAN equipment in service corridors should be moved to dedicated Communications closets in accordance with Shared Services Canada (SSC) requirements with a minimum of one per floor. This will allow a dedicated cooling system to provide temperature 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 Comms closet to drops on the floor areas.

3.5.9 CCTV/ Security Systems

The security for the A&L facility is provided by monitored door contacts via a Delta card access system, with CCTV cameras connected to monitors, switchers and digital recording equipment and a 24/7 security posting. Camera monitors and control are located within the security desk area.

There is minimal security coverage on floors 4-7. The majority of lab doors were keyed only. Only a few of the newly renovated labs had card access.



E-Figure 23 Keyed Lock on Lab Door, Typical

E-Figure 24 Keypad Lock on Lab Door, Typical

Recommendations:

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

3.5.10 Recommendations

Service Entrance and Distribution: 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 outside of this scope; the main 5kV switchboard feeding WTC building is an especially dated unit.

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 are aging and should be replaced.

Emergency Power System: The generators and co-gen appear to be in good working condition, although details of maintenance and testing are not known at this time. The emergency power distribution is comprised of a mix of aging and newer distribution equipment. Much of the newer distribution equipment is related to the recent Life Safety and Critical Power disambiguation work.

The majority of Critical Power Panels including the one feeding A&L (CPP-4) are relatively new (dated 2009) and in good condition. Large portions of the life safety distribution system are quite dated. Many of aging life safety distribution equipment does not directly affect the Labs on floors 4-7 but we recommend further investigation outside of this scope. As part of the LMP scope, we recommend replacing Main Life Safety Panel LSP-1 and A&L Life Safety Panel LSP-4.

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

Laboratory Power Systems: 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 new laboratory renovations include in their scope the relocation of panelboards to the front of the room where they are easily accessible while maintaining adequate clearances.

Lighting: The 7th floor corridors are not as well lit as other floors, although lighting tests were not conducted. Upgrades to lighting are recommended if any ceiling work is planned on the 7th floor.

Lighting within existing laboratories appears to be inconsistent. Except for special considerations for particular labs, recommended lighting levels for labs is generally around 500 lx. Specialty labs based on user requirements may require higher lighting levels for the performance of tasks of low contrast and small size. In these areas, we recommend supplemental task lighting be installed to address these situations. Task lighting should also be considered under upper cabinets.

There does not appear to be any LED lighting in the new labs. We recommend any new lab renovations as part of the Lab Modernization Project are LED type for improved efficiency and control options. Notwithstanding upgrades to aging distribution equipment noted in other parts of this report, upgrading to LED lighting should allow for increased and consistent illuminance levels to be achieved while remaining within the existing capacity of the distribution system.

Emergency Lighting/Exit Lighting: Notwithstanding upgrades to aging distribution equipment noted in other parts of this report, there exists sufficient infrastructure capacity for life safety and emergency lighting throughout the building. Further review of the emergency lighting on each floor should be undertaken to determine if lighting levels reach minimum lux required for safe egress.

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.

Fire Alarm System: A review of the fire alarm system indicated that the Fire Alarm system was in good condition from an infrastructure perspective. A device level review of the fire alarm system was not conducted as part of this investigation and report. We recommend a further investigation to confirm that all magnetic locking devices and hold open devices are connected to the fire alarm system, as well as a review of pull station locations

Receptacles and Branch Wiring: The condition of existing branch wiring and conduit seems to be fair and does not require any work in near future. However, for all new renovations we recommend wire in conduit shall be utilized as much as possible for wall and ceiling devices. Uses of BX should be kept to a minimum, with maximum recommended length of 3.5m. It was also noted that outlets near sinks were not always GFCI type. This safety hazard can be exasperated by the use of power bars.

Lack of sufficient receptacles is a common problem in the labs, which can lead to unsafe conditions such as extension cords, power bars, and overloaded breakers. Any renovated labs should have numerous receptacles along the counters/millwork/benches/etc. Outlets and wiring should be installed in a lab-safe raceway with multiple channels for data, normal power, and emergency power where needed. Where required for island furniture, vertical raceway should be used to provide services to the work area.

Some equipment within labs may need to be moved to the emergency/critical power system (fridges, freezers, some specialty lab equipment, etc

Telecommunication Systems: We recommend that as part of the Lab Modernization Project all LAN equipment in service corridors should be moved to 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 Comms closet to drops on the floor areas

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

4 Building Code Review

4.1 Report and Applicable Codes

DIALOG has prepared the following building code review on the life safety for Floors 4 to 7 of the Administration and Laboratory Building of the NWRI. This review is specific to Floors 4 to 7 but cannot be taken in isolation without a review of the entire building. The following 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. It should be noted that there are many areas of operations and maintenance which are beyond the scope of this review. 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 Authority Having Jurisdiction (AHJ) will be the Labour Canada – Fire Protection. This report is limited to the A&L Building only within the context of the much larger facility. The building beyond the area in question was not reviewed and was not part of the project mandate. There may be safety issues with respect to the Treasury Board Fire Protection Standards which do not meet the recommended standards. These code and life safety issues will be reviewed in the later design stages as applicable and in consultation with Fire Protection Engineering with PWGSC.

Legislative Requirements

The Canada Centre for Inland Waters is a federally owned and occupied building to which the Canada Labour Code (CLC) and the Canada Occupational Health and Safety Regulations (COHS Regulations) apply. As per the COHS Regulations Subsection 2.2 (2), an existing building is subject to the application of the National Building Code.

In the reference to the NBC in the COHS Regulations, the NBC is applicable only "…to the extent reasonably practicable…" This significantly qualifies the extent to which an existing building is required to be upgraded to comply with the current version of the NBC or subsequent editions, including amendments. However, the qualification is subjective and can consider many variables including construction complexity or difficulty and cost, in addition to life safety value of current Code provisions which differ from existing conditions or requirements that applied at the time of construction.

Treasury Board Standards

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 6.1.2.

6.1.2. That real property in Canada administered by the department complies with the following:

a) The fire protection requirements of the NFC, and the NBC or of applicable local codes when the following takes place:
   i. There is a change in the use of the real property;
   ii. Real property is acquired (including lease renewal) or new structures are constructed; or
   iii. Existing real property is altered and

b) The NFC or applicable local fire codes throughout the life cycle of the property.

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.

It is noted that the TB 3-6, which was applicable under the previous Treasury Board Fire Protection Policy has been revoked by Treasury Board (as of April 1, 2010) but is intended to be used as a best practice guideline and may be enforced by Government Departments as a matter of policy.

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.

There are a number of Codes, Regulations, Standards and Guidelines that are applicable to the design and construction associated with the CCIW A&L Building and in particular the LMP project and include the following:

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
- CSA B149.1-10 Natural Gas and Propane Installation Code

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;
- Labour Canada's, Fire Commissioner of Canada Standards including;
- National Fire Protection Association (NFPA)
- NFPA 10; Standard for Portable Fire Extinguishers - 2010
- NFPA 13; Standard for Installation of Sprinkler Systems - 2010
- NFPA 14; Standard for Installation of Standpipe and Hose Systems - 2010
- NFPA 30; Flammable and Combustible Liquids Code
- NFPA 45; Standard on Fire Protection for Laboratories Using Chemicals
- NFPA801 – Facilities Handling Radioactive Materials
- NSF 49 – Biological Safety Cabinet Standards
- NFPA 99 – Fire Protection for Health Related Laboratories

4.2 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 Fire Protection Engineering of PWGSC as the 'Authority Having Jurisdiction' (AHJ) in Federal facilities. Knowing the occupancy types is critical in order to ensure proper assessment of required fire separations, egress and exit requirements. This report has made some assumptions and recommendations for Floors 4 to 7 of the A&L Building as well as some assumptions of requirements for the rest of the NWRI Building.

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 freight 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 **3,612m^2** with the Floors 4 to 7 having a building area of **2,978 m^2**. The Useable area excluding shafts, stairs, elevators is **2,638m^2**

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 **2,898 m^2**.

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 **7,002m^2** and the Second Floor Offices is **742m^2**

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 **856m^2**

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 **5,492m^2** .

The overall ground floor footprint or area of the NWRI as measured under the NBC '*building area*' is approximately **20,602m²**. 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.

4.3 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 to 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 1 h 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.

4.4 Fire Separations and Closures

Construction, based on the application of the 2010 NBC, is required to meet the following fire separation requirements in Table 1 with fire protection ratings of doors indicated in Table 2.

Table 1: Location and Type of Fire Separations.

Location	Fire Separation / Fire Resistance Rating
Exit Stairs	Fire separation with 2 hour FR rating
Vertical Service Space (Shafts)	Fire separation with 2 hour FR rating
Janitor's Closet	No fire separation required (1h FRR required in non-sprinklered building)
Major Electrical Rooms	Fire separation with 1 hour FR rating
Electrical Closets	Unrated fire separation
Storage Rooms	Unrated fire separation
Vestibules at Exits	Unrated fire separation
Elevator Machine Room	Fire separation with 1 hr FR rating
Mechanical Rooms with Fuel-Fired Equipment	Fire separation with 1 hr FR rating
Mechanical Rooms without Fuel-Fired Equipment	Unrated fire separation

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)).

Table 2: Fire Protection Ratings of Closures (per NBC Table 3.1.8.4.)

Fire Resistance Rating of Assembly	Fire Protection Rating of Door
Unrated	No rating applicable
45 minutes	45 minutes
1 hour	45 minutes
2 hours	1½ hours

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).

A-Figure 49 Service Core penetration without fire stopping

A-Figure 50 Service Core penetration without fire stopping

A-Figure 51 Abandon opening

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 2h 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:

(a) 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
(b) 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.

4.5 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 Stair S01 and S03 but the maximum allowable travel distance in a non-sprinklered building of 30 m is exceeded in a number of areas. (Refer to Appendix B) 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 NBC requires that exits from floor areas support an occupant load of the building at a rate of 6.1mm/person for doorways, corridors and passageways. Stairs with risers not more than 180mm and not less than 280mm treads shall be designed at 8mm/person.

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.

A-Figure 52 Typical Stairwell

A-Figure 53 Room at top of Stairwell

-Figure 54 Top of Stairwell

A-Figure 55 Heater at top of Stairwell

Exit through Lobbies
In accordance with Article 3.4.4.2.(2), not more than one *exit* from a floor area is permitted to lead through a lobby, provided

a) the lobby floor is not more than 4.5m above *grade*
b) the path of travel through the lobby to the outdoors is not more than 15m,
c) the adjacent rooms having direct access to the lobby do not contain a *care, residential or industrial occupancy*
d) the lobby is not located within an *interconnected floor space* other than as described in Sentence 3.2.8.2.(6)
e) the lobby conforms to the requirements for *exits*, except that
    i. rooms other than *services rooms* and storage rooms are permitted to open onto the

lobby

ii. *the fire separation* between the lobby and a room used for the sole purpose of control of the *building* need not have a *fire-resistance* rating

iii. the *fire separation* between the lobby and adjacent *occupancies* that are permitted to open onto the lobby need not have a *fire-resistance* rating provided the lobby and adjacent *occupancies* are *sprinklered*, and

iv. passenger elevators are permitted to open onto the lobby provided the elevator doors are designed to remain closed

f) a *fire separation*, constructed in accordance with Sentence 3.4.4.1.(1), is maintained between the lobby and any *exit* permitted by the Sentence to lead through the lobby.

4.6 Code Compliance and Recommendations

A number of items have been identified as part of this Report and from previous reviews by the Treasury Board Fire Protection Compliance Monitoring Inspection. The issues identified throughout the facility are described within the report 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 PWGSC Fire Protection Engineering), 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 in order to meet the applicable sections of the NBC 2010. 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 4 ½" (115mm). 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 3.1.8.11. - Not all service core doors are not equipped with self-closing devices (some corridor doors, all lab doors).

d) NBC 3.3.1.3.(8)(b)(i) - Required second exit from the 4th to 7th floor Service Cores lead through adjacent laboratories. The travel distance within these Service Cores exceeds the allowable distance for a Dead End corridor especially in the South Service Core. The second exit leads through laboratories with posted hazard areas and some doors are blocked by equipment or inaccessible. In addition, many of these Service Cores have additional equipment or hazards located within them.

e) 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. Janitor's rooms such as L756 and L659 require door closers and fire separation as per the building code There are also a number of instances where doors do not have the required hardware and exit devices or have hold-open hardware, electric strikes or access control devices that are not in conformance with the with applicable code requirements. This includes Rooms L760, L759 and L730 which have thumb turn locks for the egress door. Door release hardware shall be operable by one hand and the door shall be operable with not more than one releasing operation

f) NBC 3.1.8.1. and 3.1.9.1. – The penetrations of the demising wall between the Laboratories on Floors 4 to 7 and the Service Cores does not have fire dampers on fume hoods or other exhausts. 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*. This would have to be reviewed during any proposed renovation to determine whether the required fire separation would be provided at the wall or floor assembly in order to determine the location of fire separations as the fume hood risers from laboratories below also penetrate the floor assembly at each level before they terminate at the Rooftop Mechanical penthouse. There are also many instances where there is no fire stopping in the Service Cores with penetrations without sealant, items removed and not sealed. The existing electrical panels in each laboratory which are located in the demising wall also do not provide the required fire separation.

g) NBC 3.4.4.4.(7) – There are instances where the service rooms on the 3rd floor Mechanical and Rooftop Mechanical Penthouse open directly into the Exit Stairs. A vestibule should be provided at these locations.

h) 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.

i) 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 10" (254mm). Minimum run under the NBC is 280mm. The stair tread width is 3'-6" (1,067mm) and the NBC requires a minimum

j) NBC 3.4.4.2. - Exit stairs lead through entrance vestibules, essentially making them 'exit lobbies' - only a single 'exit lobby' is permitted (in this facility it's Stair CC in the main entrance).

k) 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. (Refer to Appendix B-7th Floor Life Safety Plan)

There are a number of instances where operational and maintenance issues impact the life safety of the facility. While these are not directly related to the LMP they should be considered by Environment Canada. These include:

a) Laboratory ventilation shall be designed, maintained and tested in conformance to nationally recognized standards. There are numerous instances of fume hoods improperly used, ductwork truncated together through different floors and fire separations, chemical processes being vented that are not documented as being compliant to required standards.

b) Throughout the laboratory facilities there are numerous locations where chemicals are stored and used that has MSDS documentation that does not have any indication it is complete or up to date. Corrections shall be made.

c) Laboratory configurations change and the fire detector number and coverage are not suited for the revised layout. Corrections shall be made.

d) Room L752A, L752, L771, ZL625A, L616, L618, L545, and L472 requires fire detector coverage. Corrections shall be made.

e) Storage room L652A has missing ceiling tiles that may deter correct fire detector operation. Corrections shall be made.

f) Laboratory rooms L757 has a lab configurations that may require additional fire detector coverage or revised placement.

g) The service corridors on the 7th floor had flammable storage in them and such storage shall be removed. Corrections shall be made.

h) Numerous large freezers are being used for their original purpose, or are no longer operating as freezers and are being used for storage and offices and will require additional fire detector coverage or revised placement.

5 Barrier Free Accessibility

5.1 Description of Barrier Free Requirements

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 PWGSC 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. We will review these standards with PWGSC as part of the Feasibility and Concept Design Phases to determine if these requirements are applicable to the A&L 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

5.2 Noted Deficiencies

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.

5.3 Recommendations

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 CCIW 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.

6 Hazardous Substances

6.1 Description of Hazardous Substances

An Asbestos Assessment of the CCIW was undertaken by Pinchin Environmental on behalf of Environment Canada in July 2013. The assessment established the location and type of Asbestos Containing Materials (ACM) present in the building that was apparent to the surveyors and is noted in the Report 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 ACM's that are present. The full report must be referenced for the complete results of the assessment. This report was prepared to fulfil 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)
- Vinyl sheet flooring
- Vinyl floor tiles
- Bakelite

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

6.2 Findings from Pinchin Environmental Report

Texture Finishes (Acoustic/Decorative): Texture finish, presumed to contain asbestos of a type other than chrysotile, is present on the ceilings in the Main Corridor/Mall Area of the Main Building. The material is friable, is in good condition and is painted.

Pipe Insulation: 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.

Duct Insulation: 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.

Mechanical Equipment Insulation: Parging cement, containing chrysotile asbestos, is present over fibreglass on the green water tanks in the R & D Mechanical Penthouse and on joints of the yellow condensate tank in the WTC Mechanical Penthouse. Parging cement is a friable insulation, jacketed with canvas and is in good condition. Non-asbestos parging cement is present over fibreglass on the yellow recycled water tanks in the A&L Building Upper Mechanical Room. Remaining mechanical equipment is insulated with non-asbestos fibreglass or not insulated.

Acoustic Ceiling Tiles: A number of distinct types of acoustic ceiling tile were identified in the building and determined to be non-asbestos and by examining the manufacturer's date codes stamped on the top of the tiles (1992, 1994, 2000, 2004, 2006, 2007, or 2011 year of production) or by the nature of the material (fibreglass, wood fibre, or gypsum board).

Plaster: Non-asbestos smooth plaster is present throughout the site and non-asbestos textured plaster is present in the A&L Building Boiler Room Mezzanine.

Drywall Compound: The use of asbestos in drywall joint compound was banned under the Federal Hazardous Products Act of 1980 but it could possibly contain asbestos as late as 1986 (due to stored material and non-compliance with the ban). Most buildings undergo constant renovation, including the removal and replacement of drywall partitions. Attempts to distinguish and delineate asbestos-containing drywall compound from new non-asbestos drywall compound is often unachievable. Therefore, drywall joint compound was sampled by Pinchin at exterior walls, columns or other locations which are unlikely to have been renovated in an attempt to determine the presence of asbestos in the original drywall compound.

Drywall (gypsum board) is present as an upper wall finish within A&L Building Switch Gear Room. Drywall joint compound was found to contain chrysotile asbestos in at least one sample collected from this location. Asbestos-containing drywall joint compound is also present on drywall finishes in Lab L454 in the A&L Building. It is assumed that all drywall joint compound in these areas may contain chrysotile asbestos unless further sampling proves otherwise. Drywall joint compound is a non-friable material and is in good condition.

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).

Vinyl Floor Tile and Mastic: Five visually distinct types of asbestos-containing vinyl floor tile are present in the site buildings. All vinyl floor tiles are non-friable materials and are in good condition. Remaining types of vinyl floor tile present throughout the site were determined to be non- asbestos. Mastic used to adhere floor tiles was present as a second phase on all floor tile samples and was determined to be non-asbestos throughout the site.

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.

Presumed Asbestos-Containing Materials: A number of materials which might contain asbestos were not sampled during the Pinchin assessment. If present, these materials must be presumed to be asbestos-containing and are best sampled immediately prior to commencing renovation or demolition. Materials presumed to contain asbestos include:

- adhesives
- caulking
- components or wiring within motor control centers, breakers, motors or lights
- concrete levelling compound (for floors)
- fire resistant metal clad finishes
- fire-door cores
- insulation on or in high voltage wiring
- mechanical packing, ropes and gaskets
- moulded plastic components
- paper products where inaccessible (e.g. under wood flooring or under metal or slate roofing)
- refractory materials and insulations in boilers, incinerators and stacks (possibly friable)

6.3 Recommendations

If these materials and others identified by a DSS are present they 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.

The following is a brief list of the procedures prepared by Pinchin Environmental to be used for asbestos abatement, if and when required.

Texture Finish: If texture finish is to be disturbed use Type 3 procedures as outlined within Ontario Regulation 278/05. If only minor amounts of texture finish are to be disturbed (less than 1 square metre), Type 2 procedures would be applicable.

Pipe Insulation: If pipe insulation is to be removed, remove minor amounts (less than 1 square metre) of asbestos-containing pipe insulations using Type 2 procedures as outlined within Ontario Regulation 278/05. If larger amounts of pipe insulation (greater than 1 square metre) are to be removed, use Type 3 procedures as outlined within Ontario Regulation 278/05. Alternately use Glove Bag Procedures as outlined within Ontario Regulation 278/05.**Duct Insulation**: If duct insulation is to be removed, remove minor amounts (less than 1 square metre) of asbestos-containing duct insulations using Type 2 procedures as outlined within Ontario Regulation 278/05. If larger amounts of duct insulation (greater than 1 square metre) are to be removed, use Type 3 procedures as outlined within Ontario Regulation 278/05.

Mechanical Equipment Insulation: If insulation on mechanical equipment is to be removed, remove minor amounts (less than 1 square metre) of asbestos-containing mechanical insulations using Type 2 procedures as outlined within Ontario Regulation 278/05. If larger amounts of mechanical insulation (greater than 1 square metre) are to be removed, use Type 3 procedures as outlined within Ontario Regulation 278/05.

Plaster: In the absence of deterioration, or disturbance during renovations or demolition, asbestos-containing plaster can be managed as a non-friable material. Plaster is a non-friable material that generates friable dust, upon removal. If plaster is to be abated/demolished as a result of planned renovation or demolition, remove minor amounts (less than 1 square metre) using Type 2 procedures as outlined within Ontario Regulation 278/05. If larger amounts of plaster (greater than 1 square metre) are to be removed, use Type 3 procedures as outlined within Ontario Regulation 278/05.

Drywall Compound: If the drywall with drywall joint compound must be removed as a result of planned demolition, renovation, etc. use Type 1 procedures as outlined within Ontario Regulation 278/05 to remove less than 1 square metre of drywall with asbestos-containing drywall joint compound, or Type 2 procedures for larger quantities.

Asbestos-Cement (Transite) Materials: If asbestos cement (Transite) materials must be removed as a result of planned demolition, renovation, etc. use Type 1 procedures as outlined within Ontario Regulation 278/05 if the work is done using wet methods and using hand-held non-powered tools.

Vinyl Sheet Flooring: Vinyl sheet flooring is a non-friable material that can become friable, and can generate significant dust, upon removal. Therefore, if vinyl sheet flooring is to be abated as a result of planned demolition, renovation, etc., use Type 2 abatement procedures as outlined within Ontario Regulation 278/05 if the work is done using wet methods and using hand-held non- powered tools.

Vinyl Floor Tiles: If vinyl floor tiles must be removed as a result of planned demolition, renovation, etc, use Type 1 procedures as outlined within Ontario Regulation 278/05 if the work is done using wet methods and using hand-held non-powered tools.

Appendix 1 - A&L Building Floors 4 to 7 Room Condition

Room Number	Room Name	Group/Department	Room Reviewed	General Condition	Architectural Notes	Lab Notes	Mechanical notes	Life Safety Notes	Photo Link
4 - 400	Corridor areas, elevator	General/Service Space	yes	Dated - Fair	Walls - block, concrete, demountable - typical Floor - VCT - poor with newer patches Ceiling - Ceiling tiles T bar - new Elevator - wood slat ceiling	na	HVAC Supply: New Diffusers HVAC Exhaust: na Plumbing Fixtures: Emergency shower Controls: na Other: Fire extinguishers and fire hose cabinets. New terminal boxes installed on this floor.	Corridors have items stored that may obstruct exiting	\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\400
4 - 401	Board room	Office/Boardroom	yes	Partially Renovated - Fair	Walls - wood, demountable - typical Floor - vinyl sheet flooring - good Ceiling - Coffered ceiling tiles and T bar - poor Window Shades - excellent	na	HVAC Supply: Original induction units HVAC Exhaust: na Plumbing Fixtures: na Controls: Not observed. Other:		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\401
4 - 401	Offices	Office/Boardroom	some	Dated - Fair	Varies Typical office: Demountable walls, VCT floor, ceiling tiles that match the corridor, vertical-horizontal or black window shades	na	HVAC Supply: Original induction units HVAC Exhaust: na Plumbing Fixtures: na Controls: Not observed. Other:		Many
4 - 404	Biodiversity Science	Department of Fisheries and Oceans	yes	Dated - Fair	Walls -block and demountable - typical Floor - VCT - fair Ceiling - Ceiling tiles - fair, yellowing T-bar	Stainless steel millwork surfaces - poor wood lower millwork cabinets -fair/poor metal upper cabinets - good flammable cabinets floor and wall mounted - good	HVAC Supply: New diffusers HVAC Exhaust: Old fume hood (EF-18). Compressed gas outlets located on fume hood. Plumbing Fixtures: SS integral sinks, gooseneck, fair condition. Eye wash, fair condition. Controls: New thermostat. Other:		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\404
4 - 407	No Name	Department of Fisheries and Oceans	no	Dated - Fair	No notes		No notes	Radioactive areas	\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\407
4 - 411 & 413	Zooplankton Physiology Lab	Department of Fisheries and Oceans	some	Dated - Fair	Walls -block and demountable - typical Floor - VCT - mix of new and old between the two rooms Ceiling - Ceiling tiles - poor	Stainless steel/laminate millwork surfaces - good wood lower millwork cabinets -good wood upper cabinets - fair	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust: Fume hoods (EF-4A & EF-5), fair condition. Capped snorkel connections, poor condition. Plumbing Fixtures: SS integral sinks, gooseneck, fair condition. Eye wash, fair condition. Controls: New thermostat. Other:	Radioactive areas	\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\411-413
4 - 414	Water Quality Monitoring Lab	Water Quality Monitoring and Surveillance	yes	Fully Renovated - Excellent	Walls -block and drywall - new Floor - Non slip vinyl sheet flooring - new Ceiling - Ceiling tiles - new	Stainless steel millwork surfaces - new metal lower and upper millwork cabinets - new wood lower and upper cabinets - good	HVAC Supply: New diffusers HVAC Exhaust: New fume hood (no tag) Plumbing Fixtures: SS integral sinks, gooseneck, good condition. Eye wash, good condition. Controls: New thermostat. Other: Assorted kitchen equipment		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\414
4 - 419	Kitchenette	General/Service Space	yes	Dated - Poor	Walls -block - typical Floor - VCT - poor; floor has a step up to sink, non BF compliant Millwork - Laminate surfaces, fair - countertop, poor	na	HVAC Supply: not observed HVAC Exhaust: na Plumbing Fixtures: Countertop mounted sink, SS Controls: na Other:		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\419
4 - 420	Service Core	General/Service Space	yes	Dated - Fair	Walls - block - typical Floor - Concrete - good Ceiling - Exposed structure - good	na		No fire stopping at structure and penetrations/breaches Non-fire rated door and frame Head clearance at emergency exit doors are not to code	\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\420
4 - 424	Fish Habitat Studies	Department of Fisheries and Oceans	yes	Dated - Fair	Walls -block and demountable - typical Floor - VCT - poor with newer patches Ceiling - Ceiling tiles - poor, yellowing T-bar	Stainless steel/laminate millwork surfaces - fair wood lower millwork cabinets - fair wood upper cabinets - fair	HVAC Supply: Old diffusers, poor condition HVAC Exhaust: original fume hood (EF-27). Exhaust snorkels, fair condition. Plumbing Fixtures: SS integral sinks, gooseneck, fair condition. Eye wash, fair condition. Controls: New thermostat. Face velocity meter installed on fume hood. Other:		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\424
4 - 428	Asian Carp Lab	Department of Fisheries and Oceans	yes	Fully Renovated - Excellent	Walls -block and drywall - new Floor - Non slip vinyl sheet flooring - new Ceiling - Ceiling tiles - new	Stainless steel millwork surfaces - new metal lower and upper millwork cabinets - new flammable cabinets floor mounted - new Adjacent clean room	HVAC Supply: New diffusers HVAC Exhaust: New fume hood (no tag) Plumbing Fixtures: SS integral sinks, flexible hose, good condition. Eye wash, good condition. Controls: New thermostats. Thermostat in back room was not functioning at time of walkthrough. Other: Dishwasher.	Chemical smell in the corridor outside of this room	\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\428
4 - 429	Invertebrate Invasions Lab	Department of Fisheries and Oceans	yes	Dated - Fair	Walls - block, concrete, demountable - typical Floor - VCT - poor with newer patches Ceiling - Ceiling tiles - fair, yellowing T-bar	Stainless steel/laminate millwork surfaces - fair wood lower millwork cabinets - fair wood upper cabinets - fair flammable cabinets floor mounted - good	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust: na Plumbing Fixtures: SS integral sinks, gooseneck, fair condition. Eye wash, fair condition. Controls: New thermostat. Other:	Chemical smell in the corridor outside of this room	\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\429

4 - 431	Water Quality Monitoring Lab	Water Quality Monitoring and Surveillance	yes	Fully Renovated - Good	Walls -block and demountable - typical with acoustic materials applied Floor - Non slip vinyl sheet flooring - new Ceiling - Ceiling tiles - new	Laminate millwork surfaces - good wood lower millwork cabinets - good wood upper cabinets - fair flammable cabinets floor mounted - good	HVAC Supply: Old diffusers, fair condition. New diffusers, good condition. HVAC Exhaust: Snorkels (EF-33 & EF-33A), good condition. Plumbing Fixtures: SS integral sinks, gooseneck, good condition. Controls: New thermostat. Other: Compressed hydrogen, methane, & air are present c/w pressure monitoring gauges.	Acoustic wall material is highly flammable	\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\431
4 - 433	Water Quality Monitoring Lab	Water Quality Monitoring and Surveillance	yes	Fully Renovated - Good	Walls -block and demountable - typical Floor - Non slip vinyl sheet flooring - new Ceiling - Ceiling tiles - new	Stainless steel millwork surfaces - good wood lower millwork cabinets - good wood upper cabinets - good	HVAC Supply: Old diffusers, fair condition. HVAC Exhaust: New fume hood (no tag). Old fume hood (EF-9A). Snorkels, good condition. Plumbing Fixtures: SS integral sinks, gooseneck, fair condition. Eye wash, fair condition. Integral cup sink in fume hood (EF-9A). Controls: New thermostat. Other: Mounting points for compessed gas cylinders are present, but unused.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\433
4 - 435	Microbial/Planktonic food web ecosystem health	Department of Fisheries and Oceans	yes	Dated - Fair	Walls -block and demountable - typical Floor - VCT - poor with newer patches Ceiling - Ceiling tiles - poor, yellowing T-bar	Noted that Microscopic work is difficult due to the vibrations of the mechanical equipment on the third floor. Lab is highly cluttered. Mix and match of stainless steel/laminate millwork surfaces - fair wood lower millwork cabinets - fair wood upper cabinets - poor	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust: Old fume hood (EF-46), poor condition. Compressed gas outlet nozzles on hood. Plumbing Fixtures: SS integral sinks, gooseneck, fair condition. Integral cup sink in fume hood (EF-46). Controls: New thermostat. Other:	Emergency exit door at back of room for service core 420	\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\435
4 - 436	Men's Washroom	General/Service Space	no	Dated - Poor	Refer to notes for 7 - 733	na			
4 - 437	Women's Washroom	General/Service Space	no	Dated - Fair	Refer to notes for 7 - 734	na			
4 - 438	Mail and copy room	General/Service Space	no	Dated - Fair	Refer to notes for 4-400	na			
4 - 439	PT Sample Verification Lab	Emergencies, Operational Analytical Laboratories and Research Support	yes	Dated - Poor	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - poor, water damage, yellowing T-bar	Stainless steel/laminate millwork surfaces - poor wood lower millwork cabinets -good under fume hoods, poor under sink area wood upper cabinets - fair	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust: Old fume hood (EF-20 & EF-55), poor condition. Plumbing Fixtures: SS integral sinks, gooseneck, fair condition. Integral cup sink in fume hood (EF-46), capped. Controls: New thermostat. Other: Return air appears to be present. Laboratory refrigerator. Compressed gas is present (uknown variety).	Emergency exit door at back of room for service core 457	\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\439
4 - 441	Preparation Lab	Aquatic Ecosystem Protection Research Division	yes	Dated - Fair	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - fair	Laminate millwork surfaces - poor wood lower millwork cabinets -fair wood upper cabinets - good Addition of partitioned off back room	HVAC Supply: Old diffusers, fair condition. HVAC Exhaust: na Plumbing Fixtures: SS integral sinks, gooseneck, fair condition. Controls: New thermostat. Other:		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\441
4 - 444	Inverts & Immunotox	Aquatic Ecosystem Protection Research Division	yes	Dated - Fair	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - fair	Laminate millwork surfaces - poor wood lower millwork cabinets -fair wood upper cabinets - good	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust: Old fume hood (EF-59), poor condition. Capped snorkels (EF-92?), poor condition. Plumbing Fixtures: SS integral sinks, gooseneck, poor condition. Eye wash, fair condition. Milli-Q unit. Unused integral counter cup sinks. Controls: New thermostat. Other: Compressed gas outlets are present, functionality is unknown.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\444
4 - 446	Microbiology	Aquatic Ecosystem Protection Research Division	yes	Dated - Fair	Walls -block and demountable - typical Floor - VCT - poor with newer patches Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces - poor wood lower millwork cabinets -poor wood upper cabinets - good	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust: Old fume hood (EF-61) poor condition. Plumbing Fixtures: SS integral sinks, gooseneck, fair condition. Eye wash, fair condition. Unused integral counter cup sinks. Controls: New thermostat. Other: Compressed gas outlets are present and utilised, natural gas.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\446
4 - 448-450	Analytical Toxicology	Aquatic Ecosystem Protection Research Division	yes	Fully Renovated - Good	Walls -block and demountable - typical Floor - Non slip vinyl sheet flooring - new Ceiling - Ceiling tiles - new	Laminate/Solid surface millwork surfaces - good wood/metal lower millwork cabinets - good wood upper cabinets - fair	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust: Old fume hood (EF-61) poor condition. Plumbing Fixtures: SS integral sinks, gooseneck, fair condition. Eye wash, fair condition. Unused integral counter cup sinks. Controls: New thermostat. Other: Compressed gas outlets are present and utilised, natural gas.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\448-450
4 - 451	Digital Imaging Analysis Lab	Aquatic Ecosystem Protection Research Division	no			Staff noted that there are digital screens in room	No notes		

4 - 454	IQM - PT/CRM Sample Lab	Emergencies, Operational Analytical Laboratories and Research Support	yes	Partially Renovated - Fair	Walls -block and demountable - typical Floor - VCT - poor with newer patches Ceiling - Half ceiling tiles and Drywall - fair	Stainless steel millwork surfaces - good wood lower millwork cabinets - good wood upper cabinets - fair	HVAC Supply: New diffusers, good condition. Old diffusers, fair condition. HVAC Exhaust: Snorkels (EF-81), fair condition. Plumbing Fixtures: SS integral sinks, gooseneck, fair condition. Eye wash, fair condition. Controls: New thermostat. Other: Various water filtration equipment		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\454
4 - 455	Women's Washroom	General/Service Space	no	Dated - Poor	Refer to notes for 7 - 753	na	No Notes		
4 - 456	Men's Washroom	General/Service Space	no	Dated - Fair	Refer to notes for 7 - 754	na	No notes		
4 - 457	Service Core	General/Service Space	yes	Dated - Fair	Walls - block - typical Floor - Concrete - good Ceiling - Exposed structure - good	na		No fire stopping at structure and penetrations/breaches Non-fire rated door and frame Head clearance at emergency exit doors are not to code	\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\457
4 - 458	Janitor Closet	General/Service Space	no				No notes		
4 - 460	Cold Storage		no				No notes		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\460
4 - 461-463	Waterborne Pathogen Lab	Aquatic Ecosystem Protection Research Division	yes	Fully Renovated - Good	Walls -block (crack outside door of 461) and demountable - typical Floor - Non slip vinyl sheet flooring - new Ceiling - Ceiling tiles - good	Laminate millwork surfaces - unknown, covered Metal lower millwork cabinets - good Metal upper cabinets - good Cold Storage 461A converted to storage room	HVAC Supply: Old diffusers, fair condition. HVAC Exhaust: Old fume hood (EF-142), poor condition. Plumbing Fixtures: Not observed. Controls: New thermostat. Other: Walk in refrigerator, unknown cooling supply, functional. Ovens.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\461-463
4 - 465A	Waterborne Pathogen Lab	Aquatic Ecosystem Protection Research Division	yes	Fully Renovated - Good	Walls -block and demountable - typical Floor - Non slip vinyl sheet flooring - new Ceiling - Ceiling tiles - good	Laminate millwork surfaces - fair Metal lower millwork cabinets - good Metal upper cabinets - good Cold Storage 461A converted to storage room	HVAC Supply: New diffusers, good condition. HVAC Exhaust: na Plumbing Fixtures: SS integral sinks, gooseneck, good condition. Eye wash, fair condition. Controls: New thermostat. Other: Bilogical containment units.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\465A
4 - 467A	Molecular Biology	Aquatic Ecosystem Protection Research Division	yes	Dated - Fair	Walls -block and demountable - typical Floor - VCT - poor with newer patches Ceiling - Ceiling tiles - good	Laminate millwork surfaces - poor Metal/wood lower millwork cabinets - fair Wood upper cabinets/shelving - fair/good Door to L469 is blocked	HVAC Supply: New diffusers, good condition. HVAC Exhaust: Old fume hood (EF-107A), poor condition. Plumbing Fixtures: SS integral sinks, gooseneck, fair condition. Eye wash, fair condition. Controls: New thermostat. Other: Deep cool freezer. Window shaker located on core wall, user complainted that despite the supply air being 100% O/A, she was still too hot. Unknown wether it was too hot for process work. It did not feel exceptionally warm at time of site visit.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\467A
4 - 469	Histology/Histopathology	Aquatic Ecosystem Protection Research Division	yes	Dated - Fair	Walls -block and demountable - typical Floor - VCT - poor with newer patches Ceiling - Ceiling tiles - poor, water damage, yellowing T-bar	Laminate millwork surfaces - poor Metal/wood lower millwork cabinets - fair Wood upper cabinets/shelving - fair/good Door to L467A is blocked by Flammable Cabinets - 2 unvented Storage in back and front of 469A	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust: Old hood (EF-126), poor condition. New fume hood (EF-63A), good condition. Snorkels (EF-94), good condition. Plumbing Fixtures: SS integral sinks, gooseneck, fair condition. Eye wash, fair condition. Unused cup sink within fume hood. Controls: New thermostat. Other: Bilogical containment units.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\469
4 - 472-475	Organics Lab	Aquatic Ecosystem Protection Research Division	yes	Dated - Fair	Walls -block and demountable - typical Floor - VCT - poor with newer patches Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces - unknown, covered Wood lower millwork cabinets - fair Wood upper cabinets/shelving - fair/good	HVAC Supply: Old diffusers, poor condition. New diffusers, good condition. HVAC Exhaust: Snorkels, fair condition. Old fume hood (EF-52), poor condition. Old fume hood (EF-50), poor condition. Plumbing Fixtures: SS integral sinks, gooseneck, fair condition. Eye wash, fair condition. Controls: New thermostat. Other: Bilogical safety cabinets. Disused walk in refrigerator. Compressed carbon dioxide & other compressed gas.		
5 - 500	Corridor areas, elevator	General/Service Space	yes	Dated - Fair	Walls - block, concrete, demountable - typical Floor - VCT - poor with newer patches Ceiling - Ceiling tiles T bar - new Elevator - wood slat ceiling	na	HVAC Supply: New Diffusers. Induction units at some windows. HVAC Exhaust: na Plumbing Fixtures: Emergency shower Controls: Local t-stats (old) at induction units. Other: Fire extinguishers and fire hose cabinets. New terminal boxes installed on this floor.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\500
5 - 501	Office	Office/Boardroom	some	Dated - Fair	Varies Typical office: Demountable walls, VCT floor, ceiling tiles that match the corridor, vertical-horizontal or black window shades	na	No notes		Many
5 - 504	Analytical Chemistry	Aquatic Ecosystem Protection Research Division	yes	Partially Renovated - Fair	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces - new at metal cabinets, fair other locations Metal lower millwork cabinets - new Wood lower millwork cabinets - fair Wood upper cabinets - fair	HVAC Supply: Old diffusers, fair condition. HVAC Exhaust: Old fume hood, poor condition. Snorkel. Plumbing Fixtures: Not observed. Controls: New thermostat. Other:		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\504

5 - 506	Stream Ecology Lab	Aquatic Ecosystem Impacts Research Division	yes	Dated - Fair	Walls -block and demountable - typical Floor - VCT - poor with newer patches Ceiling - Ceiling tiles - poor, water damage, yellowing T-bar	Laminate millwork surfaces - new at metal cabinets, Stainless steel - fair at other locations Metal lower millwork cabinets - new Wood lower millwork cabinets - poor Wood upper cabinets - fair	HVAC Supply: Old diffusers, fair condition. HVAC Exhaust: Old fume hood (EF-44), poor condition. Old fume hood (EF-15), poor condition. Snorkels (EF-44/66?), some left open, some holes in ceiling tiles. Plumbing Fixtures: SS integral sinks, gooseneck, good condition. Eye wash, good condition. Cup sink in fume hood (ef-15). Sink in acid contamination unit, poor condition. Controls: New thermostat. Other: Milli-Q system installed. Compressed nitrogen. Ovens. Return located within lab space.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\506
5 - 508	Organic Chemistry Lab	Aquatic Ecosystem Protection Research Division	yes	Dated - Fair	Walls -block and demountable - typical Floor - VCT - poor with newer patches Ceiling - Ceiling tiles - poor, water damage, yellowing T-bar	Laminate millwork surfaces - fair/poor Wood lower millwork cabinets - poor Wood upper cabinets - fair	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust: Old fume hood (EF-31, 8A, 33A), poor condition. Plumbing Fixtures: SS integral sinks, gooseneck, fair condition. Eye wash, fair condition. Cup sink in fume hoods. Controls: New thermostat. Other: Compressed nitrogen, methane & helium. Trunk - unknown use, blue with round duct connecting to it, believed to be exhaust.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\508
5 - 510-514-515	Mass Spectrometer	Aquatic Ecosystem Protection Research Division	yes	Dated - Poor	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces -poor Wood lower millwork cabinets - poor Wood upper and storage cabinets - fair Workstations - poor	HVAC Supply: Old diffusers, poor condition. Diffusers with cardboard deflectors. HVAC Exhaust: Old fume hood (EF-34A, 2A, 33A), poor condition. New fume hood (EF-73), good condition. Snorkels (EF-34A). Plumbing Fixtures: SS integral sinks, gooseneck, fair condition. Eye wash, fair condition. Controls: New thermostat. Other: Compressed nitrogen & argon. Return air in lab space. Chemical storage in this space.	Not to code for a chemical storage room	\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\510 514 515
5 - 513B	Kitchenette	General/Service Space	yes	Dated - Poor	Walls -block - typical Floor - VCT - poor; floor has a step up to sink, non BF compliant Millwork - Laminate surfaces, fair	na	No notes		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\513B
5 - 517	Service Core	General/Service Space	no						
5 - 520	Water Quality Monitoring Lab	Water Quality Monitoring and Surveillance	yes	Fully Renovated - Excellent	Walls -block and drywall - new Floor - Non slip vinyl sheet flooring - new Ceiling - Ceiling tiles - new	Laminate, stainless steel millwork surfaces - new laminate lower and upper millwork cabinets - new Clean room with updated finishes and plastic (polypropylene) cabinets - new	HVAC Supply: new diffusers, good condition. HVAC Exhaust: Fume hood (EF-26B), appears to have been refurbished. New fume hood, good condition. Plumbing Fixtures: SS integral sinks, gooseneck, good condition. Eye wash, good condition. Controls: New thermostat. Other: Biological containment units.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\520
5 - 522	C.E.C.I.L.I.A	Office/Boardroom	yes	Dated - Fair	Walls -block and demountable - typical Floor - VCT - fair/good Ceiling - Ceiling tiles - poor, yellowing T-bar	Room is being used as an office/storage space	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust: na Plumbing Fixtures: na Controls: New thermostat. Other:		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\522
5 - 525	GCMS Instrument Lab	Aquatic Ecosystem Management Research Division	yes	Fully Renovated - Excellent	Walls -block and demountable - new Floor - Non slip vinyl sheet flooring - new with staining from HE tanks Ceiling - Ceiling tiles - new	Stainless steel millwork surfaces - new Metal lower and upper millwork cabinets - new Wood top workstations - new	HVAC Supply: New diffusers, good condition. Split DX system, good condition. HVAC Exhaust: New fume hood. New snorkels. Plumbing Fixtures: SS intergral sink, gooseneck, good condition. Eye wash, good condition. RO water, good condition. Plastic lab resistant drainage under sink. Controls: New thermostat. Other: return air in lab. Compressed nitrogen & helium, possibly other gasses.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\525
5 - 527	Organic Sediments	Aquatic Ecosystem Impacts Research Division	yes	Dated - Poor	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces -poor Wood lower millwork cabinets - poor Wood upper and storage cabinets - fair Room is being used as storage, not a lab	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust: Old fume hood (EF-37). Plumbing Fixtures: Cup sinks in fume hood. Controls: New thermostat. Other: Compressed nitrogen, air, oxygem, hydrogen, helium & argon.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\527
5 - 530	Geochemistry Lab	Aquatic Ecosystem Protection Research Division	yes	Dated - Poor	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces -poor Wood lower millwork cabinets - poor Wood upper and storage cabinets - fair Room is being used as storage and a lab with usable equipment	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust: Old fume hoods. Plumbing Fixtures: SS intergral sink, gooseneck, poor condition. Eye wash, poor condition. Floor drain, fair condition. Controls: New thermostat. Other: Compressed gasses.	Emergency exit door at back of room for service core 517 is blocked by boxes and clutter	\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\530

5 - 533	Trace Metals Clean Lab	Aquatic Ecosystem Protection Research Division	yes	Fully Renovated - Excellent	Walls -block and drywall - new Floor - Non slip vinyl sheet flooring - new Ceiling - drywall (533) and ceiling tiles (533A)- new	Wood and plastic (polypropylene) millwork surfaces - new Metal and plastic (polypropylene) lower millwork cabinets - new Clean room (533A) with updated finishes and all plastic (polypropylene) furniture and equipment, no metal in lab - new Fume Hood - plastic (polypropylene)	HVAC Supply: new diffusers, good condition. HEPA filters. HVAC Exhaust: New fume hoods (EF-48), good condition. Direct connected exhaust to a piece of equipment. Plumbing Fixtures: epoxy intergral sink, plastic gooseneck, good condition. Eye wash, good condition. Floor drain, fair condition. Plastic cup sink in fume hood c/w plastic gooseneck. Controls: New thermostat. Other: Compressed air c/w smart switching system. No/limited metals in this lab.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\533
5 - 537	Trace Organic Instrument Lab	Aquatic Ecosystem Protection Research Division	yes	Dated - Fair	Walls -block and demountable - typical Floor - VCT - fair Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces -fair Wood lower millwork cabinets - fair Wood upper and storage cabinets - fair	HVAC Supply: Old diffusers, poor condition. Split DX system. HVAC Exhaust: Old fume hood. Plumbing Fixtures: SS intergral sink, gooseneck, poor condition. Controls: New thermostat. Other: Compressed helium, nitrogen, methane, hydrogen, air.	Emergency exit door at back of room for service core 558	\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\537
5 - 539	Algal Physiology & Nutrient Dynamics	Aquatic Ecosystem Management Research Division	yes	Partially Renovated - Fair	Walls -block and demountable - typical Floor - vinyl sheet flooring - good w/ few stains Ceiling - Ceiling tiles - fair, yellowing T-bar	Laminate millwork surfaces - fair/poor Wood lower millwork cabinets - good Wood upper cabinets - good	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust: Snorkels, good condition. Plumbing Fixtures: SS intergral sink, gooseneck, fair condition. Cup sink, poor condition. Controls: New thermostat. Other: Milli-Q.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\539
5 - 541-543	Persistent organics pathways/fate	Aquatic Ecosystem Protection Research Division	yes	Fully Renovated - Good	Walls -block and drywall - new Floor - Non slip vinyl sheet flooring - new Ceiling - Ceiling tiles - new	Laminate millwork surfaces - fair/good wood lower millwork cabinets - good wood upper cabinets - good	HVAC Supply: New diffusers, good condition. HVAC Exhaust: Snorkels, good condition. New fume hood, good condition. Plumbing Fixtures: SS intergral sink, gooseneck, fair condition. Cup sink, good condition. Controls: New thermostat. Other: Milli-Q.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\541
5 - 545-548	Ecophysiology & Lipid Biochemistry	Aquatic Ecosystem Management Research Division	no		Client notes Semi Reno		No notes		
5 - 551	Algal Physiology & Nutrient Dynamics	Aquatic Ecosystem Management Research Division	no		Client notes Semi Reno		No notes		
5 - 558	Service Core	General/Service Space	no						
5 - 565	Storage – Aquatic Invertebrate Taxonomy	Aquatic Ecosystem Impacts Research Division	yes	Dated - Poor	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - poor, yellowing T-bar	Mix match of storage and cabinetry	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust: Fume hood (EF-38), unknown. Plumbing Fixtures: SS intergral sink, gooseneck, fair condition. Cup sink, good condition. Controls: New thermostat. Other: return air in lab. Lab equipment with condensate drain.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\565
5 - 567	Lead - 210 Dating	Aquatic Ecosystem Protection Research Division	yes	Dated - Poor	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate and stainless steel millwork surfaces - poor wood lower millwork cabinets - fair wood upper cabinets - fair	HVAC Supply: Old diffusers, poor condition. Split DX system installed. HVAC Exhaust: Snorkels (EF-16), fair condition. Exposed exhaust duct opening. New fume hood, Plumbing Fixtures: SS sink, gooseneck, poor condition. Eye wash, fair condition. Cup sink, poor condition. Controls: New thermostat. Other: Compressed helium.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\567
5 - 567A	No name	Aquatic Ecosystem Protection Research Division	yes	Partially Renovated - Fair	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces - good wood lower millwork cabinets - poor wood upper cabinets - fair New wood top desks	See above, Combined.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\567A
5 - 570	Organic Geochemistry	Aquatic Ecosystem Impacts Research Division	yes	Dated - Poor	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces - poor wood lower millwork cabinets - poor wood upper cabinets - fair	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust: Old fume hood (EF-104 & 42), poor condition. Plumbing Fixtures: SS sink, gooseneck, fair condition. Eye wash, fair condition. Cup sink, poor condition. Controls: New thermostat. Other: Oven, compressed gasses.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\570
5 - 572	Benthic Ecology Sediment Water Interactions	Aquatic Ecosystem Impacts Research Division	yes	Dated - Poor	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces - fair/poor wood lower millwork cabinets - poor wood upper cabinets - fair	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust: New fume hood (EF-101), poor condition. Plumbing Fixtures: SS sink, gooseneck, fair condition. Eye wash, fair condition. Cup sink, poor condition. Integral sink with CW in fume hood. Controls: New thermostat. Other: Oven, compressed gasses.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\572

5 - 574	Geochemistry Lab	Aquatic Ecosystem Protection Research Division	yes	Dated - Fair	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces - fair/poor wood lower millwork cabinets - fair wood upper cabinets - fair New wood top desks	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust: Old fume hood (EF-94/95), poor condition. Plumbing Fixtures: SS integral sink, gooseneck, poor condition. Eye wash, poor condition. Cup sink, poor condition. Controls: New thermostat. Other: Compressed oxygen.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\574
5 - 576	Mossbauer Studies	Aquatic Ecosystem Protection Research Division	yes	Dated - Poor	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - poor, yellowing T-bar	Currently being used as storage or swing space	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust: na Plumbing Fixtures:Cup sink, poor condition. Controls: New thermostat. Other:		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\576
5 - 578	Geochemistry Lab	Aquatic Ecosystem Protection Research Division	yes	Fully Renovated - Excellent	Walls -block and drywall - new Floor - Non slip vinyl sheet flooring - new Ceiling - Ceiling tiles - new	Plastic (polypropylene) millwork surfaces - new Plastic (polypropylene)upper, lower and storage millwork cabinets - new All furniture, equipment and finishes are plastic (polypropylene), no metal in lab Fume Hood - plastic (polypropylene)	HVAC Supply: new diffusers, good condition. HEPA filters. HVAC Exhaust: new fume hood (EF-90), good condition. Snorkels, good condition. Plumbing Fixtures: Plastic integral sink, plastic gooseneck, good condition. Combined eye wash/shower, good condition. Controls: New thermostat. Other: HEPA particulate cabinate. Milli-Q. Oven.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\578
5 - 580	Harmful Blooms & Nutrient Management	Aquatic Ecosystem Management Research Division	yes	Dated - Fair	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces - unknown, covered wood lower millwork cabinets - fair wood upper cabinets - fair New wood top desk	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust: Biological containment unit with exhaust opening above it. Old fume hood (EF-49), poor condition. Plumbing Fixtures: SS integral sink, gooseneck, poor condition. Eye wash, poor condition. Cup sink, poor condition. Controls: New thermostat. Other: Deep cool freezer,		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\580
6 - 600	Corridor areas, elevator	General/Service Space	yes	Dated - Fair	Walls - block, concrete, demountable - typical Floor - VCT - poor with newer patches Ceiling - fair, yellowing T-bar Elevator - wood slat ceiling	na	HVAC Supply: New Diffusers. Induction units at some windows. HVAC Exhaust: na Plumbing Fixtures: Emergency shower Controls: na Other: Fire extinguishers and fire hose cabinets.	Corridors have items stored that may obstruct exiting	\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\600
6 - 601	Office/Boardroom	Office/Boardroom	some	Dated - Fair	Boardroom was occupied, looked to be dated through the window; old carpet, old coffered ceiling. Offices 602A, 602, 603, 606, 607, 609, 609A, 611, 612 have been partially renovated. Others are typical.	na	No notes		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\607
6 - 604	Density / Organic Lab	Aquatic Ecosystem Management Research Division	yes	Dated - Fair	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces - poor wood and metal lower millwork cabinets - fair wood upper cabinets - fair	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust: Old fume hood (EF-19), poor condition. Plumbing Fixtures: SS counter mounted sink, gooseneck, poor condition. Controls: Old thermostat. Other: Gas nozzles appear to be functional.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\604
6 - 605	Sedimentology Geotechnical Lab	Aquatic Ecosystem Management Research Division	yes	Dated - Fair	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces at wood cabinets- poor, Laminate millwork surfaces at metal cabinets- fair metal lower millwork cabinets - good wood lower millwork cabinets - poor wood upper cabinets - fair	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust: Oven or other equipment with direct exhaust. Old fume hood (EF-14), poor condition. Plumbing Fixtures: SS integral sink, gooseneck, poor condition. Eye wash, fair condition. Controls: Old thermostat. Other: Compressed Oxygen.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\605
6 - 608	Groundwater Chemistry	Aquatic Ecosystem Management Research Division	yes	Dated - Fair	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces - mostly covered, fair wood lower millwork cabinets - good wood upper and storage cabinets - good	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust:Old fume hood (EF-10, 135), poor condition. New fume hood (EF-135), fair condition. Plumbing Fixtures: SS integral sink, gooseneck, fair condition. Eye wash, fair condition. Controls: Old thermostat. Old pneumatic thermostat present. Other: Compressed Argon and other gasses. Mili-Q		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\608
6 - 610	Organics Lab	Aquatic Ecosystem Management Research Division	yes	Dated - Fair	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces - fair wood lower millwork cabinets - fair wood upper and storage cabinets - good	HVAC Supply: Old diffusers, poor condition. New diffusers, good condition. New & old diffusers are placed side by side in some circumstances - potential for the old ones to be inactive. HVAC Exhaust: Snorkels EF-16. Old fume hood (EF-7, 8, 26), poor condition. Plumbing Fixtures: SS integral sink, gooseneck, poor condition. Eye wash, fair condition. Cup sink within fume hood, poor condition. Controls: Old thermostat. Other: Milli-Q. Compressed nitrogen, hydrogen, helium, air and various mixes. Low temp freezer.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\610
6 - 613	No name	General/Service Space	yes	Dated - Poor	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - poor, yellowing T-bar	Storage for 610	See above, Combined.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\613

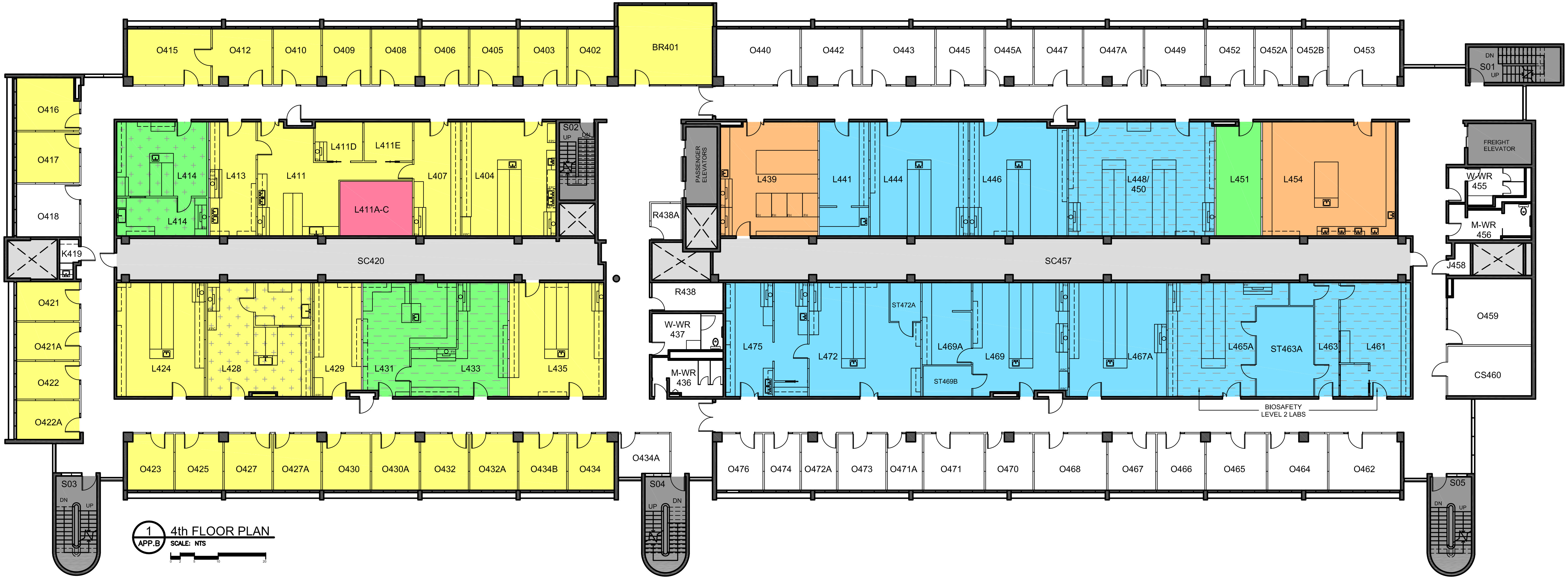
6 - 620	Janitor Closet	General/Service Space	no		Drinking fountain beside closet has been removed and capped with wood		No notes		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\620
6 - 621	Service Core	General/Service Space	no						
6 - 625	Biogeochemistry	Aquatic Ecosystem Management Research Division	yes	Dated - Poor	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - water stains - poor, yellowing T-bar	Laminate millwork surfaces - fair wood lower millwork cabinets - fair wood upper cabinets - good portion of room used as storage area	HVAC Supply: Old diffusers, poor condition. New diffusers, good condition. New & old diffusers are placed side by side in some circumstances - potential for the old ones to be inactive. HVAC Exhaust: Old fume hood, poor condition. Plumbing Fixtures: SS integral sink, gooseneck, fair condition. Eye wash, fair condition. Controls: Old thermostat. Other: Compressed gasses.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\625
6 - 625A	Groundwater Quality	Aquatic Ecosystem Management Research Division	yes	Dated - Poor	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - water stains - poor, yellowing T-bar	Laminate millwork surfaces - unknown, covered wood lower millwork cabinets - poor metal lower millwork cabinets - good wood upper cabinets - good	HVAC Supply: Old diffusers, poor condition. New diffusers, good condition. HVAC Exhaust: Old fume hood, poor condition. Plumbing Fixtures: SS integral sink, gooseneck, fair condition. Eye wash, fair condition. Controls: Old thermostat. Other: Compressed gasses.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\625A
6 - 627	Groundwater Quality	Aquatic Ecosystem Management Research Division	yes	Dated - Poor	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces - unknown, covered wood lower millwork cabinets - poor/fair wood upper cabinets - fair Room is being used as storage area	HVAC Supply: Old diffusers, poor condition. New diffusers, good condition. HVAC Exhaust: Old fume hood (EF-137, 30), poor condition. Plumbing Fixtures: SS integral sink, gooseneck, fair condition. Eye wash, fair condition. Cup sink in fume hoods. Controls: Old thermostat. Other: return air in lab. Unused refrigerator (walk in).		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\627
6 - 629	Groundwater Bioremediation	Aquatic Ecosystem Management Research Division	yes	Dated - Fair	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces - unknown, covered wood lower millwork cabinets - fair wood upper cabinets - fair	HVAC Supply: Old diffusers, poor condition. New diffusers, good condition. HVAC Exhaust: Old fume hood (EF-138, 33, 39), poor condition. Direct exhaust to a piece of equiment, good condition (EF-168). Plumbing Fixtures: SS integral sink, gooseneck, fair condition. Eye wash, fair condition. Cup sink, fair condition. Cup sink in fume hood, poor condition. Controls: Old thermostat. Other: Biological containment unit. Compressed Nitrogen and Argon.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\629
6 - 632	Sedimentology Lab	Aquatic Ecosystem Management Research Division	yes	Partially Renovated - Good	Walls -block and demountable - typical Floor - Non slip vinyl sheet flooring - new Ceiling - Ceiling tiles -fair	Laminate millwork surfaces on outer walls - poor Laminate millwork surfaces on island - good wood lower millwork cabinets - good wood upper cabinets - good	HVAC Supply: new diffusers, good condition. New diffusers, good condition. HVAC Exhaust: Snorkels, good condition. New fume hood, good condition. Plumbing Fixtures: Epoxy integral sink, gooseneck, good condition. Eye wash, good condition. Cup sink, fair condition. Controls: Old thermostat. Other:	Emergency exit door at back of room for service core 621	\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\632
6 - 634	Wildlife Toxicology and Disease	Ecotoxicology and Wildlife Health Division	yes	Partially Renovated - Fair	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - poor, yellowing T-bar	Stainless steel millwork surfaces - fair wood lower millwork cabinets - poor wood upper and storage cabinets - fair	HVAC Supply: new diffusers, good condition. New diffusers, good condition. HVAC Exhaust: Snorkels, good condition. New fume hood (EF-47), good condition. Plumbing Fixtures: SS integral sink, gooseneck, poor condition. Eye wash, poor condition. Cup sink, fair condition. RO Water. Controls: Old thermostat. Other: Water filtration equipment.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\634
6 - 637	Women's Washroom	General/Service Space	yes	Dated - Fair	Refer to notes for 7 - 734	na	No notes		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\637
6 - 639	Organics Pathways / Fate	Aquatic Ecosystem Protection Research Division	yes	Partially Renovated - Good	Walls -block and drywall - new Floor - Non slip vinyl sheet flooring - new Ceiling - Ceiling tiles - new	Laminate millwork surfaces - good wood lower millwork cabinets - good wood upper cabinets - good	HVAC Supply: New diffusers, good condition. HVAC Exhaust: New fume hood, good condition. Plumbing Fixtures: Epoxy integral sink, gooseneck, good condition. Eye wash, good condition. Controls: Old thermostat. Other: Water filtration equipment.	Emergency exit door at back of room for service core 658	\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\639
6 - 643	Analytical Toxicology	Aquatic Ecosystem Protection Research Division	yes	Partially Renovated - Good	Walls -block and demountable - typical Floor - VCT - new Ceiling - Ceiling tiles -fair, yellowing T-bar	Laminate millwork surfaces - fair/poor wood lower millwork cabinets - good wood upper cabinets - good New wood top desk	HVAC Supply: New diffusers, good condition. HVAC Exhaust: New fume hood, good condition. Snorkels, good condition. Direct exhaust from equip. Plumbing Fixtures: SS integral sink, gooseneck, fair condition. Controls: Old thermostat. Other: Compressed gas.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\643

6 - 646	Acid Deposition / Metals Chemistry	Aquatic Ecosystem Management Research Division	yes	Dated - Poor	Walls -block and demountable - typical Floor - VCT - poor with newer patches Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces - poor wood lower millwork cabinets on outer wall - poor wood lower millwork cabinets on island - fair wood upper cabinets - good	HVAC Supply: Old diffusers, fair condition. HVAC Exhaust: old fume hood, poor condition. Rigid snorkel, poor condition. Plumbing Fixtures: SS integral sink, gooseneck, fair condition. Eye wash, poor condition. Controls: Old thermostat. Other: Oven		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\646
6 - 649-651	Brominated Flame Retardant Research	Aquatic Ecosystem Protection Research Division	yes	Dated - Fair	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces - fair wood lower millwork cabinets - fair wood upper cabinets - fair	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust: old fume hood (EF-71), poor condition. Rigid snorkel, good condition. Snorkels, fair condition. Plumbing Fixtures: SS integral sink, gooseneck, fair condition. Eye wash, fair condition. Controls: Old thermostat. Other: Compressed gases. Oven.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\649-651
6 - 653-655	Priority Substances Effects	Aquatic Ecosystem Protection Research Division	yes	Dated - Fair	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate and stainless steel millwork surfaces - fair/poor wood lower millwork cabinets - fair wood upper cabinets - fair	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust: old fume hood (EF-79), poor condition. Capped snorkel rough-in. Plumbing Fixtures: SS integral sink, gooseneck, fair condition. Eye wash, fair condition. Controls: Old thermostat. Other: Compressed gases. freezer. Milli-Q.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\653-655
6 - 662	Instrument lab	Aquatic Ecosystem Protection Research Division	no				No notes		
6 - 658	Service Core	General/Service Space	yes	Dated - Fair	Walls - block - typical Floor - Concrete - good Ceiling - Exposed structure - good	na		No fire stopping at structure and penetrations/breaches Non-fire rated door and frame	\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\658
6 - 666	Organics Pathways / Fate	Aquatic Ecosystem Protection Research Division	yes	Dated - Poor	Walls -block and demountable - typical Floor - VCT - poor with newer patches Ceiling - Ceiling tiles - water stains - poor, yellowing T-bar	Laminate millwork surfaces - fair/poor wood lower millwork cabinets - fair/poor wood upper cabinets - fair	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust: old fume hood (EF-151), poor condition. Plumbing Fixtures: SS integral sink, gooseneck, fair condition. Eye wash, fair condition. Controls: Old thermostat. Other: Compressed gases.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\666
6 - 668	Analytical Instrument Laboratory	Aquatic Ecosystem Protection Research Division	yes	Dated - Fair	Walls -block and demountable - typical Floor - VCT - poor with newer patches Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces - fair wood lower millwork cabinets - fair wood upper cabinets - fair New wood top desks	HVAC Supply: Old diffusers, poor condition. Split DX system installed, and still utilize a floor fan at doorway. HVAC Exhaust: old fume hood, poor condition. Direct exhaust for equipment. Snorkel, poor condition. Plumbing Fixtures: SS integral sink, gooseneck, fair condition. Eye wash, fair condition. Cup sinks, fair condition. Controls: Old thermostat. Other: Compressed gases.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\668
6 - 670	Organic Chemistry Lab	Aquatic Ecosystem Protection Research Division	yes	Dated - Fair	Walls -block and demountable - typical Floor - VCT - poor with newer patches Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces - fair wood lower millwork cabinets - fair/poor wood upper cabinets - fair	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust: old fume hood , poor condition. Plumbing Fixtures: SS integral sink, gooseneck, fair condition. Eye wash, fair condition. Controls: Old thermostat. Other: Compressed gases.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\670
6 - 672	Toxic Substances Identification	Aquatic Ecosystem Protection Research Division	yes	Partially Renovated - Good	Walls -block and demountable - typical Floor - Non slip vinyl sheet flooring - new Ceiling - Ceiling tiles - new	Laminate millwork surfaces - good wood lower millwork cabinets -good wood upper cabinets - good	HVAC Supply: new diffusers, good condition. HVAC Exhaust: old fume hood , poor condition. Snorkels, good condition. Plumbing Fixtures: not observed. Controls: Old thermostat. Other: Compressed gases. Milli-Q.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\672
6 - 674	Total Mercury	Aquatic Ecosystem Protection Research Division	yes	Dated - Fair	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces - fair wood lower millwork cabinets -fair wood upper cabinets - fair Room divided by fairly new demountable partitions	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust: old fume hood (EF-18), poor condition. Plumbing Fixtures: SS integral sink, gooseneck, fair condition. Eye wash, fair condition. Cup sinks, fair condition. Controls: Old thermostat. Other: Compressed gases.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\674
6 - 676	Organics Pathways / Fate	Aquatic Ecosystem Management Research Division	yes	Dated - Fair	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces - good wood lower millwork cabinets - fair wood upper cabinets - good/fair Room used as storage	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust: na Plumbing Fixtures: na Controls: Old thermostat. Other: na		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\676
6 - 678-680	Organics Pathways / Fate	Aquatic Ecosystem Management Research Division	yes	Dated - Fair	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces - poor wood lower millwork cabinets - fair wood upper cabinets - good/fair Portion of room used as storage	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust: old fume hood (EF-145), poor condition. Plumbing Fixtures: not observed. Controls: Old thermostat. Other:		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\678-680
6 - 682	Organics Bioaccumulation	Aquatic Ecosystem Protection Research Division	yes	Dated - Fair	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces - good wood lower millwork cabinets - good wood upper cabinets - good Freezer room	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust: na Plumbing Fixtures: na Controls: Old thermostat. Other: Compressed gases.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\682

6 - 684	Organics Bioaccumulation/ Persistence	Aquatic Ecosystem Protection Research Division	no				No notes		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\684
7 - 700	Corridor areas, elevator	General/Service Space	yes	Dated - Fair	Walls - block, concrete, demountable - typical Floor - VCT - poor with newer patches Ceiling - fair, yellowing T-bar Elevator - wood slat ceiling	na	HVAC Supply: New Diffusers. Induction units at some windows. HVAC Exhaust: na Plumbing Fixtures: Emergency shower Controls: na Other: Fire extinguishers and fire hose cabinets.	Corridors have items stored that may obstruct exiting	\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\700
7 - 701	Office/Boardroom	Office/Boardroom	some	Dated - Fair	Boardroom was occupied, looked to be updated through the window; wood laminate floor. Offices are typical. 726A has no door.	na	No notes		Many
7 - 703	Regents Preparation Lab	Emergencies, Operational Analytical Laboratories and Research Support	yes	Partially Renovated - Fair	Walls -block and demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces at metal cabinets- good metal lower millwork cabinets - good wood lower millwork cabinets - poor wood upper and storage cabinets - fair South partition - new	HVAC Supply: Old diffusers, poor condition. HVAC Exhaust: New fume hood (EF-45), good condition. Snorkels to serve equipment, good condition. Plumbing Fixtures: SS integral sink, gooseneck, fair condition. Eye wash, fair condition. Controls: Old thermostat. Other: Compressed gases.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\703
7 - 705	Nutrients Analysis Lab	Emergencies, Operational Analytical Laboratories and Research Support	yes	Dated - Fair	Walls - block, concrete, demountable - typical Floor - VCT - poor with newer patches Ceiling - Ceiling tiles - water stains - poor, yellowing T-bar	Laminate millwork surfaces - parts unknown, covered/good wood lower millwork cabinets - good wood upper cabinets - good	HVAC Supply: new diffusers, fair condition. HVAC Exhaust: poor fume hood (EF-167), poor condition. Snorkels to serve equipment (EF-26A), good condition. Plumbing Fixtures: SS integral sink, gooseneck, fair condition. Eye wash, fair condition. Controls: Old thermostat. Other:	Emergency exit door at back of room for service core 716	\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\705
7 - 707-708	Minor Ions Analysis Lab	Emergencies, Operational Analytical Laboratories and Research Support	yes	Dated - Fair	Walls - block, concrete, demountable - typical Floor - VCT - poor with newer patches Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces -fair wood lower millwork cabinets - good wood upper cabinets - good	HVAC Supply: new diffusers, fair condition. HVAC Exhaust: Old fume hood (EF-167), poor condition. Snorkels to serve equipment (EF-26A), good condition. Plumbing Fixtures: SS integral sink, gooseneck, good condition. Eye wash, good condition. Controls: Old thermostat. Other: Milli-Q. Biological containment units.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\707-708
7 - 711	Minor Ions & Total Phosphorus Analysis	Emergencies, Operational Analytical Laboratories and Research Support	yes	Dated - Fair	Walls - block, concrete, demountable - typical Floor - VCT - poor with newer patches Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces -fair/poor wood lower millwork cabinets - fair/good wood upper cabinets - good Portion of lab is storage/fridges	HVAC Supply: new diffusers, fair condition. HVAC Exhaust: Old fume hood (EF-2), poor condition. Snorkels to serve equipment (EF-29, 26A), poor condition. Plumbing Fixtures: SS integral sink, gooseneck, good condition. Eye wash, good condition. Controls: Old thermostat. Other: Compressed gasses (O2, helium)		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\705
7 - 715	Kitchenette	General/Service Space	yes	Dated - Poor	Walls -block - typical Floor - VCT - poor; floor has a step up to sink, non BF compliant Millwork - Laminate surfaces, fair - countertop, poor	na	No notes	Using electronic equipment below the drinking fountain is hazardous.	\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\715
7 -716	Service Core	General/Service Space	yes	Dated - Fair	Walls - block - typical Floor - Concrete - good Ceiling - Exposed structure - good	na		No fire stopping at structure and penetrations/breaches Non-fire rated door and frame Previous emergency exit door remained, sealed on lab side only (L730A). Covered by clear plastic on corridor side.	\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\716
7 - 719-721	Mass Spectrometry Liquid Chromatography	Emergencies, Operational Analytical Laboratories and Research Support	yes	Partially Renovated - Fair	Walls -block and demountable - typical with acoustic materials applied Floor - VCT - poor Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces - fair/good wood lower millwork cabinets - good wood upper cabinets - good New wood top desks Loud equipment	HVAC Supply: Old diffusers, poor condition. New diffusers, good condition. HVAC Exhaust: Direct exhaust from equipment, good condition. Snorkels, good condition. Plumbing Fixtures: SS integral sink, gooseneck, fair condition. Eye wash, fair condition. Cup sinks, fair condition. Controls: Old thermostat. Other: Compressed gasses. return air in lab.	Acoustic wall material is highly flammable	\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\719-721
7 - 724-725	Mass Spectrometry & Gas Chromatography	Emergencies, Operational Analytical Laboratories and Research Support	yes	Partially Renovated - Fair	Walls - block, concrete, demountable - typical Floor - VCT - poor with newer patches Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces - poor/fair wood lower millwork cabinets - good wood upper cabinets - good New wood top desks	HVAC Supply: Old diffusers, fair condition. Old diffusers, poor condition. HVAC Exhaust: Snorkels, fair condition. Plumbing Fixtures: SS countertop mounted sink, gooseneck, good condition. Eye wash, good condition. Controls: Old thermostat. Other:		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\724-725
7 - 727	High Resolution Mass Spectrometry	Aquatic Ecosystem Protection Research Division	yes	Dated - Fair	Walls -block and demountable - typical with acoustic materials applied Floor - VCT - poor with newer patches Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate and stainless steel millwork surfaces - fair wood lower millwork cabinets - poor wood upper cabinets - poor New wood top desks	HVAC Supply: new diffusers, good condition. Old diffusers, fair condition. HEPA filter? HVAC Exhaust: Direct exhasut for equipment, fair condition. Old fume hood, poor condition. Plumbing Fixtures: SS integral sink, gooseneck, fair condition. Eye wash, fair condition. Controls: Old thermostat. Other: Compressed helium. Cooling unit for process. Condensate pumps and drain lines.	Acoustic wall material is highly flammable	\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\727

7 - 730	Trace Organic Contaminant (Clean Room)	Aquatic Ecosystem Protection Research Division	yes	Dated - Fair	Walls -block and drywall Floor - vinyl sheet flooring - poor, seal deteriorating Ceiling - drywall - poor, cracking and pealing	Stainless steel surfaces at metal cabinets- good metal lower millwork cabinets - good wood upper cabinets - fair	HVAC Supply: HEPA filtered air. HVAC Exhaust: Direct exhaust for equipment, fair condition. Old fume hood (EF-147, 148, 149, 166), poor condition. Capped snorkel roughins. Plumbing Fixtures: Eye wash, fair condition. Controls: Old thermostat. Other: Compressed nitrogen.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\730
7 - 733	Men's Washroom	General/Service Space	yes	Dated - Poor	Walls -block Floor - 2"x2" mosaic ceramic tile Ceiling - drywall Layout and fixtures are not barrier free compliant Finishes are extremely dated	na	No notes		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\733
7 - 734	Women's Washroom	General/Service Space	yes	Dated - Fair	Walls -block Floor - 2"x2" mosaic ceramic tile Ceiling - drywall Layout and fixtures are barrier free compliant but not up to current code Finishes are extremely dated	na	No notes		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\734
7 - 736	Nutrients & Total Phosphorus Lab	Emergencies, Operational Analytical Laboratories and Research Support	yes	Dated - Fair	Walls - block, concrete, demountable - typical Floor - vinyl sheet flooring - fair with stains Ceiling - drywall - fair	Laminate millwork surfaces - poor wood lower millwork cabinets -fair wood upper cabinets - fair	HVAC Supply: new diffusers, fair condition. HVAC Exhaust: new fume hood (EF-22), fair condition. Plumbing Fixtures: Epoxy integral sink, gooseneck, fair condition. Eye wash, fair condition. Controls: Old thermostat. Other:		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\736
7 - 738	Mass Spectrometry	Emergencies, Operational Analytical Laboratories and Research Support	yes	Dated - Fair	Walls - block, concrete, demountable - typical Floor - VCT - poor Ceiling - Ceiling tiles - fair, yellowing T-bar	Laminate millwork surfaces - good wood lower millwork cabinets -good metal, wood equipment desks - good	HVAC Supply: new diffusers, good condition. Split DX system. HVAC Exhaust: Direct exhasut for equipment, good condition. Plumbing Fixtures: SS counter mounted sink, gooseneck, fair condition. Eye wash, fair condition. Plumbing roughins, capped. Controls: Old thermostat. Other: Compressed gasses.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\738
7 - 740	Metals – Water Sample Lab	Emergencies, Operational Analytical Laboratories and Research Support	yes	Dated - Poor	Walls - block, concrete, demountable - typical Floor - VCT - very poor Ceiling - Ceiling tiles - fair, yellowing T-bar	Laminate millwork surfaces - poor wood lower millwork cabinets -poor wood upper cabinets - fair	HVAC Supply: new diffusers, good condition. HVAC Exhaust: Old fume hood, poor condition. Plumbing Fixtures: SS integral sink, plastic gooseneck, fair condition. Eye wash, fair condition (counter mounted and plastic). Controls: Old thermostat. Other: Water filtration system.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\740
7 - 742	Sample Storage & Preparation Lab	Emergencies, Operational Analytical Laboratories and Research Support	yes	Dated - Poor	Walls - block, concrete, demountable - typical Floor - VCT - very poor with newer patches Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces - poor wood lower millwork cabinets -poor wood upper cabinets - fair	HVAC Supply: new diffusers, good condition. HVAC Exhaust: Old fume hood, poor condition. Plumbing Fixtures: SS integral sink, gooseneck, fair condition. Eye wash, fair condition. Plastic gooseneck faucets on one sink. Other: Biological containment unit. Milli-Q. Compressed argon.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\742
7 - 745	Instrumental	Emergencies, Operational Analytical Laboratories and Research Support	yes	Dated - Fair	Walls - block, concrete, demountable - typical Floor - VCT - fair Ceiling - Ceiling tiles -fair, yellowing T-bar	Laminate millwork surfaces - fair wood lower millwork cabinets -fair wood upper cabinets - fair	HVAC Supply: new diffusers, good condition. HVAC Exhaust: Old fume hood, poor condition. Snorkels, poor condition. Direct exhaust from equipment, good condition. Plumbing Fixtures: SS integral sink, SS & plastic gooseneck, fair condition. Eye wash, good condition. RO water. Controls: Old thermostat. Other: Compressed gasses.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\745
7 - 747	Sediment Preparation Lab	Emergencies, Operational Analytical Laboratories and Research Support	yes	Dated - Fair	Walls - block, concrete, demountable - typical Floor - VCT - very poor Ceiling - Ceiling tiles - fair, yellowing T-bar	Laminate millwork surfaces at wood cabinet- poor Laminate millwork surfaces at metal cabinet- good wood lower millwork cabinets -poor metal lower millwork cabinets -fair/poor wood upper cabinets - fair Acid ware	HVAC Supply: new diffusers, good condition. HVAC Exhaust: New fume hood (EF-76A), good condition. Snorkels, poor condition. Plumbing Fixtures: SS integral sink, gooseneck, poor condition. Eye wash, poor condition. Controls: Old thermostat. Other:		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\747
7 - 750	Biota Preparation	Emergencies, Operational Analytical Laboratories and Research Support	yes	Dated - Poor	Walls - block, concrete, demountable - typical Floor - VCT - very poor Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces - poor wood lower millwork cabinets -poor wood storage cabinets - fair	HVAC Supply: new diffusers, fair condition. HVAC Exhaust: New fume hood, good condition. old fume hood, poor condition. Plumbing Fixtures: SS integral sink, gooseneck, poor condition. Eye wash, poor condition. Controls: Old thermostat. Other: Compressed gasses.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\750

7 - 752	Ultra-Trace Lab	Department of Fisheries and Oceans	yes	Fully Renovated - Excellent	Walls -block and drywall - new Floor - Concrete epoxy sealed floor Ceiling - drywall (vest) and metal/plastic T-bar and ceiling tiles (752)- new	Stainless steel millwork surfaces - excellent Stainless steel lower millwork cabinets -excellent Stainless steel upper storage cabinets - excellent	HVAC Supply: HEPA filters, good condition. HVAC Exhaust: New fume hood, good condition. Plumbing Fixtures: SS integral sink, gooseneck, good condition. Eye wash, good condition. Integral cup sinks in fume hoods, good condition. Controls: Old thermostat. Other: Return air in space. Emergency gas shut off. Milli-Q.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\752
7 - 753	Women's Washroom	General/Service Space	yes	Dated - Poor	Walls -block Floor - 2"x2" mosaic ceramic tile Ceiling - drywall Layout and fixtures are not barrier free compliant Finishes are extremely dated	na	No notes		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\753
7 - 754	Men's Washroom	General/Service Space	yes	Dated - Fair	Walls -block Floor - 2"x2" mosaic ceramic tile Ceiling - drywall Layout and fixtures are barrier free compliant but not up to current code Finishes are extremely dated	na	No notes		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\754
7 - 755	Service Core	General/Service Space	yes	Dated - Fair	Walls - block - typical Floor - Concrete - good Ceiling - Exposed structure - good	na		No fire stopping at structure and penetrations/breaches Non-fire rated door and frame Emergency exit door to 774A is partially blocked by a pipe.	\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\755
7 - 757-758	Chemical Stores	General/Service Space	yes	Dated - Fair	Walls - block - typical Floor - Concrete - good Ceiling - Exposed structure - good	Step up into second storage room	HVAC Supply: old diffusers, poor condition. HVAC Exhaust: na Plumbing Fixtures: na Controls: na Other: CO2 fire suppression. Blast vent. Chemical storage, compressed gasses.	Fire proof room Door is 1.5 hour rated door.	\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\757
7 - 760	Under Construction	Emergencies, Operational Analytical Laboratories and Research Support	yes	Fully Renovated - Excellent	Currently under renovation, all finishes removed Underside of beam height is 12'-6"		HVAC Supply: ductwork in ceiling space. HVAC Exhaust: ductwork in ceiling space. Plumbing Fixtures: na Controls: na Other:	Exposed breaches into service corridor	\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\760
7 - 761	Organic Extraction Lab	Emergencies, Operational Analytical Laboratories and Research Support	yes	Dated - Fair	Walls - block, concrete, demountable - typical Floor - sealed concrete, fair Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces - fair wood lower millwork cabinets -fair wood upper cabinets - fair	HVAC Supply: old diffusers, poor condition. HVAC Exhaust: Old fume hood (EF-108, 110, 152, 154), poor condition. Snorkels (equipment tag was obscure), fair condition. Plumbing Fixtures: SS integral sink, gooseneck, fair condition. Eye wash, fair condition. Controls: Old thermostat. Other: Compressed nitrogen. Milli-Q		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\761
7 - 765	Organic Standards Lab	Emergencies, Operational Analytical Laboratories and Research Support	some	Dated - Fair	Walls - block, concrete, demountable - typical Floor - VCT - poor with newer patches Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces - unknown, covered wood lower millwork cabinets -fair wood upper cabinets - fair	HVAC Supply: old diffusers, poor condition. HVAC Exhaust: Old fume hood, poor condition. Plumbing Fixtures: not observed. Controls: Old thermostat. Other:		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\765
7 - 766	ASE Extraction	Emergencies, Operational Analytical Laboratories and Research Support	yes	Dated - Fair	Walls - block, concrete, demountable - typical Floor - sealed concrete, fair Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces - fair wood lower millwork cabinets -fair wood upper cabinets - fair	HVAC Supply: old diffusers, poor condition. HVAC Exhaust: Old fume hood (EF-92, 93, 105), poor condition. Snorkels (EF-92, 93), poor condition. Plumbing Fixtures: SS integral sink, gooseneck, fair condition. Eye wash, fair condition. Cup sinks, SS, fair condition. Controls: Old thermostat. Other: Compressed air, nitrogen.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\766
7 - 768	Organic Biota Lab	Emergencies, Operational Analytical Laboratories and Research Support	yes	Dated - Fair	Walls - block, concrete, demountable - typical Floor - sealed concrete, fair Ceiling - Ceiling tiles - poor, yellowing T-bar	Laminate millwork surfaces - poor wood lower millwork cabinets -poor wood upper cabinets - fair	HVAC Supply: new diffusers, fair condition. HVAC Exhaust: Old fume hood, poor condition. New fume hood, good condition. Plumbing Fixtures: SS integral sink, gooseneck, fair condition. Eye wash, fair condition. Cup sinks, SS, fair condition. Controls: Old thermostat. Other: Compressed gasses.		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\768
7 - 771	Walk in Cooler	Emergencies, Operational Analytical Laboratories and Research Support	yes	Dated - Poor		Walk in cooler, looks extremely dated	No notes		\\Torfile\data\Buildings\09946T\01\2 DESIGN\ARCH\PHOTOS\2014-11-04\771
7 - 774	Organic Analysis Lab	Emergencies, Operational Analytical Laboratories and Research Support	yes	Dated - Fair	Walls - block, concrete, demountable - typical Floor - sealed concrete, fair and VCT - poor with newer patches Ceiling - Ceiling tiles - poor, water damage, yellowing T-bar, lighting yellowed	Laminate millwork surfaces - fair wood lower millwork cabinets -fair wood upper cabinets - fair	HVAC Supply: new diffusers, good condition. Old diffusers, poor condition. HVAC Exhaust: New fume hood (EF-102), good condition. Old fume hood (EF-92, 96, 97, 156), poor condition, Plumbing Fixtures: SS integral sink, gooseneck, fair condition. Eye wash, fair condition. Cup sinks, epoxy fair condition. Floor drain, fair condition. Controls: Old thermostat. Other: Compressed nitrogen. returns in lab space.		



1 APP.B 4th FLOOR PLAN
SCALE: NTS

DEPARTMENT LEGEND			
COLOUR	DIVISION / DESCRIPTION	COLOUR	DIVISION / DESCRIPTION
	WATERSHED HYDROLOGY & ECOLOGY RESEARCH DIVISION (WHERD)		WATER QUALITY MONITORING AND SURVEILLANCE (WQMS)
	AQUATIC CONTAMINANTS RESEARCH DIVISION (ACRD)		DEPARTMENT OF FISHERIES AND OCEANS
	EMERGENCIES, OPERATIONAL ANALYTICAL LABORATORIES AND RESEARCH SUPPORT (EOALRS)		STAIRS AND ELEVATORS
	ECOTOXICOLOGY AND WILDLIFE HEALTH DIVISION (EWHD)		SERVICE AND SHAFT SPACE
	OFFICES, CORRIDORS, AND OTHER SHARED AREAS		

LAB CONDITION LEGEND	
HATCH	CONDITION OF SPACE
	FULLY RENOVATED – EXCELLENT
	FULLY OR PARTIALLY RENOVATED – GOOD CONDITION
	PARTIALLY RENOVATED OR AGED – FAIR TO POOR CONDITION

ABBBREVIATIONS

- BR – BOARDROOM
- CS – COLD STORAGE
- FH – FUME HOOD
- FP – FIREPROOF
- J – JANITOR
- K – KITCHENETTE
- L – LABORATORY
- O – OFFICE
- R – ROOM
- S – STAIR
- SC – SERVICE CORE
- ST – STORAGE
- WR – WASHROOM

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APPENDIX B - 4TH FLOOR PLAN

DIALOG®

ISSUED: 2015-01-12 V-4

CANADA CENTRE FOR INLAND WATERS (CCIW) - NATIONAL WATER RESEARCH INSTITUTE (NWRI) A&L BUILDING

2 APP.B 5th FLOOR PLAN
SCALE: NTS

DEPARTMENT LEGEND			
COLOUR	DIVISION / DESCRIPTION	COLOUR	DIVISION / DESCRIPTION
(pink)	WATERSHED HYDROLOGY & ECOLOGY RESEARCH DIVISION (WHERD)	(green)	WATER QUALITY MONITORING AND SURVEILLANCE (WQMS)
(blue)	AQUATIC CONTAMINANTS RESEARCH DIVISION (ACRD)	(yellow)	DEPARTMENT OF FISHERIES AND OCEANS
(orange)	EMERGENCIES, OPERATIONAL ANALYTICAL LABORATORIES AND RESEARCH SUPPORT (EOALRS)	(dark grey)	STAIRS AND ELEVATORS
(purple)	ECOTOXICOLOGY AND WILDLIFE HEALTH DIVISION (EWHD)	(light grey)	SERVICE AND SHAFT SPACE
(white)	OFFICES, CORRIDORS, AND OTHER SHARED AREAS		

LAB CONDITION LEGEND	
HATCH	CONDITION OF SPACE
(+ hatch)	FULLY RENOVATED – EXCELLENT
(dash hatch)	FULLY OR PARTIALLY RENOVATED – GOOD CONDITION
(no hatch)	PARTIALLY RENOVATED OR AGED – FAIR TO POOR CONDITION

ABBBREVIATIONS

- BR – BOARDROOM
- CS – COLD STORAGE
- FH – FUME HOOD
- FP – FIREPROOF
- J – JANITOR
- K – KITCHENETTE
- L – LABORATORY
- O – OFFICE
- R – ROOM
- S – STAIR
- SC – SERVICE CORE
- ST – STORAGE
- WR – WASHROOM

3 APP.B 6th FLOOR PLAN

SCALE: NTS

DEPARTMENT LEGEND

COLOUR	DIVISION / DESCRIPTION	COLOUR	DIVISION / DESCRIPTION
	WATERSHED HYDROLOGY & ECOLOGY RESEARCH DIVISION (WHERD)		WATER QUALITY MONITORING AND SURVEILLANCE (WQMS)
	AQUATIC CONTAMINANTS RESEARCH DIVISION (ACRD)		DEPARTMENT OF FISHERIES AND OCEANS
	EMERGENCIES, OPERATIONAL ANALYTICAL LABORATORIES AND RESEARCH SUPPORT (EOALRS)		STAIRS AND ELEVATORS
	ECOTOXICOLOGY AND WILDLIFE HEALTH DIVISION (EWHD)		SERVICE AND SHAFT SPACE
	OFFICES, CORRIDORS, AND OTHER SHARED AREAS		

LAB CONDITION LEGEND

HATCH	CONDITION OF SPACE
	FULLY RENOVATED – EXCELLENT
	FULLY OR PARTIALLY RENOVATED – GOOD CONDITION
	PARTIALLY RENOVATED OR AGED – FAIR TO POOR CONDITION

ABBBREVIATIONS

- BR – BOARDROOM
- CS – COLD STORAGE
- FH – FUME HOOD
- FP – FIREPROOF
- J – JANITOR
- K – KITCHENETTE
- L – LABORATORY
- O – OFFICE
- R – ROOM
- S – STAIR
- SC – SERVICE CORE
- ST – STORAGE
- WR – WASHROOM

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APPENDIX B - 6TH FLOOR PLAN

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CANADA CENTRE FOR INLAND WATERS (CCIW) - NATIONAL WATER RESEARCH INSTITUTE (NWRI) A&L BUILDING

DEPARTMENT LEGEND			
COLOUR	DIVISION / DESCRIPTION	COLOUR	DIVISION / DESCRIPTION
(pink)	WATERSHED HYDROLOGY & ECOLOGY RESEARCH DIVISION (WHERD)	(green)	WATER QUALITY MONITORING AND SURVEILLANCE (WQMS)
(blue)	AQUATIC CONTAMINANTS RESEARCH DIVISION (ACRD)	(yellow)	DEPARTMENT OF FISHERIES AND OCEANS
(orange)	EMERGENCIES, OPERATIONAL ANALYTICAL LABORATORIES AND RESEARCH SUPPORT (EOALRS)	(dark grey)	STAIRS AND ELEVATORS
(purple)	ECOTOXICOLOGY AND WILDLIFE HEALTH DIVISION (EWHD)	(light grey)	SERVICE AND SHAFT SPACE
(white)	OFFICES, CORRIDORS, AND OTHER SHARED AREAS		

LAB CONDITION LEGEND	
HATCH	CONDITION OF SPACE
(cross hatch)	FULLY RENOVATED – EXCELLENT
(dashed hatch)	FULLY OR PARTIALLY RENOVATED – GOOD CONDITION
(no hatch)	PARTIALLY RENOVATED OR AGED – FAIR TO POOR CONDITION

ABBBREVIATIONS

BR – BOARDROOM
CS – COLD STORAGE
FH – FUME HOOD
FP – FIREPROOF
J – JANITOR
K – KITCHENETTE
L – LABORATORY
O – OFFICE
R – ROOM
S – STAIR
SC – SERVICE CORE
ST – STORAGE
WR – WASHROOM

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APPENDIX B - 7TH FLOOR PLAN

DIALOG®

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CANADA CENTRE FOR INLAND WATERS (CCIW) - NATIONAL WATER RESEARCH INSTITUTE (NWRI) A&L BUILDING

5
APP.B

7th FLOOR LIFE SAFETY PLAN

SCALE: NTS

BUILDING AREAS:		
A&L: OVERALL INTERIOR OF 4-7: 2854 m2		
A&L:	GROUND FLOOR:	3612 m2
R&D:	GROUND FLOOR:	2898 m2
HYDRAULICS LAB:	GROUND FLOOR:	7002 m2
HYDRAULICS OFFICES:	GROUND FLOOR:	742 m2
BOILER PLANT:	GROUND FLOOR:	856 m2
WAREHOUSE	GROUND FLOOR:	5492 m2
GROUND FLOOR TOTAL:		20602 m2

FIRM NAME : DIALOG
NAME OF PROJECT : CCIW – NWRI – A&L

NATIONAL BUILDING CODE DATA MATRIX - PART 3 - FIRE PROTECTION, OCCUPANT SAFETY AND ACCESSIBILITY			NBC REFERENCE
3.1	BUILDING CLASSIFICATION	GROUP F3 – LOW HAZARD INDUSTRIAL OCCUPANCIES GROUP D – BUSINESS AND PERSONAL SERVICES	3.1.2.1.
	SEPARATION OF MAJOR OCCUPANCIES	NO SEPARATION IS REQUIRED BETWEEN A GROUP 'F3' MAJOR OCCUPANCY AND A GROUP 'D' MAJOR OCCUPANCY	3.1.3.1. TABLE 3.1.3.1.
	USEABLE FLOOR AREA	7TH FLOOR (F3) : 1 377.3 SM = 14 825 SF 7TH FLOOR (D) : 1 261.3 SM = 13 576 SF TOTAL FLOOR AREA : 2 638.6 SM = 28 401 SF	1.4.1.2.
	OCCUPANT LOAD	☐ BY SF OF BUILDING ☒ BY DESIGN OF BUILDING IF A FLOOR AREA HAS BEEN DESIGNED FOR AN OCCUPANT LOAD OTHER THAN THAT DETERMINED FROM TABLE 3.1.16.1. THEN A PERMANENT SIGN INDICATING THAT OCCUPANT LOAD SHALL BE POSTED IN A CONSPICIOUS LOCATION. TOTAL OCCUPANT LOAD : 75 PERSONS – 7TH FLOOR ONLY	3.1.17. 3.1.17.1.
3.2	MAJOR OCCUPANCY	GROUP F3, ANY HEIGHT, ANY AREA, SPRINKLERED	3.2.2.78
	PERMITTED CONSTRUCTION	BUILDING SHALL BE OF NONCOMBUSTIBLE CONSTRUCTION BUILDING SHALL BE SPRINKLERED THROUGHOUT FLOOR ASSEMBLIES SHALL BE FIRE SEPARATIONS WITH A FIRE RESISTANCE RATING OF NOT LESS THAN 2 HOURS LOADBEARING COLUMNS SHALL HAVE A FIRE RESISTANCE RATING OF NOT LESS THAN 2 HOURS	3.2.2.78.(2) 3.2.2.78.(2)(a) 3.2.2.60.(2)(b) 3.2.2.60.(2)(d)
3.3	CORRIDORS	DEAD END CORRIDOR IS PERMITTED PROVIDED ITIS NOT MORE THAN 6M (19'–8") LONG	3.3.1.9.(7)
	DOOR SWING	A DOOR THAT OPENS INTO A CORRIDOR SHALL SWING IN THE DIRECTION OF TRAVEL TO THE EXIT.	3.3.1.11
3.4	MINIMUM NUMBER OF EXITS FOR FLOOR AREA	EVERY FLOOR AREA INTENDED FOR OCCUPANCY SHALL BE SERVED BY AT LEAST (2) EXITS	3.4.2.1.
	LOCATION OF EXITS TRAVEL DISTANCE	EXIT SHALL BE LOCATED SO THAT THE TRAVEL DISTANCE TO AT LEAST ONE EXIT SHALL NOT BE MORE THAN: 45M (147'–7") PROVIDED IT IS SPRINKLERED 30M (98'–5") PROVIDED IT IS NOT SPRINKLERED	3.4.2.5.(1)(c) 3.4.2.5.(1)(f)
3.7	PLUMBING FACILITIES	THE MINIMUM NUMBER OF WATER CLOSETS REQUIRED FOR BUSINESS AND PERSONAL SERVICES SHALL BE 75 PERSONS : 3 FIXTURES REQD EACH SEX FOR BUSINESS AND PERSONAL 75 PERSONS : 4 FIXTURES REQD EACH SEX FOR INDUSTRIAL 3 FIXTURES EXISTING FOR EACH SEX	3.7.2.2.(12) TABLE 3.7.2.2.(B)

CURRENT MAXIMUM TRAVEL DISTANCE: 30M (98'–5")

AREAS THAT REQUIRE 2 HOUR FIRE SEPARATION

EXISTING EXIT

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APPENDIX B - 7TH FLOOR LIFE SAFETY PLAN

DIALOG

CANADA CENTRE FOR INLAND WATERS (CCIW) - NATIONAL WATER RESEARCH INSTITUTE (NWRI) A&L BUILDING

Lab Standards

Space Standards & Design Guidelines

DRAFT

Phase 1

Bench top Labs for

Health Science Laboratories

Prepared for the

Real Property Transformation Group

In support of

Federal Laboratory Integrated Governance

March 2014

Canada

Lab Standards Team

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Table of Contents

1 INTRODUCTION

1.1 BACKGROUND

1.1.1 THE REAL PROPERTY TRANSFORMATION GROUP (RPTG)

.1 RPTG, in support of the Federal Laboratory Integrated Governance (FLIG) Initiative has taken the lead on developing a pilot program for Health Science Laboratory Standards.

  .1 RPTG consists of nine federal Science-Based Departments and Agencies (SBDAs) and this working group provides an opportunity for departments to identify and collectively carry out integrated activities to increase synergies, and develop innovative solutions resulting in horizontal efficiencies, cost savings, and sound stewardship.

  .2 The development of Lab Standards (Space Standards and Design Guidelines) is just one of the innovative solutions currently being explored by RPTG.

1.2 CONTEXT

1.2.1 OBJECTIVE

.1 This project's overarching aim is to enhance science while improving real property portfolio management, through the establishment of common federal laboratory space standards and design guidelines.

.2 This pilot project (Phase 1) addresses only the most common Health Science Bench-top types of Labs for the purpose of demonstrating the value of establishing Lab Standards when planning new lab facilities or retrofitting existing labs.

.3 Phase 2 to 4 will address the remaining science lab types.

  .1 The future phases of Lab Standards are expected to address:

    1 Food & Animal Science Labs (Phase 2),

    2 Engineering & Physics Labs (Phase 3), and

    3 Environment & Energy Labs (Phase 4)

1.2.2 PRINCIPLES

.1 Modernizing of federal laboratories for whole of government

.2 Implementing an enterprise approach to space standards and design guidelines for laboratories

.3 Collaborating between Real Property and Science for developing optimal federal lab standards

.4 Relying upon Science for project success, using expertise for comprehensive and encompassing standards for whole of federal government science needs

.5 Incorporating best practices into lab standards from the whole of government

.6 Developing building blocks for generic lab standards and design guidelines across science stakeholders to meet the needs of science across the whole of government.

  .1 The initial focus is on bench top labs, which are the most common laboratory type for federal SBDAs

  .2 Criteria for Standards are performance based rather than prescriptive, and containment levels for Standards. Design Guidelines are applicable only to Containment Levels 1 & 2, as CL-3 & CL-4 labs already have very prescriptive standards and design guidelines in place.

1.2.3 Objectives

.1 Develop space standards and design guidelines for laboratories and support spaces by:

  .1 Describing the space standards and fit-up guidelines for laboratories by type and functional group

  .2 Identifying energy efficiency opportunities that can be easily gained

  .3 Establishing basic space standards and design guidelines to assist in determining space requirements for retrofitting existing lab space on RPTG's Pilot Project for NCR Lab Rationalization

1.2.4 Purpose of Lab Standards

.1 The purpose of Lab Standards is to:

  .1 Define the appropriate space allocations to be applied when planning laboratory facilities for health science laboratories, and;

  .2 Describe the minimum laboratory design guidelines for Architectural, Mechanical, Electrical and Structural applications to meet health & safety requirements, codes & regulations and to ensure operational efficiencies and flexibility for future adaptation to constantly changing research programs

1.2.5 Application of Standards

.1 The standards and guidelines provided in this document are offered as a means to convey specific technical requirements, applicable to all laboratories.

.2 Lab designers are encouraged to propose systems and strategies that they believe are more efficient and effective than those identified in these standards.

1.3 LABORATORY SPACE STANDARDS

1.3.1 Bench Top Labs

.1 The RPTG working group has agreed that Phase 1 will focus on Health Science bench top laboratory standards only, for Wet labs (CL-1 & CL-2), Dry Labs, Labs and lab support spaces.

1.3.2 Allocation of Functional Laboratory Space

.1 When planning laboratory space for new or renovated health science departments, the determination of functional laboratory space should be based on the number of Full Time Equivalent (FTE) Principle Investigators (PIs) and support staff for which the department has an ongoing requirement to accommodate.

.2 The example plans included in appendix A indicate a lab arrangement for two (2) PIs and they include required space for supporting lab technicians.

1.3.3 Lab Function

.1 As there is no conventional practice for the consistent naming of laboratories, for the purposes of this exercise, the term *Lab Function* has been used to develop the preliminary list of labs to be considered for standardization.

.2 The term *Lab Function* shall be considered interchangeable with common variations in lab identification, such as lab type; lab name; lab program, research project or lab classification.

.3 Definitions included in Appendix B have been adopted from OmniClass Definitions

  .1 Web Site: http://www.omniclass.org/tables.asp

  .2 OmniClass does not yet have a complete set of definitions for all Lab Functions currently under consideration.

1.3.4 SPACE GROUPS

.1 In order to address lab standards in a more systematic manageable approach, bench top labs were separated into four initial groups:

.1 **Health Sciences**

1 These are predominantly wet labs and biological testing labs.

.2 **Food and Animal Sciences**

1 These include wet labs, dry labs, Greenhouse labs, Agriculture, Vivariums, Marine biology labs, testing labs and process labs.

.3 **Engineering and Physics Sciences**

1 These are predominantly dry labs.

.4 **Energy and Environment Sciences**

1 These are predominantly dry labs with some specific wet labs and testing labs.

1.4 LABORATORY DESIGN GUIDELINES

1.4.1 PERFORMANCE STANDARDS

.1 Performance Standards use generic descriptions of systems and components, which identify clearly definable, measurable, minimum or maximum standards for the performance of each component, system or integrated system.

.2 The standards for CL-1 labs also include consideration factors for future conversion to CL-2 labs.

1.4.2 SPECIFIC STANDARDS

.1 Specific standards are similar to specifications that describe the specific requirements for components, systems or integrated system. In addition to the description, reference may be made to include naming proprietary components or systems as being acceptable.

.2 For federal projects, the use of specific standards must be justifiable, as this may limit the competitive bidding process and appear to show favouritism to one company over others, which is not in compliance with Treasury Board Policies.

1.5 METHODOLOGY

1.5.1 PRELIMINARY INFORMATION

.1 PWGSC prepared a preliminary Health Science draft of information for Review by the RPTG Science representatives, including:

.1 A preliminary list of Lab Functions

.2 A preliminary list of Design Elements to:

1 Determine which Elements should have standards established for each Lab Function,

2 Identify if the standards should be performance based, specific or both.

3 Develop Design Guideline for each Bench Top Health labs.

.3 A list of Omni-class definitions related to labs

1.5.2 SPACE STANDARDS & DESIGN GUIDELINES

.1 Space Standards and Design Guidelines were developed for each lab type using best practices for lab planning and with reference to lab design principles applied to the Sir Frederick G. Banting Research Centre (Ottawa) and the J. C. Wilt Laboratory (Winnipeg) which serve to demonstrate real applications of the proposed standards.

2 GENERAL LABORATORY STANDARDS

2.1 BIOSAFETY

2.1.1 HEALTH SCIENCE LABS

.1 The majority of health science labs are dedicated to work involving low risk or inactive agents. As a result, the majority of health science labs will be designed to Containment Level 2 standards as defined in the most current edition of the Canadian Biosafety Standards and Guidelines (CBSG).

.2 The lab area should be separated from public areas by a locked door and will be controlled via card access.

.3 Access to specific lab suites within the lab area should be through lockable doors and controlled via card access.

.4 Although not required for CL2 requirements, office areas should be located outside of the containment lab zone.

.5 Directional inward airfow should be provided such that air will flow towards (not away from) labs

.6 Primary containment should be achieved through the use of biosafety cabinets and fume hoods.

.7 Hand-wash sinks should be provided in all rooms/labs where there is a possibility of handling an infectious substance.

.8 Staff should be required to wear appropriate personal protective equipment (gloves, clothing and eyewear)

.9 Walls separating the lab zones from administrative zones are considered as a containment barrier. As such, these walls should extend from floor to underside of structure and be free of openings.

.10 Appropriate signage indicating the nature of the hazard being used should be posted outside of each laboratory.

.11 All labs should have observation windows to an adjoining corridor.

.12 All labs should have intercom stations or some other easy method of connecting to security / reception desk for safety and security reasons.

2.2 CONTAINMENT LABS

2.2.1 CANADIAN BIOSAFETY STANDARDS AND GUIDELINES (CBSG)

.1 CBSG describes the containment performance requirements, based on risk, for four levels of biological containment, ranging from CL1 labs which have the lowest risk to human health conditions to CL4 which have the highest risk conditions.

.2 Chapter 3 (Physical Containment Requirements), in the GBSG outlines very specific design standards for all four biocontainment levels. Although these Health Science Laboratory Standards are limited to CL1 and CL2 labs, GBSG also has identified requirements for an enhanced CL2, called CL2-Ag for Agriculture Labs.

  .1 Enhanced CL2 labs are often referred to as CL2+ Labs.

  .2 While there is actually no clear definition in CBSG for the requirements of an enhanced CL2 lab (CL2+) for Health Science Research, in the interest of ensuring the lowest level of risk to human health, the following section (CL2+) is included in these lab standards to provide some CL2 enhancement guidelines to address potential increased risk circumstances.

2.2.2 CL2 + Labs

.1 In order to apply the design principles of a "CL2+" Lab, it is important to understand the fundament differences between the CL2 and CL3 physical containment requirements.

.1 Probably the most important difference to understand is that HVAC systems for CL3 labs are completely different from the requirements for a CL2 lab.

.2 There is a common misunderstanding that conversion of a CL2 lab to a CL3 is relatively simple, when in fact it is not. While in some instances it is actually physically impossible, it is almost always cost prohibitive to convert a CL2 Lab to a CL3 Lab, as the mechanical system must be completely replaced.

.2 The following description is very basic and addresses only the fundament differences. For specific details, refer to CBSG Guidelines.

.1 Containment Barrier

1 A CL2 lab or suite of labs is physically contained on all sides (floors, walls & ceilings), called the containment barrier, which is sufficiently sealed to maintain the required pressure differential (negative or positive) between adjacent rooms or suites.

2 A CL3 lab or suite of labs is also physically contained, however, **All** joints, connections and penetrations, including doors and windows, electrical outlets, lights, etc.), are fully sealed to ensure no air leakage from the lab, other than through the dedicated exhaust system.

.2 Access

1 Access to a CL2 lab is controlled through (locked) doors, which are sealed, but this does allow some air movement between adjacent rooms when opened.

2 Access to a CL3 is tightly controlled by two doors on either side of an anteroom, similar in principle to a submarine or a spaceship. Anterooms are required to provide a clothing change area and shower for personnel.

.3 Air Handling

1 HVAC system for CL2 labs is only required to provide sufficient air changes per hour (AC/hr) to serve the function of the lab and is usually designed to ensure inward directional flow, depending on adjacent room functions.

2 HVAC systems for CL3 labs must be independent of other areas, unless backdraft protection is provided and that is only applicable if combined with areas of lower containment. The system also requires pressure differential monitoring, HEPA filtration and numerous other controls, such as isolation dampers, airflow control to prevent positive pressurization, etc.

.4 Facility Services

1 Facility service requirements for CL3 Labs are much more stringent than for CL2 Labs, which impact the plumbing, venting and electrical services.

.5 Effluent Treatment Systems

1 Effluent Treatment Systems is another area where the CL3 Lab requirements are much more stringent than for CL2 Labs.

.3 CL2+ Guidelines

.1 The purpose of enhancing a CL2 Lab to "CL2+" is to reduce risk to human health.

1 The decision to enhance a CL2 Lab is essentially a judgement call in consideration of special circumstances related to specific types of research or testing being conducted.

2 The enhancement options are similar to the guidelines already in place in the CBSG for CL2-Ag, which serves as a very good reference point for Health Science Labs as well as Agriculture Labs, even though several of the requirements may not be applicable.

.2 Some reasons for considering enhancement to a CL2 Lab are:

1 Working with higher risk agents (such as the growth and manipulation of a culture of HIV or Hepatitis); or

2 Temporary high risk situations resulting from accidental spills or release of airborne contaminates such as; harmful substances, noxious gases or chemicals, pathogens, toxins, aerosol emissions (including sneezing from contagious subjects), etc.

.3 Additional biosafety features to consider for CL2+ Labs (or Suite of Labs) are:

1 Locate CL2+ area away from external building envelope walls.

2 Surround CL2+ area by CL2 labs or lab support space, thereby minimizing any potential contamination to other areas, such as office areas or to the exterior environment

3 Walls separating the CL2+ area from the balance of the CL2 lab zone should designed as a containment barrier and as such, these walls should extend from floor to underside of structure, be free of openings or seal all penetrations and seal all joints at the floor and ceiling.

4 Access to the CL2+ area should be provided via a clean anteroom and dirty anteroom

1 Protective Lab equipment dedicated to the CL2+ zone should be kept in the dirty anteroom.

2 Doors between the 2 anterooms should be interlocked doors (doors cannot be opened simultaneously) equipped with manual override for emergency exit.

5 Supply air to the CL2+ zone should be independent of other lab areas.

6 Biowaste from the CL2+ Labs shall be autoclaved in a dedicated CL2+ autoclave prior to leaving the CL2+ Lab suite.

2.3 BIOLOGICAL MATERIAL MOVEMENT

2.3.1 SHIPPING / RECEIVING DESK

.1 The Shipping / Receiving desk should be located adjacent to the loading area, as it will be responsible for logging all incoming and outgoing material, including media, supplies, equipment and samples.

2.3.2 SAMPLE RECEIPT, HANDLING AND STORAGE

.1 All incoming samples should be processed in the sample receipt lab, directly adjacent to the shipping and receiving desk. The lab is responsible for opening, identifying, logging and tagging incoming samples, as well as holding samples until retrieved by the addressee.

2.3.3 FREEZER / REFRIGERATOR ROOMS

.1 Designated Freezer / Refrigerator Rooms should be used for the secure and safe storage of low risk agents and inactive samples.

2.3.4 WASTE STERILIZATION

.1 A centralized autoclaving facility should be provided to decontaminate all contaminated materials, both solid and liquid.

.1 Two barrier (pass-through) autoclaves should be located between a Waste staging room and a wash-up room.

.2 One 'dirty' autoclave should be utilized for sterilizing Biowaste; the second 'clean' autoclave will be used for sterilizing glassware and equipment.

.2 If a CL2+ zone is planned for, a third pass-through autoclave should be located between the CL2+ autoclave room and the primary corridor within the CL lab zone. This autoclave will be used exclusively for sterilization of waste produced within the CL2+ lab suite.

.3 Biowaste should be collected daily and sterilized.

2.4 OPERATIONAL CONTINUITY

.1 Containment

.1 Critical containment systems should be designed to so that equipment failure or power loss does not result in a breach of containment.

.2 Equipment

.1 Lab equipment which is used for storage of temperature sensitive material (freezers, refrigerators, incubators, etc.) should be connected to a Lab Equipment Monitoring and Information System, so that equipment failure can be identified immediately.

.3 Shutdown

.1 The lab should allow for safe shutdown in event of power failure or other emergency by providing:

1 Backup power to allow Biosafety cabinets to operate while lab operations are shutdown and disinfection is being carried out

2 Light levels necessary to allow users to perform disinfection procedures and safe exit.

3 Sufficient water to allow for appropriate levels of user handwashing and showering

2.4.2 SUSTAINABLE DESIGN AND ENERGY CONSERVATION

.1 The laboratory should be designed to a high level of efficiency, with low energy consumption.

.2 Above and beyond any required LEED rating, the project should incorporate principles and strategies as specified in LABS21 Environmental Performance Criteria (EPC).

.1 The Labs21 Environmental Performance Criteria (EPC) is a rating system for use by laboratory building project stakeholders to assess the environmental performance of laboratory facilities.

.2 The EPC leverages and builds on the Canadian Green Building Council's widely used LEED™ Rating System, extending it to set appropriate and specific requirements for laboratories.

.3 EPC credits may qualify as 'Innovation' credits under the LEED program.

.3 LABS21 does not provide a certification process for EPC.

.1 The Consultant is required to provide a spreadsheet outlining all potential EPC credits, credits successfully achieved by the project as well as rationale for credits which could not be achieved.

.4 The Design Team should:
- .1 Provide energy use metrics (e.g. BTU/sf/yr) as well as system efficiency metrics (e.g. W/cfm).
  - 1 The metrics to be provided:
    - 1 Upon completion of the design phase (i.e. estimated), and
    - 2 At the end of the first year of operation
- .2 Submit all benchmarking data onto the LABS21 benchmarking database.
  - 1 Refer to: http://www.labs21century.gov/pdf/bench_aceee_508.pdf
- .3 Incorporate energy conservation strategies and technologies to mitigate high energy use due to high air flows, high outdoor air requirements and high internal heat gains. Potential strategies / technologies include:
  - 1 High efficiency equipment (motors, lights, boilers, etc)
  - 2 Manifold lab exhaust system
  - 3 Variable air volume control
  - 4 Dynamic control of air change rates within labs
  - 5 Setback and setup controls to adjust for occupancy and seasonal variations
  - 6 Use of heat exchanging equipment

3 ARCHITECTURAL & STRUCTURAL STANDARDS

3.1 INTRODUCTION

3.1.1 INTERIOR ARCHITECTURE

.1 Architectural Standards for Laboratories are limited to interior architectural elements and finishes.

.2 Wherever possible, unless in conflict with functional requirements, labs should be located to optimize natural day lighting

.3 Natural light is less important in lab support areas due to intermittent usage.

.4 Planning should isolate noise-generating lab equipment wherever possible.

3.1.2 STRUCTURAL

.1 From a structural perspective, the primary concerns for a laboratory are floor load, roof load, floor stiffness and vibration control.

3.2 ARCHITECTURAL LAB FINISHES

3.2.1 FLOOR PERFORMANCE CHARACTERISTICS

.1 Research Areas and Lab support spaces
- .1 Flooring should be:
  - 1 Hard, Resilient, Impervious to chemicals, Durable, Cleanable, Non-Slip and Seamless
- .2 Base materials should be compatible with flooring, coved and integral w/floor

.2 Support Areas, including Security, Reception Area, Public Corridors, Lab Corridors Lobby, etc.
- .1 Flooring should be hard, resilient, durable, washable, slip resistant, high traffic and easy to maintain.

.3 Office and Office support areas
- .1 Flooring should be resilient, durable and easy to maintain

3.2.2 INTERIOR WALL PERFORMANCE CHARACTERISTICS

.1 Research Areas and Lab support spaces
- .1 Walls should be Highly Durable, Cleanable, Water resistant, Washable, and easy to maintain
- .2 Wall Finishes should be Washable, Paintable, or prefinished washable surface

.2 Support Areas, including Office, Office support, Security, Reception Area, Public Corridors, Lab Corridors, Lobby, etc.
- .1 Walls should be paintable, hard surface, durable and easily cleanable,

3.2.3 CEILINGS PERFORMANCE CHARACTERISTICS

.1 Research Areas and Lab support spaces
- .1 Ceilings should be Acoustical, Cleanable, Washable and easy to maintain
- .2 Gypsum board, equipped with access panels should be provided in rooms where potential moisture exists, such as autoclave rooms and glassware washing rooms.
- .3 Ceilings for CL2+ areas should be easy to sterilize

.4 If a lab is open to the u/s of structure, the exposed elements should be paintable, cleanable and incorporate an acoustical baffle system to minimize noise disruption, which is cleanable.

.2 Ceiling Finishes should be either paintable, or prefinished material and cleanable

3.2.4 Interior Doors

.1 Interior doors serving labs and lab support rooms should be minimum 915mm x 2150mm.

.2 Where large lab equipment is required, higher doors or doors with removable transoms are required and doors should be minimum 1050mm x 2150mm.

.3 Where space permits, lab doors should swing in the direction of egress.

.4 Card access or security hardware should be provided on access doors at the following locations:

- .1 Labs and lab suites,
- .2 Designated labs,
- .3 Lab zones,
- .4 Administrative zones,
- .5 Designated lab support areas, and
- .6 Telecom/IT closets.

.5 Where anterooms are provided, doors shall be interlocked to ensure doors cannot be opened simultaneously.

3.2.5 Hardware

.1 Hinges should be High Security with non-re-moveable pins.

.2 Lockset & Latch-set should have High Security Key or Card Access with Lever handles.

.3 Closers and hold open devices should be O/H and easy to clean and maintain.

.4 Specialties should be stainless steel wherever possible.

3.2.6 Glazing

.1 For labs with exterior walls, the window units shall be a minimum double glazed with clear glass.

- .1 Venetian blind systems located within the sealed unit or other suitable sun shading control should be provided on exterior glazing.

.2 Interior windows should be tempered glazing in pressed steel frames.

3.3 SUPPORT SPACES

3.3.1 Equipment spaces

.1 Freezers and Refrigerators should be grouped and located in a controlled environment space to deal with heat gain and use heat recovery systems to save energy and costs.

.2 Other service equipment spaces, such as autoclaves, glass washers, etc. should also be grouped in a controlled environment space for operational efficiencies and cost savings.

.3 Equipment and supply storage should be centralized to minimize the storage requirements within the labs.

3.4 LAB CASEWORK

3.4.1 LOWER CASEWORK:

.1 Lower casework should be flexible and moveable to allow for easy reconfiguration of lab work areas.

.2 Materials should be highly durable (preferably metal) with corrosion resistant finishes

.1 Lab bench tops must be highly durable with a corrosion resistant finish.

.3 Components (drawers, cupboards, etc,) should be plug and play type units that are interchangeable to provide ease of reconfiguration

3.4.2 UPPER CASEWORK:

.1 Upper casework should be ceiling suspended if possible to allow for maximum efficient use of lower case surface area

.2 Materials should be highly durable (preferably metal) with corrosion resistant finishes

.3 Components (shelves, cupboards, etc,) should be plug and play type units that are interchangeable to provide ease of reconfiguration.

3.5 STRUCTURAL

3.5.1 MINIMUM FLOOR LOAD CRITERIA

.1 Office, Office support, Security, Reception Area, Public Corridors, Lab Corridors and Lobby should be designed to hold 500kg/m².

.2 Laboratories, Lab support spaces and Service corridors that are expected to support heavy equipment should be designed to hold 730kg/m² to allow for future flexibility; or

.3 For Structural slabs and Slab-on-grade areas they should be designed to hold 1,000kg/m².

3.5.2 VIBRATION

.1 A generic vibration criteria level VC-B is required for most labs.

3.5.3 FLOOR STIFFNESS

.1 Where optical microscopes are located, the level of floor stiffness should be 1000X.

.2 Isolation may be required for more sensitive equipment.

4 MECHANICAL STANDARDS

4.1 INTRODUCTION

4.1.1 SYSTEMS

.1 The mechanical systems consist of HVAC, plumbing, building automation, distribution of air and water, fire protection, utilities and others to support the functionalities of the administrative and laboratory spaces.

.2 All system sizing and proposed alternatives must be supported by good laboratory practice as outlined in the PWGSC Guide: MD 15126 - 2014; Guide for Laboratory Heating, Ventilation and Air Conditioning (HVAC).

- .1 Mechanical systems should be designed to provide a high seasonal performance.
- .2 Selection of systems should be the most energy efficient, as determined or confirmed by computerized program analysis.
- .3 To facilitate operation and maintenance, all mechanical systems should be centralized, except for those cases where the requirements are unique to the processes or equipment.

.3 The information provided in these design guidelines indicates the minimum quality and standards that should be provided to meet acceptable laboratory design practices.

- .1 It is only a guideline and is not intended to discourage the applications of new, innovative or alternate systems and approaches not addressed in these guidelines. Alternative systems and approaches should at least be equivalent or better to the guidelines with respect to quality, efficiency, effectiveness, functionality, performance, health and safety, operations and maintenance.

.4 Mechanical services to labs should be designed to be as flexible as possible; such as using O/H gas, air and vacuum distribution services or incorporating services as integral part of the upper casework to maximize lower casework flexibility and minimize disruption to research programs when adding new mechanical services.

4.2 HVAC

4.2.1 LABORATORY HVAC SYSTEMS

.1 HVAC systems play a vital role in managing laboratory temperature, humidity, and control of airborne contaminants, pressure differential and containment requirements.

.2 HVAC system main air handling units shall conform to ASHRAE 52.1.

.3 Where consideration for future ventilation, heating and cooling loads is important, standby capacity of 20% or greater should be added to the design of the main air-handling units and their associated heating and cooling coils.

.4 For laboratory modules identified as requiring minimal disruption from neighboring and adjacent spaces or laboratories, each laboratory module should be treated as a unique thermal zone with its own dedicated ventilation supply air and exhaust systems, its utility distribution system complete with isolation values and dampers to facilitate operation and maintenance of each module.

- .1 Environmental conditions should meet ASHRAE Standard 55.
- .2 Each module should be complete with its own dedicated supply and ventilation terminal units and control panel for the automation controls of all the systems within the module.

.3 Part of the laboratory make-up air may be from the corridors as long as the air quantity is small and the air quality complies with AHRARE Standard 62. No make-up air is allowed from the adjoining laboratories.

4.2.2 Laboratory Pressure Differentials

.1 HVAC systems should be capable of providing sufficient ventilation and make-up air to meet the exhaust air requirements required to control all fumes, odors, and other airborne contaminants.

.1 Airflow should provide the directional flow of air from areas of least contamination to those of greatest contamination.

.2 Directional air flow should be based on the principle that there is more exhaust airflow rate than the supply airflow rate within the same laboratory space.

.1 Interlock the total supply and exhaust to maintain a minimum and constant airflow offset.

.3 Where critical air-balance is required, a personnel entry or exit anteroom (airlock) should be provided as a positive means of maintaining pressure differential control.

4.2.3 Air Distribution Systems

.1 Ventilation systems should be designed to replace exhausted air and provide the temperature, humidity, and air quality required to meet the laboratory procedures and protocols without creating drafts or any other negative impact on the performance of Chemical fume hoods, Biosafety cabinets, Canopies and other laboratory equipment and exhaust systems.

.1 Proper diffuser types and locations are critical to provide optimum ventilation efficiency with minimal air turbulence.

.2 Dependant on the types of substances used, a demand air supply system with full monitoring, may be considered to reduce the number of air changes required, in order to maximize cost savings and minimize both energy consumption and green house gas emissions.

.3 Fume hood locations should be as per recommendations from CSA Z316.5-94, Fume Hoods and Associated Exhaust Systems

4.2.4 Fume Dispersion Modeling

.1 Dispersion modeling using numerical techniques is recommended to determine exit velocities and air intake locations for all fume exhaust systems (fume hoods, chemical storage areas, loading and receiving docks, emergency generators, kitchens, garage and other exhaust systems) and modeling should be conducted by a firm specializing in this area, with considerable experience in computer modeling of fume dispersions.

4.2.5 Exhaust Systems

.1 The laboratory areas should have dedicated exhaust air units, separate from other functional areas, such as reception, meeting rooms, offices, etc.

.2 To provide flexibility, maintainability, and redundancy, a central manifold exhaust air system should be considered for fume hoods and other local exhaust, unless there is a significant difference in static pressure or the fume hoods are exhausting very hazardous substances, such as Perchloric acid, etc.

.3 Exhaust fans should be carefully selected to account for system effects and other important unforeseen factors and shall be adequately sized to meet the current and future demands.

.4 Dedicated exhaust and supply air systems should be provided for chemical storage rooms as per NFPA 30 and National Fire Code of Canada. Monitoring alarms should be provided to the central building automation system to indicate the failure of the exhaust systems.

.5 Flammable storage cabinets, if vented, should be compliant with NFPA 30.

4.2.6 SUSTAINABILITY DESIGN AND LIFE CYCLE COST ANALYSIS OF HVAC SYSTEMS

.1 Sustainability Development Strategies for HVAC Systems is considered to be one of the most important design principles for guiding the design and development of a research facility. The intent is to:

- .1 Sustain Canada's natural resources, by: ensuring sustainable use of renewable resources and efficient use of non-renewable resources;
- .2 Improve the quality of life and well-being of Canadians;
- .3 Foster improved productivity through environmental efficiency and
- .4 Support innovation towards sustainable development.

.2 HVAC systems should be analyzed as an integrated approach with the considerations of the various architectural features such as the types of windows and glazing, wall and roof insulation, building orientations, window fins, overhangs and other shading devices, roof types, building orientations, and other building system parameters, as well as the electrical systems.

- .1 An energy analysis computer program should be used to simulate the various systems to determine the life cycle costs of both the HVAC systems and the integrated systems for a research facility, including energy consumption of the integrated systems, investment costs, energy costs, operation and maintenance costs, replacement and repair costs, and salvage values.
- .2 Energy analysis should also include the impacts of building envelope, lighting energy input, weather conditions, domestic heating, part load performance of all equipment, automatic operation modes of HVAC, temperature and pressure resets, and others.
- .3 To maximize energy efficiency, it is recommended that low face velocities should be used for air filters, coils, and air distribution systems.

4.2.7 ENERGY RECOVERY

.1 The HVAC design team should evaluate the various systems and identify possibilities and options for energy recovery.

- .1 Energy in the form of waste heating and cooling should be considered as potential candidates for evaluations.
- .2 Life cycle costs should be the major factor when considering Life Cycle feasibility options.

.2 Federal Buildings Initiative (FBI) program, introduced by Natural Resources Canada should be considered for application to all renovated federal laboratories.

- .1 https://www.nrcan.gc.ca/energy/efficiency/communities-infrastructure/buildings/federal/4481
- .2 The extended payback concept introduced by the FBI program offers the opportunity for existing federal labs to take advantage of cost savings generated by the reduction of energy consumption and extend the payback time beyond time expected to recover costs associated with improving energy efficiency and apply the additional savings to address other building deficiencies facing Canada's aging laboratory infrastructure, such as Health & Safety issues, rust out problems, outdated equipment, functional inefficiencies, etc.

1 For example, if the payback time is 8 years, for an energy recovery program of 2M$, by simply extending the payback to 12 years, an additional $1M becomes available to address other important deficiencies.

4.2.8 Design Conditions

.1 Outdoor Design Conditions

.1 For the laboratory ventilation systems, which employ 100% outdoor air, sufficient capacity should be provided to meet the following design conditions.

1 Summer temperature: 23ºC, +/- 2ºC and RH: 60% +/- 5%

2 Winter temperature: 23ºC +/- 2ºC and RH: 30% +/- 5%

4.2.9 Ventilation System Overview and Goals

.1 The primary mechanical goal is health and safety, based primarily on directional air flow.

.1 While the first line of health and safety is usually provided by Biosafety cabinets and Fume Hoods, which operate on the principles of directional air flow and HEPA filtration, the ventilation system should be designed to address safety during emergency conditions, such as spills, equipment malfunction, etc. and should also provide reasonable flexibility for future modifications to the lab areas.

.2 Comfortable working conditions are also required to ensure that laboratory areas are functionally effective for the users.

4.2.10 Ventilation Criteria

.1 Laboratories:

.1 Ventilation systems should be designed to address worst of the following requirements:

1 Hood or special exhaust requirements,

2 Thermal load requirements, or

3 As a minimum, if requirements for 1 and 2 above are not defined, design for 10 air changes per hour of supply air with the ability to set back to 6 air changes for un-occupied mode.

.2 If allowable, a Demand Air Supply (DAS) system should be considered to reduce the minimum number of air changes per hour.

1 A DAS system apples the concept of an air monitoring system to detect unsafe or unhealthy conditions in a lab and automatically initiate the emergency ventilation system to flush exhaust the lab and return it to safe conditions while the problem is being identified and resolved.

2 The effective use of a DAS system is dependent on the substances and materials being used in the lab, as some hazardous substances may not be detectable by the monitoring system.

.2 Lab Support Areas:

.1 Ventilation design should be based on worst case of the following:

1 Special exhaust requirements,

2 Thermal loads, or

3 A minimum of 6 air changes per hour of supply air, unless a DAS system is being used.

.3 Office Areas:

.1 9.4 L/s·person (20 cf/m·person) of outside air, will be provided from the main building 100% outside air system.

- .4 Washrooms:
  - .1 35.4 L/s (75 cf/m) per water closet or urinal, or minimum of 21.5 L/s ·m² (2 cf/m·ft²).
- .5 Corridors:
  - .1 0.55 L/s ·m² (0.05 cf/m·ft²)
- .6 Storage Rooms (Hazardous Material):
  - .1 10.7 L/s ·m² (1 cf/m·ft²).

4.2.11 Chemical Fume hoods

- .1 Recommended Criteria
  - .1 Low flow velocity (high efficiency) fume hoods should be seriously considered for all Health Science labs.
  - .2 Design, installation and testing should adhere to ASHRAE 110-1995, ANSI/AIHA Z9.5-2012 or the requirements of the PWGSC Guidelines: MD 15128, Minimum Guidelines for Laboratory Fume Hoods.

4.2.12 Bio-Safety Cabinet

- .1 Recommended Criteria
  - .1 Class II A2 (re-circulated air or canopy exhaust):
    - 1 70% HEPA filtered air re-circulated or canopy exhaust to manufacturer's specifications.
  - .2 Class II B2 (ducted):
    - 1 100% HEPA filtered air exhausted to outside building via house exhaust air system to manufacturer's specifications.
  - .3 Unless canopy exhausted, all ducted Bio Safety Cabinets to run continuously. Exhaust will be constant air volume.
  - .4 Class III Ventilated Glove box (ducted):
    - 1 100% HEPA filtered air exhausted to outside building via house exhaust air system to manufacturer's specifications.
    - 2 Airflow based on glove box manufacturers design data.

4.2.13 Space Pressurization

- .1 Recommended Criteria
  - .1 CL-2 level labs:
    - 1 Each lab and lab support room will be provided with dedicated supply and exhaust terminal air units.
    - 2 Both supply and exhaust terminal units will track each other to a predetermined delta - L/s (cf/m) airflow between their maximum and minimum set-point limits, to maintain room airflow relationship with adjacent areas or corridor.
    - 3 Rooms with hood exhausts will be maintained at constant air volume with set-points on the supply and exhaust air terminal units adjusted to for the required delta L/s (cf/m).
    - 4 Unless otherwise identified by the owner, the airflow room balance relationship for labs and related lab support areas will be set at a negative air balance relative to adjacent corridor, public and office areas.
  - .2 Offices and related administrative areas:
    - 1 Zoning shall meet the requirements of ASHRAE 55 – 2005.

2 Quantity of ventilation air from the outside air unit will be determined by the total required for minimum code ventilation, make-up to miscellaneous exhausts, area air balance relationship to the lab areas, and that required for building pressurization.

.3 Washroom/locker rooms, mechanical and electrical utility equipment rooms will have a negative air balance relative to the adjacent areas.

.4 Tele-Communication (IT) Closets and Server rooms will be held at a positive air balance relative to the adjacent areas.

4.2.14 Noise Control

.1 Recommended Criteria

.1 Room noise criteria are resultant noise levels used when selecting mechanical equipment and designing distribution systems.

.2 These noise criteria levels are based upon an unoccupied space with only mechanical systems operating, and do not take into account any noise generated by users, animals or equipment within the space.

.3 Noise readings are normally taken in the center of the room, about 1.5M above the floor.

.4 The following are Noise Criteria (NC) level guidelines:

1	Office Space	NC40
2	Laboratories and Lab Support	NC45
3	Autoclave/Glass wash Areas	NC55

4.2.15 Heating, Cooling and Humidification

.1 General heating and cooling should be provided at each AHU or fan coil unit with supplement heating at the lab terminal units;

.2 General Heating and Humidification is required in the winter and terminal reheat may be required year round.

4.3 CONTROLS

.1 Building Automation System (BAS) should be a complete stand-alone PC-Based, distributed digital control system.

.1 System should communicate over a high speed local area network (LAN) to provide automated control and monitoring of various mechanical and electrical equipment located in the building

.2 The lab area control systems should be designed such that these systems can be stand-alone.

.1 The system should be fully operational without depending on the remainder of the BAS systems being connected or operational.

.3 The BAS should be fully electronic, including all control damper and valve actuators.

.1 Each controller should include all hardware, software, signal conditioning and termination devices to provide full monitoring and control of its data environment.

.2 Power conditioning (isolation transformers) should be used.

.3 All controllers should be served from electric distribution circuits with emergency power backup.

.4 BAS contractor should provide an Uninterruptible Power Supply per cabinet.

.4 BAS Operator Workstations should consist of the following equipment:

.1 CPU(s), Monitor, Printers (Alarm and Trend/log), Data Archive Media

4.4 PLUMBING

4.4.1 Introduction

.1 Design and installation of plumbing systems should meet the requirements of Sections 6 and be fully compliant with the Laboratory Biosafety Guidelines.

.2 Electrical services to labs should be as flexible as possible, such as O/H wire mould service as an integral part of the upper casework.

4.4.2 Domestic Water

.1 An analysis should be provided to determine the required water pressure delivery to the building's emergency showers and sterilization equipment.

.2 Building domestic water softening equipment should be provided.

4.4.3 Laboratory Plumbing Services

.1 Emergency shower equipment and eyewash facilities should be provided to Code and ANSI Z358.1.

.2 Laboratory waste from the laboratory sinks, laboratory related equipment and glass washing areas should l be collected and treated at a laboratory neutralization system before being released to the municipal sewer system.

.3 The laboratory areas should be served by dedicated laboratory waste/vent stacks to eliminate potential cross-contamination.

4.4.4 Laboratory Gases

.1 Gas cylinders for CO_2, Natural Gas, Propane, Air, Oxygen, Nitrogen, Nitrous Oxide, Hydrogen, etc., should be stored securely, with brackets, in an area close to the lab, but preferably not inside the research area.

.2 Gas lines should be distributed in a manner that achieves the most flexibility for users and that is easily adaptable to future change, such as O/H lines through the upper case work.

4.4.5 Laboratory Liquids

.1 Where Purified Water is required:

- .1 Type 3 - (RO) water should be provided at lab sinks.
- .2 Type 1 - (deionised) water should be provided in the following locations:
  - 1 1 dispensing station in each of the main corridors
  - 2 1 source either directly in the Calibration Lab, or within the Surveillance and Reference Services area
  - 3 1 source in Research lab located within the Immune Monitoring area

.2 Where Liquid nitrogen is required general use should be provided in a central location accessible to all researchers.

4.5 FIRE PROTECTION

4.5.1 Introduction

.1 Installation of site hydrant(s), fire department connection and building hose valves are normally subject to local standards and NFPA.

4.5.2 Sprinkler System

.1 The sprinkler system should be designed to FC403; Fire Protection Standard for Sprinkler Systems – Nov 1994 and NFPA.

4.5.3 FIRE EXTINGUISHERS

.1 Fire extinguishers should be provided within each laboratory to facilitate quick response.

.2 Fire extinguishers should be located throughout the facility to the requirements of FC401: Standard for Fire Extinguishers – Nov 1966.

5 ELECTRICAL STANDARDS

5.1 POWER

5.1.1 Building Power Distribution

.1 Power distribution should be coordinated with the local electrical service provide distribution to ensure appropriate sizing of transformers providing 120/208V distribution to the building, and transformers providing 347/600V distribution to the building, to ensure proper provision of power to service mechanical loads.

.2 Where practical, additional empty conduits extending to ceiling spaces from recessed panel boards should be provided to accommodate the panel circuit capacity for future use

5.1.2 Laboratory Power

.1 Power service to lab areas should provide sufficient and properly located:

- .1 Convenience Outlets;
  - 1 2 Phase, 110 Volts, with ground fault protection. Wire mould outlets are preferred in lab areas to provide flexibility.
- .2 Equipment Outlets:
  - 1 2 Phase, 110 Volts for standard equipment such as clock, microwave, fridge, freezer, etc.
  - 2 3 Phase, 220 Volts for special equipment such as Laminar Flow Hoods, Fume Hoods, Autoclaves, Biosafety Cabinets, etc.
- .3 Low Voltage Service:
  - 1 Low voltage service for communication devices, security, doors, etc.

5.1.3 Emergency Power and Distribution

.1 Lab areas should be provided with emergency power and control/transfer panels conforming to CSA-282-00 to provide interruptible power to essential equipment and services.

5.1.4 UPS Power

.1 Lab areas should be provided with a UPS system to accommodate essential systems such as specialized lab equipment, CCTV/access control systems, etc., complete with batteries, racks, annunciator panels and all related equipment.

5.1.5 Metering

.1 The provision of a metering system is recommended as good practice and to comply with LEED requirements.

5.2 LIGHTING

5.2.1 Lab Lighting Systems

.1 Lab lighting should be of high-quality, in terms of both brightness and uniformity.

.2 Lighting systems should be designed as an energy efficient quality artificial lighting system satisfying aesthetic, safety, security and operational requirements at a minimal life-cycle cost, determined through a cost analysis of capital cost and ongoing operating and maintenance costs.

.3 Illumination levels should be in conformance with IES, PWGSC and Labour Canada standards and guidelines.

.4 Manual controls may also be provided, which consist of line switches, low voltage switches, time switches, photo-controls & contactors and other switches.

.5 Direct or direct-indirect fluorescent luminaries may be utilized, preferably with pure virgin acrylic lenses, or parabolic louvers.

  .1 LED lighting and occupancy sensors should also be considered, where appropriate to reduce energy consumption.

.6 Provide emergency lighting system with light units in locations required by the National Building Code and FCC standard No. 501;

  .1 Emergency lighting may consist of centralized inverter, individual battery banks, or fluorescent fixtures with integral emergency lighting ballasts.

  .2 Illumination levels of emergency lighting system must be in accordance with the National Building Code.

.7 All exit lights for federal labs must be bilingual and are to conform to CSA C860-01.

5.3 LIFE SAFETY SYSTEMS

5.3.1 Fire Alarm

.1 Provide an addressable building fire alarm system in accordance with the National Building Code and Treasury Board Fire Protection Standards.

5.4 SECURITY

5.4.1 Access Control System

.1 An electronic security system should be provided.

  .1 The system should be comprised of electronic intrusion alarms, electronic door locks, motion detectors, and card readers (swipe and proximity readers).

  .2 All controlled access points should be electronically connected to a central monitoring system, so that access to and from areas can both be programmed and recorded.

  .3 It is recommended that different methods of access control be investigated for security systems (proximity card, biometrics, etc.), to ensure that sensitive research programs are appropriately protected.

5.4.2 Intrusion Alarm System

.1 A monitored intrusion alarm system should be provided in accordance with user security requirements.

  .1 The central security control panel should be located in the (controlled access) electrical room. This panel is normally used to control the status of systems including security monitors, alarms, controlled access points, emergency communications systems.

5.4.3 Video Surveillance System

.1 A video surveillance system should be provided, complete with interior and exterior cameras as required. Utilize IP based cameras and equipment.

.2 Security camera monitors should be located at the Security reception desk. The monitors will enable surveillance of threats and/or incidents and expedite immediate response time.

.3 All closed circuit surveillance should be connected to a central CCTV system and recorded.

.4 All technical decisions are to be in accordance with user security requirements.

5.5 COMMUNICATIONS

5.5.1 Telecommunications Systems

.1 A structured wiring system should be provided, complete with dedicated telecommunications rooms for labs.

  .1 Access to Rooms should be controlled with proximity cards

.2 An infrastructure of telecommunications rooms should be provided, with "closets", and pathways meeting the requirements of TIA-569-B "Commercial Building Standard for Telecommunications Pathways and Spaces".

.3 The system should be designed in accordance with latest version of all applicable standards.

.4 Zoned conduit system or cable trays for telecommunications pathways should be considered.

.5 The structured wiring system should utilize Category 6 wiring or better.

5.5.2 Voice Communications System

.1 A public address system should be provided. In accordance with user requirements

  .1 Investigate an integrated telephone/public address system.

  .2 Investigate provision and implementation of an integrated fire alarm voice communication system.

5.5.3 Clock System

.1 A central clock system should be provided for safety reasons, unless the user program requires an alternate system.

6 COMMISIONING

6.1 INTRODUCTION

6.1.1 General

.1 Commissioning is a systematic process aimed at ensuring that all building systems are designed, installed, tested, documented and capable of being operated and maintained in conformity with design intent.

.2 This is a critical activity given the reliance of building users on building systems for Biosafety.

.3 The Consultant shall develop a full commissioning plan including the following activities or as otherwise required in the Consultant's RPF:

6.1.2 Design Phase

.1 Develop commissioning plan

.2 Hold commissioning meetings with all stakeholders

.3 Submit design intent documentation

.4 Develop commissioning specifications

.5 Develop verification forms for components, systems and integrated systems, along with all required checklists

.6 Arrange design review to be carried out by commissioning agent, if applicable

6.1.3 Construction / Start-up Phase

.1 Review submitted documentation

6.1.4 Acceptance Phase

.1 Verify functional tests

.2 Verify operator training

.3 Review O&M Manuals

6.1.5 The commissioning team

.1 The team should consist of representatives from the following parties:

- .1 Owners Representative
- .2 Commissioning Authority
- .3 Design Consultant
- .4 Biosafety Specialist
- .5 O&M Representative
- .6 General Contractor and Sub-contractor, including System start-up specialists

6.1.6 Process

.1 The commissioning process should achieve the following results:

- .1 Verification that the facility has been designed and constructed to meet the defined program requirements and design intent, in a manner that ensures maximum operational efficiency
- .2 Ensure reliability and maintainability of the facility during regular operating scenarios as well as during emergency scenarios.
- .3 Ensure all redundant mechanical, electrical and plumbing systems are fully functional and will ensure the safety of the users.
- .4 Ensure that adequate emergency responses are in place, including system responses and staff protocols.
- .5 Train personnel in the operation and maintenance of all systems

7 CODES, REGULATIONS, STANDARDS & GUIDELINES

7.1 CODES AND REGULATIONS

7.1.1 CODES

.1 The NRC National Building Code of Canada 2010
.2 The NRC National Fire Code of Canada, 2010
.3 The NRC National Plumbing Code of Canada 2010
.4 The NRC Model National Energy Code for Buildings 1997
.5 The Canadian Electrical Code
.6 The Canada Labour Code
  .1 http://laws.justice.gc.ca/en/L-2/
.7 The Canadian Council of Ministers of the Environment (CCME) *Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products* (CCME, 2003)
.8 International Mechanical Code – Latest Version
.9 Canadian Standards Association
  .1 CSA B51-09 Boiler, pressure vessel and pressure piping Code
  .2 CSA B52-05 Mechanical Refrigeration Code
  .3 CSA B139-09 Installation Code for Oil Burning Equipment
  .4 CSA B149.1-10 Natural Gas and Propane Installation Code

7.1.2 REGULATIONS

.1 The Canada Occupational Health and Safety Regulations
  .1 http://laws.justice.gc.ca/eng/SOR-86-304/index.html
.2 All other Territorial and Municipal Acts, Codes, By-laws and regulations appropriate to the area of concern.

7.2 STANDARDS AND GUIDELINES

7.2.1 STANDARDS

.1 Standards and Directives of the Treasury Board (TB):
  .1 http://www.tbs-sct.gc.ca/pol/index-eng.aspx?tree=standard
  .2 http://www.tbs-sct.gc.ca/pol/index-eng.aspx?tree=directive And including:
    1 Accessibility Standard for Real Property;
      1 http://www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=12044
    2 Fire Protection Standard;
      1 http://www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=17316
.2 Labour Canada's, Fire Commissioner of Canada Standards
  .1 http://www.hrsdc.gc.ca/eng/labour/fire_protection/policies_standards/commissioner/index.shtml. And including;
    1 FC-301 Standard for Construction Operations, June 1982
    2 FC-302 Standard for Welding and Cutting, June 1982
    3 FC-311 Standard for Record Storage, May 1979
    4 FC-403 Fire Protection Standard for sprinkler Systems, November 1994

.3 Labour Canada's, Technical Documents
  .1 http://www.hrsdc.gc.ca/eng/labour/fire_protection/policies_standards/guidelines/index.shtml
  .2 And Including;
    1 Fire Protection for Information Technology Facilities and Equipment
.4 National Fire Protection Association (NFPA)
  .1 NFPA 10; Standard for Portable Fire Extinguishers - 2010
  .2 NFPA 13; Standard for Installation of Sprinkler Systems - 2010
  .3 NFPA 14; Standard for Installation of Standpipe and Hose Systems - 2010
  .4 NFPA 30; Flammable and Combustible Liquids Code
  .5 NFPA 45; Standard on Fire Protection for Laboratories Using Chemicals
  .6 NFPA801 – Facilities Handling Radioactive Materials
  .7 NSF 49 – Biological Safety Cabinet Standards
  .8 NFPA 99 – Fire Protection for Health Related Laboratories
.5 Agriculture Canada
  .1 Containment Standards for Veterinary Facilities
.6 SMACNA – HVAC Air Duct Leakage Test Manual
.7 Canadian Standards Association
  .1 CSA B64-01 Backflow Preventers and Vacuum Breakers
  .2 CSA B651-04 Accessible Design for the Built Environment
  .3 CSA Part 1, C22.1-06
  .4 CSA Standard Z316.3-95 - BSC
  .5 CSA Z316.594 – Fume Hoods and Associated Exhaust Systems – Health Care Technology
  .6 CAN/CSA – Z318.2 – 95, Commissioning of Control Systems in Health Care Facilities
  .7 CAN/CSA – B64.10-94 – Manual for the Selection, Installation, Maintenance and Field Testing of Backflow Prevention Devices
  .8 CAN/CSA-C22.2 No. 214-94 "Communications Cables"
.8 J-STD-607A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications, ANSI-J-STD-607-A-2002
.9 Telecommunications Industry Association (TIA)
  .1 Commercial Building Telecommunications Cabling Standard
    1 Part 1: General Requirements, TIA/EIA-568-B.1.
    2 Part 2: Balanced Twisted Pair Cabling Components, TIA/EIA-568-B.2.
    3 Addendum 1 - Transmission Performance Specification for 4-pair 100 Ohm Category 6 Cabling, TIA/EIA-568-B.2-1.
  .2 Pathways and Spaces, ANSI/TIA/EIA-569-B
  .3 Optical Fibre Cabling Components Standards, TIA/EIA-568-B.3
  .4 Optical Fibre Cabling Components Standard Addendum 1 - Additional Transmission Performance Specifications for 50/125 µm Optical Fibre Cables, TIA/EIA-568-B.3-1.
  .5 Telecommunications Infrastructure Standard for Data centres TIA-942.
.10 Air Conditioning and Refrigeration Institute (ARI)
.11 Air Diffusion Council (ADC)

.12 Air Movement and Control Association (AMCA)
.13 American National Standards Institute (ANSI).
.14 ANSI/AIHA Z9.5, Laboratory Ventilation
.15 ANSI Z358.1, Emergency Eyewash and Shower Equipment
.16 ANSI/AWS D9.1 – 90 – Sheet Metal Welding Code
.17 ANSI 510 – Testing of Nuclear Air Treatment Systems
.18 American Society of Mechanical Engineers (ASME)
.19 American Society for Testing and Materials (ASTM)
.20 American Welding Society (AWS)
.21 Associated Air Balance Council (AABC)
.22 Institute of Boiler and Radiation, Hydronic Institute (IBR)
.23 Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA) Standards;
  .1 SMACNA HVAC Duct Construction Standards
  .2 SMACNA HVAC System Duct Design
  .3 SMACNA Air Duct Leakage Test Manual
  .4 Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems
  .5 Seismic Restraint Manual Guidelines for Mechanical Systems
.24 SEFA 1.2, Scientific Equipment & Furniture Association

7.2.2 GUIDELINES

.1 Canadian Biosafety Standards and Guidelines for Facilities handling Human and Terrestrial Animal Pathogens, Prions and Biological Toxins
.2 National Institute of Health – Guide for the Care and Use of Laboratory Animals
.3 Canadian Council on Animal Care – Guide to the Care and use of Laboratory Animals
.4 LABS21, Environmental Performance Criteria
.5 Laboratory Biosafety Guidelines – 3rd Edition 2004, Health Canada
.6 Public Works and Government Services MD Guidelines (Latest Edition)
  .1 MD 15116; Computer Room Air conditioning Systems
  .2 MD 15126; Guide for Laboratory Heating, Ventilation and Air Conditioning (HVAC)
  .3 MD 15128; Minimum Guidelines for Laboratory Fume Hoods
  .4 MD 15129; Perchloric Acid Fume Hoods and Their Exhaust Systems
  .5 MD 15166; Guidelines for Building Owners, Design Professionals and Maintenance Personnel
  .6 MD 250005; Energy Monitoring and Control Systems Design Guidelines
  .7 MD 16001; Air Filters for HVAC Systems
  .8 CDC - Biosafety in Microbiological and Biomedical Laboratories
.7 Canadian Standards Association
  .1 CAN/CSA-T528-93, "Design Guidelines for Administration of Telecommunications Infrastructure in Commercial Buildings", Canadian Standards Association
.8 American Conference of Governmental Industrial Hygienists (ACGIH, Industrial Ventilation Handbook)

.9 American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE), including but not limited to;
  .1 ASHRAE Laboratory Design Guide
  .2 ASHRAE 110 – Method of Testing performance of Laboratory Fume Hoods
  .3 ASHRAE Standards and Guidelines
  .4 ASHRAE Applications Handbook - 2007
  .5 ASHRAE HVAC Systems and Equipment Handbook – 2008
  .6 ASHRAE Fundamentals Handbook – 2009
  .7 ASHRAE Refrigeration Handbook - 2010
  .8 ASHRAE 52.2 Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size - 2007
  .9 ASHRAE 90.1, Energy Efficient Design of New Buildings - 2010
  .10 ASHRAE 105: Standard Method of Measuring and Expressing Building Energy Performance
  .11 ASHRAE 111; Practices for Measurement, Testing, Adjusting and Balancing of Building HVAC&R Systems
  .12 ASHRAE 114; Energy Management Control Systems Instrumentation
  .13 ASHRAE 135; BACnet: A Date Communication Protocol for Building Automation and Control Networks.
  .14 ANSI/ASHRAE 62.1, Ventilation for Acceptable Indoor Air Quality - 2010
  .15 ANSI/ASHRAE 55, Thermal Environmental Conditions for Human Occupancy - 2004
.10 ACGIH – America Conference of Governmental Industrial Hygienists, Industrial Ventilation: a manual of recommended practice
.11 Manufacturers Standardization Society of Valve and Fitting Industry (MSS)
.12 Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

Appendices

A. LABORATORY TYPES

A.1 LAB GROUPS

A.1.1 MODULE CONCEPT

1 The module concept is the application of modular laboratory design principles, which have been proven to maximize the *functionality* of lab design to economically accommodate the constant changes to health science research.

A.1.2 FRAMEWORK OF UNDERSTANDING

1 The intended outcome of a laboratory project is to provide a new (or renovated) facility of sustained value which is achieved by optimizing the balance of *flexible, adaptable, scalable, laboratory spaces*. Finding the right balance of these variables optimizes scientific objectives (to owners, to scientists), programming goals, and operational models within the framework of sustainable whole building design. *It is with this frame of reference and understanding that these guidelines have been developed.*

A.1.3 DEFINING ALTERABILITY (FLEXIBLE, ADAPTABLE AND SCALABLE ENVIRONMENTS)

1 The degree of "alterability" is achieved through flexible, adaptable and scalable strategies to achieve the desired functionality and is defined by what level the change can occur and who changes them.

2 ***Flexibility*** is at the user level (i.e. rearranging bench top working set-ups).

3 ***Adaptability*** is at the facility level (i.e. changing a major function of a particular room)

4 ***Scalability*** refers to planning strategies that support program growth within the existing footprint of a building or through future expansion.

  1 Scalability within the existing foot print would be an open laboratory planning concept that allows scientific teams to grow or shrink based on grant activity or seasonal surges of visiting professors and students with minimal renovations or interruptions, and/or;

  2 Scalability is also planning and engineered systems concepts that allow for a future addition, shelled space, or additional floors to prolong the life of a facility.

A.1.4 MODULARITY

1 Modular thinking for laboratory design strategically combines specialization with systemization to produce the most efficient and cost effective laboratory solution.

2 While each laboratory type is unique, the development of a baseline lab module (open lab, wet corridor and support) with flexible component parts (mobile lab casework and plug and play building services) permits customization at the module level without having to modify base building systems.

3 Applying standardized program areas by laboratory type alleviates the customization that typically leads to program 'creep' and is often used to both generate and validate area requirements of laboratory projects.

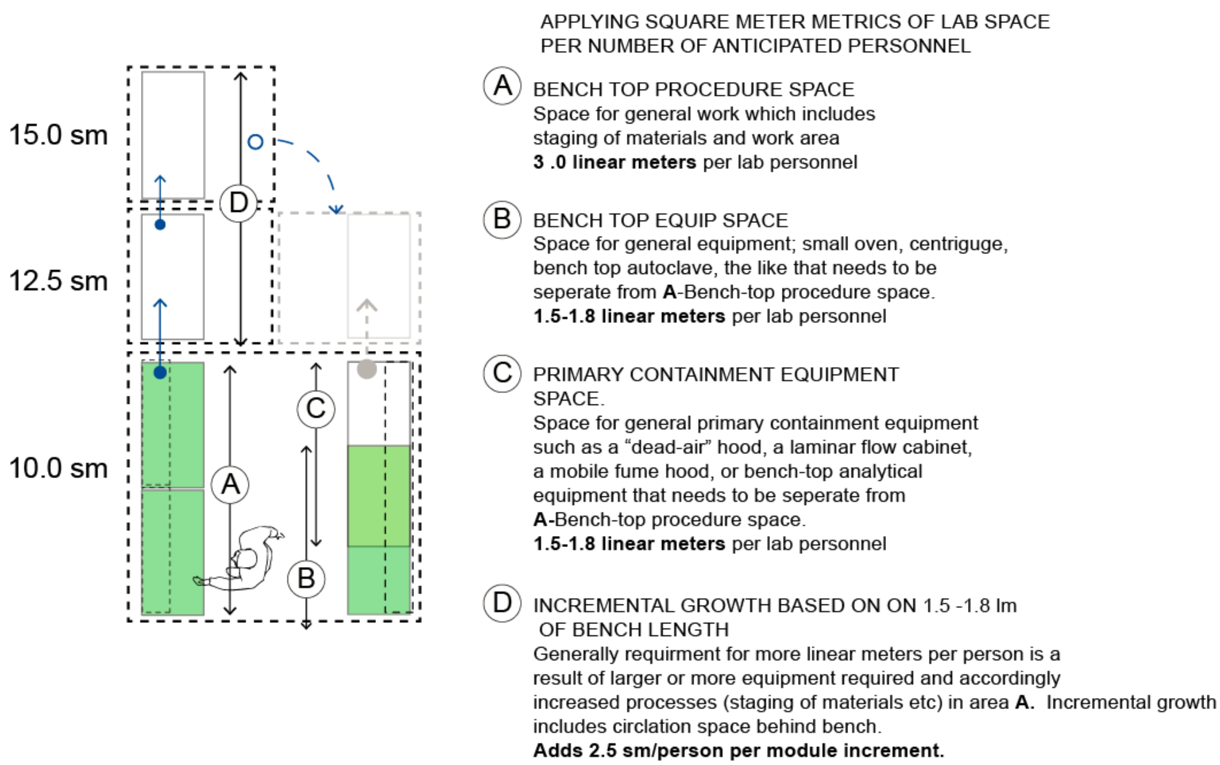
A.1.5 SPACE ALLOCATION

1 Generally, wet and dry research laboratory space allocation varies from about 10.0m2/person to 16.5 m2/person (net area) depending on equipment demand of the science.

   1 A teaching platform might see the allocations reduced by approximately 15% as students are generally sharing a bench and/or fume hood.

2 Establishing the correct net to gross ratio is necessary in order to determine the optimum overall building area. This ratio is affected by the planning concepts, flexibility requirements, approach to shared services, and building form and orientation.

3 The following diagram illustrates some of the complexities associated with Laboratory Planning, but can be used as a preliminary guide when determining space needs at the pre-planning stage.



A.1.6 THE LABORATORY MODULE

1 The laboratory planning module is critical to achieving a flexible laboratory. A universal and repetitive module (size, shape and orientation) sets the flexible framework to allow for expansion and contraction of science programs (research, diagnostic or teaching). Modularity further informs the approach to mechanical and electrical service integration.

2 Application of a universal module will provide flexibility for conversion should the program demand a different makeup in the future. A universal planning module ensures an efficient and consistent positioning of high density services to support changes.

A.1.7 CONCEPTS SUPPORTING THE LABORATORY MODULE

1 **Clustered High Density Technology Laboratories /Function**:

1 Strategic clustering of the labs requiring a high ratio of servicing (i.e. fume hoods) will ensure the remaining open laboratories are not encumbered by high density service runs that impede future reconfiguration.

2 Locating shared common use areas, such as freezer rooms, fume hoods and other service intensive spaces along a central service zone supports a horizontal duct distribution.

3 Service distribution (block duct sizing) to the open laboratories is minimized to maintain higher ceiling heights above these areas.

This concept would support open, high ceiling spaces in the open laboratories and minimize service access requirements in the open labs

2 **Matching Science Risks with Mechanical Design Concepts**:

1 Understanding the science to be performed will assist in the 'right sizing' of the air systems, helping to balance cost, sustainability and flexibility.

2 Activities in the laboratory areas vary in terms of the degree of safety and associated air change rates, i.e. data entry or bench top functions versus areas with volatile chemical use.

3 Understanding that higher risk activities are performed in fume hoods should allow for the design of lower risk, more open laboratories with lower air change rates with enough redundancy in the system to allow for reasonable ramp up of air in the event of a localized spill or contamination.

4 The clustering of functions as described above simplifies mechanical concepts/zoning such that lower risk areas are not buried within high risk areas and by design, overdesigned.

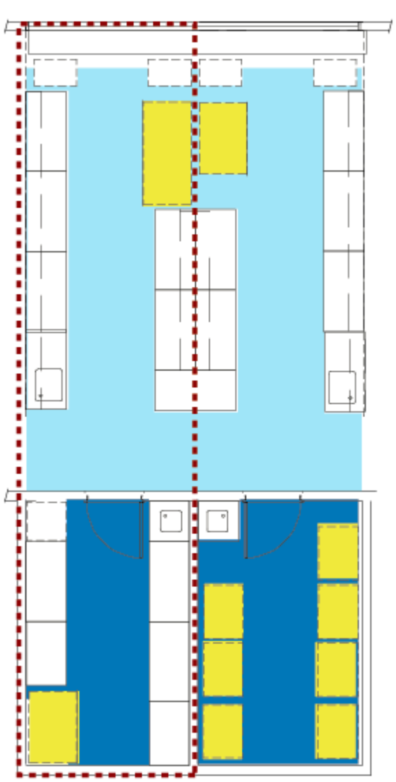
3 **Open Laboratory Concepts**:

1 Open, modular and repetitive laboratory planning concepts provide the greatest degree of flexibility for future program expansions. Clustering collaborative, compatible research and/or teaching units leverages shared support laboratories and maximizes the usable laboratory space. The provision of open ceilings or partial open ceiling facilitates ease of access and modifications of laboratory utility infrastructure.

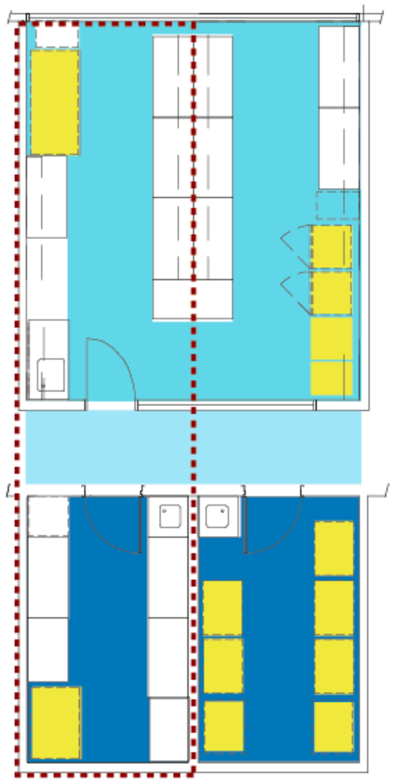
A.1.8 OPEN, ENCLOSED AND DEDICATED LABORATORY MODULES

1 Laboratory design is based upon a modular system that is repetitive in which services are regularized for current and future needs. There are three basic modules (open, enclosed or dedicated) and are directly tied to the degree of alterability and operational intensity of a laboratory. It is critical to select the modules (open, enclosed and dedicated) based on contamination risks of the science. The majority of health science lab programs will utilize all three modules within their laboratory space

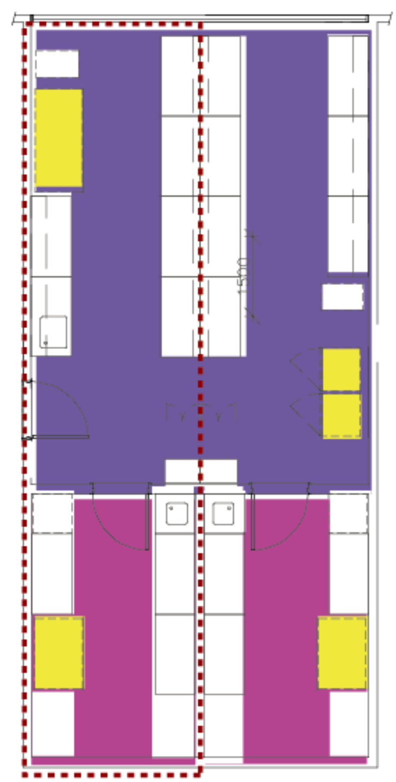
2 Dedicated laboratories are significantly more operationally intensive than an open module concept laboratory and are not intended to be selected to provide security or "ownership" of the resources (equipment, samples, other) within for the laboratory users. As science risk increases (defined by biosafety personnel) for staff, environment or product – there is corresponding requirement for the lab space to be more enclosed or dedicated. In addition, it is critical to plan the science in a manner that the dedicated laboratory module is optimized and sized for the intended purpose.



Open Lab



Enclosed Lab

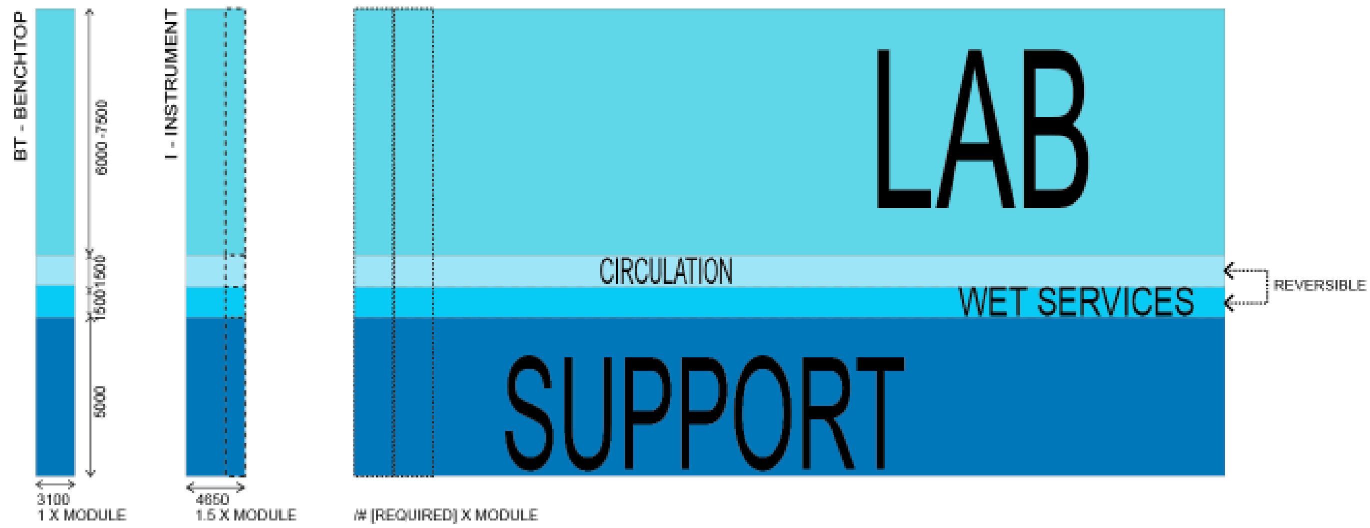


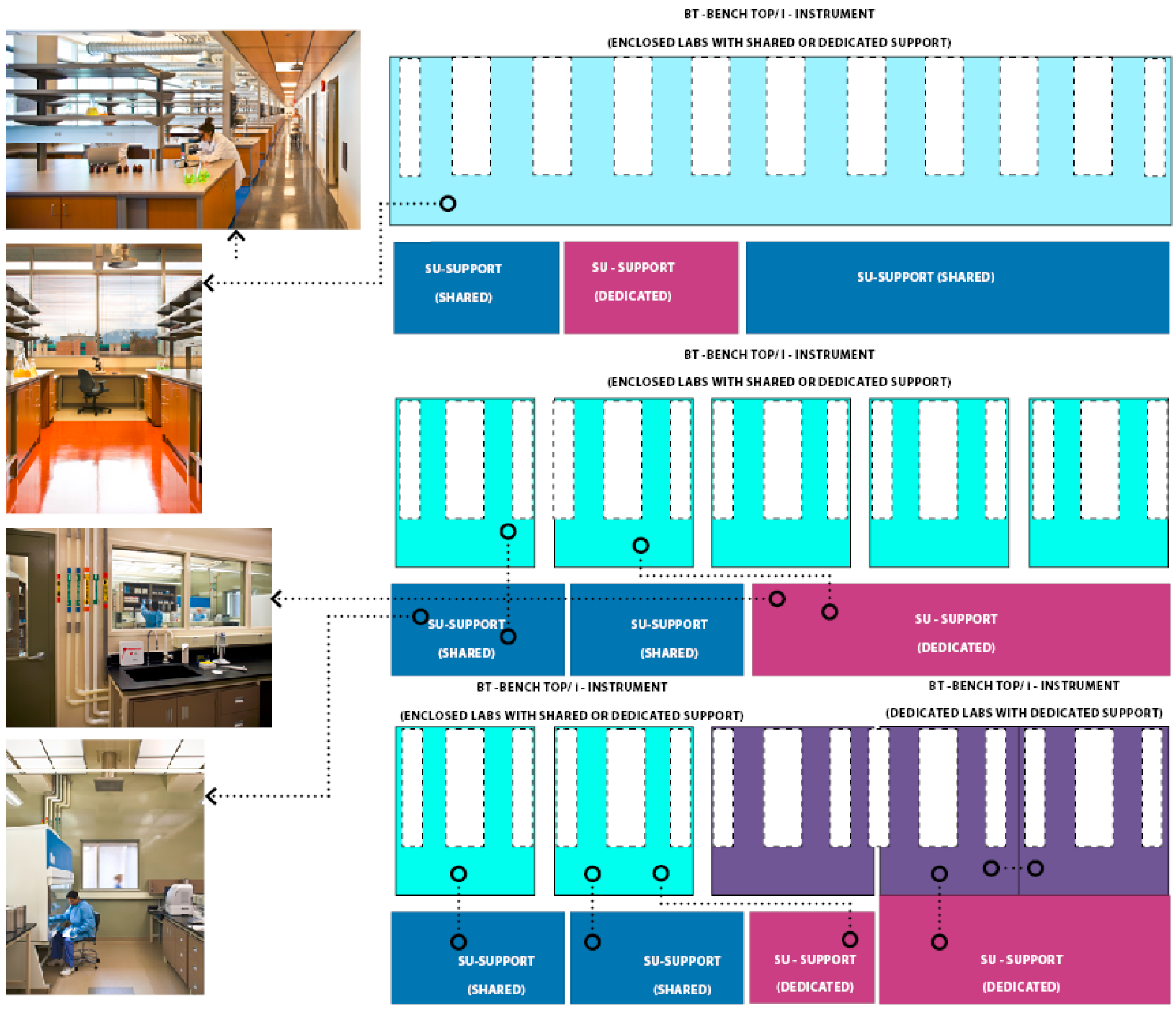
Dedicated Lab

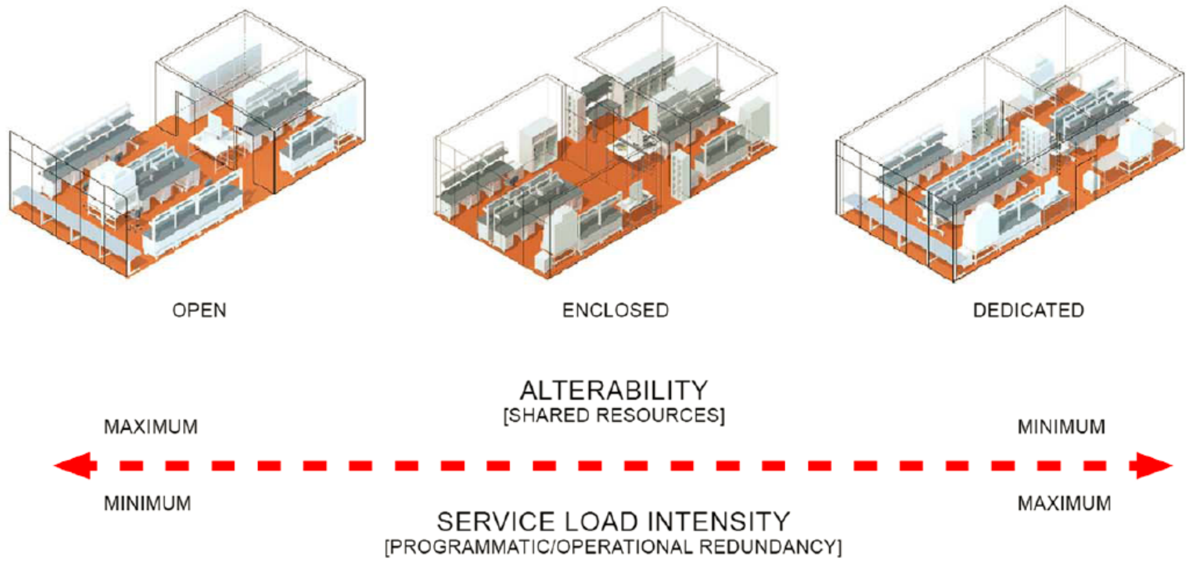
Legend

- OPEN LAB
- ENCLOSED LAB
- DEDICATED LAB
- SHARED CIRCULATION
- SHARED SUPPORT
- DEDICATED SUPPORT
- LAB BENCH + FURNITURE
- LAB EQUIPMENT
- 1 X MODULE

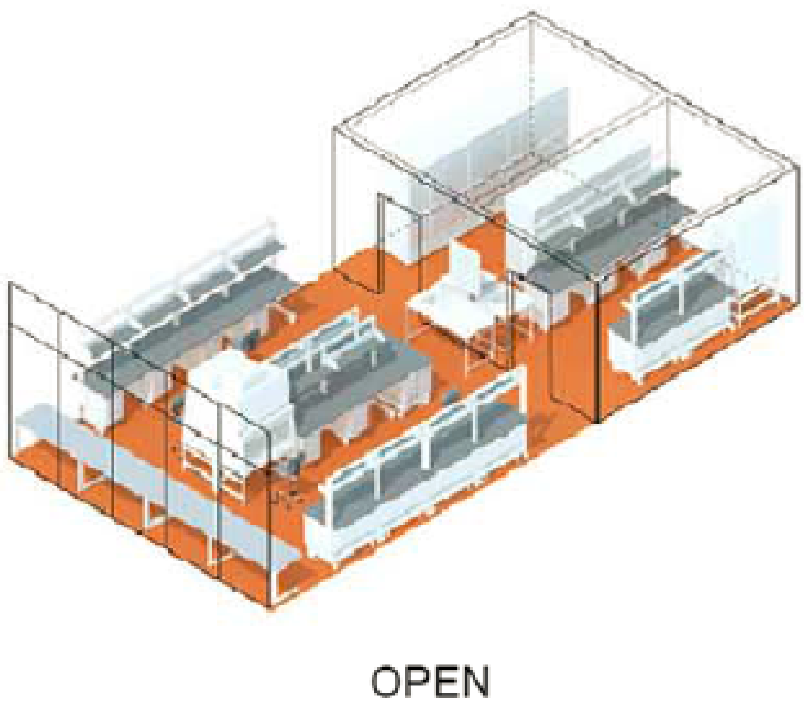
A.1.9 Basic Principle of Aggregation.



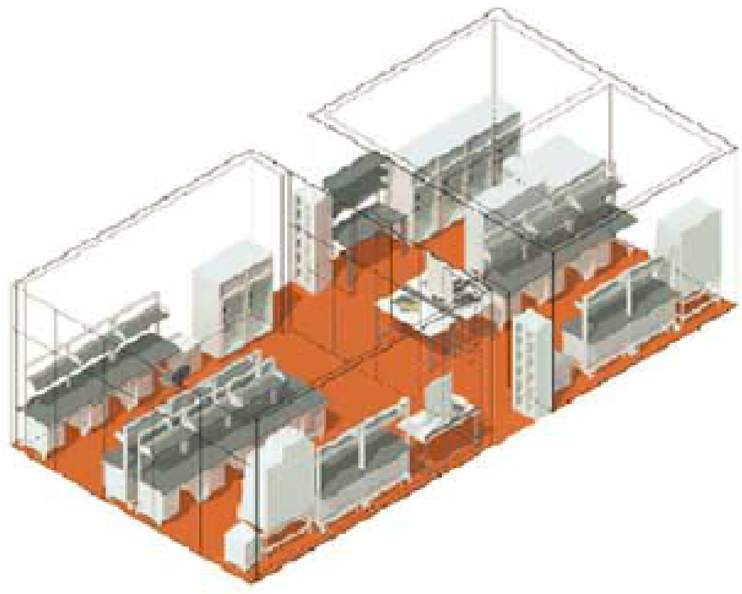




A.1.10 UNIVERSAL MODULE

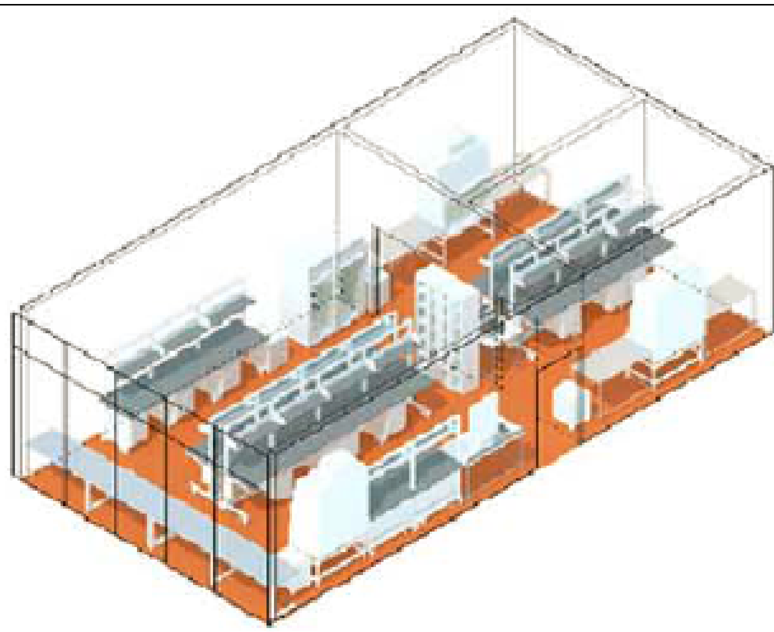


The *Open laboratory* is the most efficient of the planning modules.
It provides for bench top activities, wet or dry, in a "dance floor concept" meaning that the configuration of the lab bays flexible to suit a variety of program needs.



The *Enclosed lab* module builds on the open module by partitioning the open lab area to provide a moderate degree of isolation for programs (science) requiring either personnel protection, product protection, or both. Enclosing of areas allows positive or negative pressure controls (directional air flow) to more sensitive work areas.

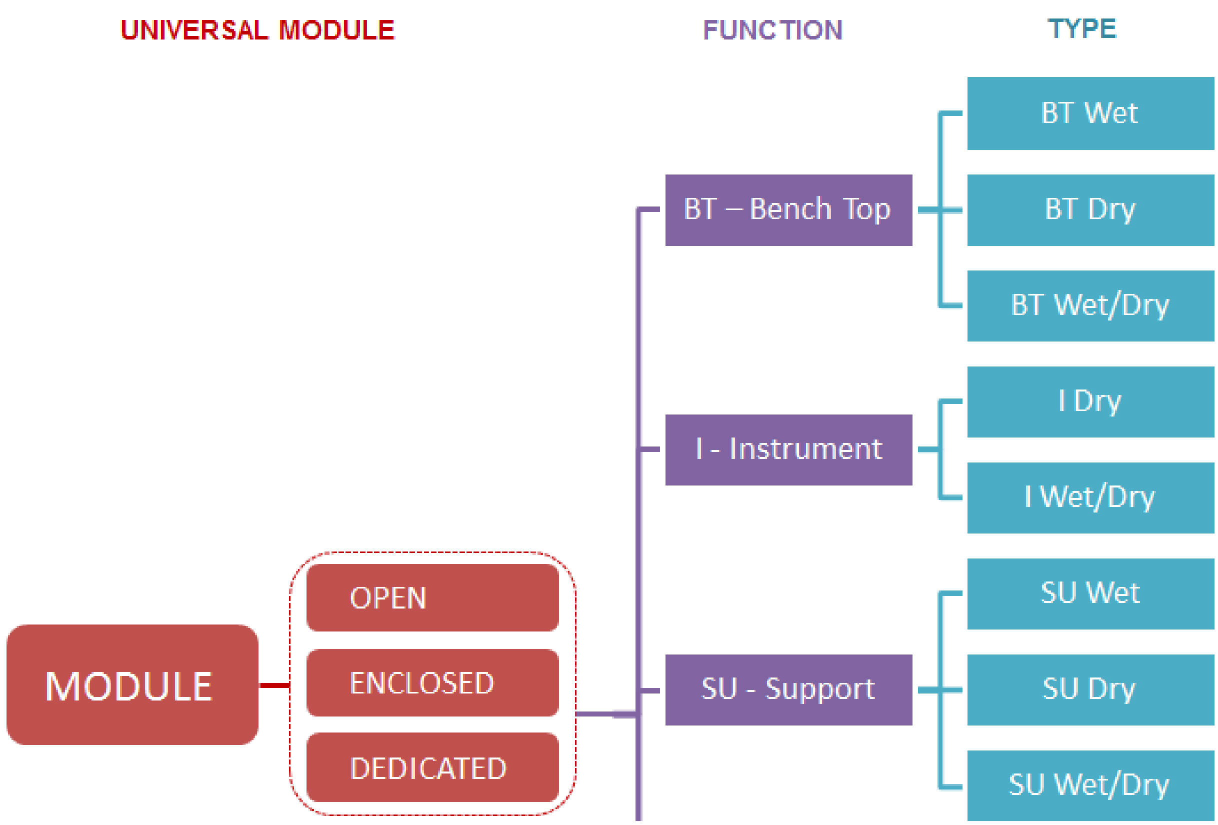
The enclosed lab also has access to the isolation or procedure labs and support functions noted above. These labs can be shared between programs (PI's), or assigned to a particular program as deemed appropriate. Access to this area is shared by the open lab users.



The *Dedicated lab* module is reserved for science programs requiring a high degree of environmental isolation and control and/or biosecurity. Support functions such as isolation or procedure labs, equipment rooms, fridge/freezer rooms, and ante rooms are accessed directly from the dedicated laboratory space and are not shared with other programs.

A.1.11 Lab Module and Function

1 The majority of health science lab programs can be grouped into three (3) major lab functions, each with their own sub-set of lab types. These group functions are:
  1 **Bench Top (BT);**
    1 Any science (diagnostic or research) done in a controlled laboratory setting on a standard laboratory bench surface.
  2 **Instrument (I)**;
    1 Any science requiring analytical or computational processes.
  3 **Support (SU);**
    1 Any activity required to support Bench top or Instrument Science laboratory work.



A.1.12 LAB TYPE

1 Each function has either one or two sub-sets which are identified as a Lab Type (wet, dry and wet/dry).

1 **WET:**

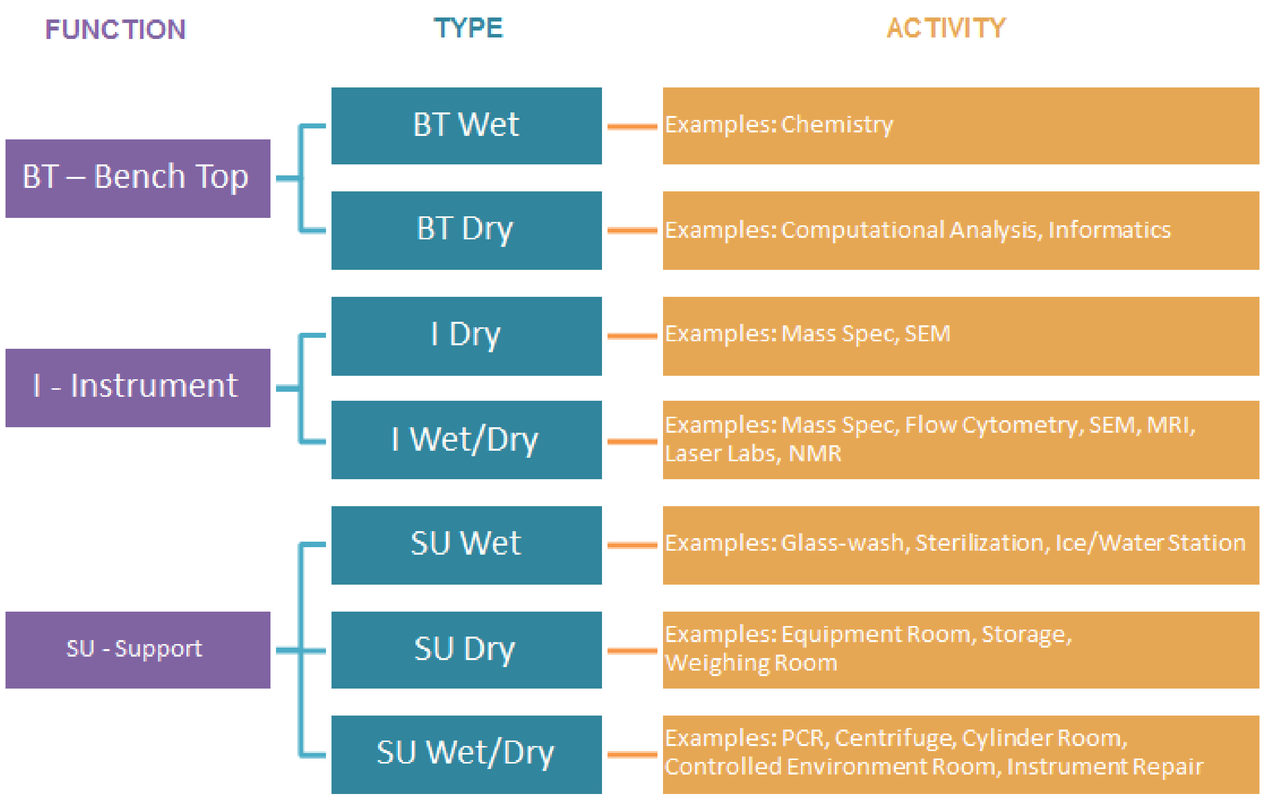
1 Wet-bench laboratories are defined by those activities that use living cells or organisms, chemicals and drugs where tests are conducted and analyzed. These laboratory spaces require water, ventilation and specialized equipment in experiments that demonstrate the functions and lifestyles of biology.

2 **DRY:**

1 Dry Laboratory space type is specific to work with dry stored materials, electronics, and/or large instruments with few piped services. The laboratories defined by this space type are analytical laboratories that may require accurate temperature and humidity control, dust control, and clean power.

3 **WET/DRY:**

Wet/dry laboratories are flexible labs with full wet services, but are also designed to accommodate special dry lab functions. Each Lab Type is suitable to accommodate several different functional activities.



A.1.1 Lab Activity

1 The following is an example list of laboratory *Activities* for the various lab *Types* identified in A.1.8 Lab Module and Function.

2 A comprehensive list of Fields and Sub-fields utilizing wet, dry and wet/dry laboratory types is described in Appendix B.

3 **BENCH TOP (BT)**

Wet Labs	**Dry Labs**
Biochemistry	Analytical Labs
Molecular Biology	Computational Chemistry
Cell Biology	Computational Physics
Tissue Culture	Sequencing Labs
Pathology	
Anaerobic Chamber	
Fermenter	
Organic Chemistry	
Physical Chemistry	
Immunology	

4 **INSTRUMENT (I)**

Wet/Dry Labs	**Dry**
Electrophysiology/Biophysics Lab	Confocal/Microscopy Lab
Electromagnetic Instrument labs (MRI, NMR ESRS)	Laser Labs
x-ray crystallography labs	Robotic Equipment Labs
Mass Spectrophotometry	Electron Microscope lab
Flow Cytometry	

5 **SUPPORT (SU)**

Wet labs	**Wet/Dry Lab**	**Dry labs**
Autoclave/Sterilizer room	Isolation Labs	Fridge/Freezer Room
Glass Wash	Media Prep	Supply Storage
Controlled Environment Rooms		Controlled Environment Rooms
Free Standing Equipment Areas		Dark Rooms
Radioactive Work Areas		Archival Repositories
Ice/Water rooms		

A.1.2 DRAWING LEGEND AND NOTES

NOTES

A LAB ENTRY
B MAIN LABORATORY
C LAB SUPPORT ROOM

Z1 FIXED BENCHING WITH IN-WALL SERVICES
Z2 FLEXIBLE BENCHING WITH OH SERVICES
Z3 MOBILE BENCHING/EQUIPMENT WITH OVERHEAD SERVICES
Z4 INSTRUMENT OR EQUIPMENT SERVICE ZONE

1 LAB DOOR OPTIONAL PENDING RISK ASSESSMENT
2 DEDICATED HAND WASH SINK; HANDS FREE.
3 EMERGENCY SHWR/EYEWASH
4 PPE SUPPLY/STORAGE/LAB COATS
5 PRIMARY CONTAINMENT EQUIPMENT (BSC OR FUME HOOD)
6 CONNECTION TO ADJOING LABORATORIES PENDING LAB MODULE (OPEN/ENCLOSED/DEDICATED)
7 OPTIONAL LAB BENCH
8 FLEX ZONE; ADDITIONAL BENCHING, EQUIPMENT, STOR. PENDING LAB MODULE AND FUNCTION.
9 OPTIONAL WALL PENDING LAB MODULE AND FUNCTION.
10 MOBILE CART
11 GLASS WARE WASHER (PASS-THRU)
12 GLASS WARE WASHER (SINGLE SIDED)
13 CONSIDERATION OF FUTURE ROUGH-INS WHERE
14 DOOR SWING DEPENDENT ON PRESSURE DIFFERENTIALS (DIRECTIONAL AIR FLOW REQUIREMENTS)
15 ANTE ROOM ACTIVITY DEPENDANT ON SCIENCE RISK.

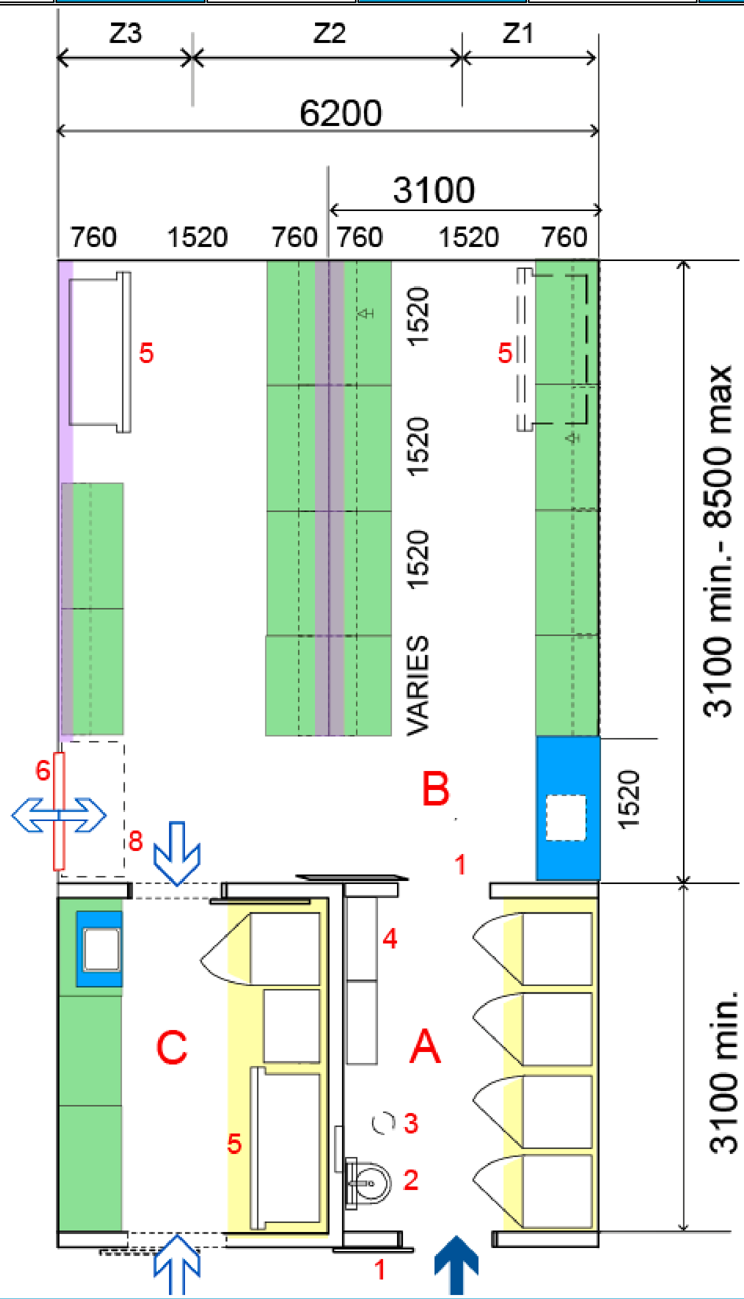
LEGEND

LAB SINK, TYP.
OVERHEAD SERVICE CARRIER SHELVES/CABINETS
MOBILE BASE CABINETS
LAB BENCHING (SYSTEM OR TABLES)
EQUIPMENT ZONE
LAB ACCESS
ALTERNATE ACCESS/EGRESS PENDING LAB FUNCTION/ACTIVITY.

A.2 BENCH TOP (BT)

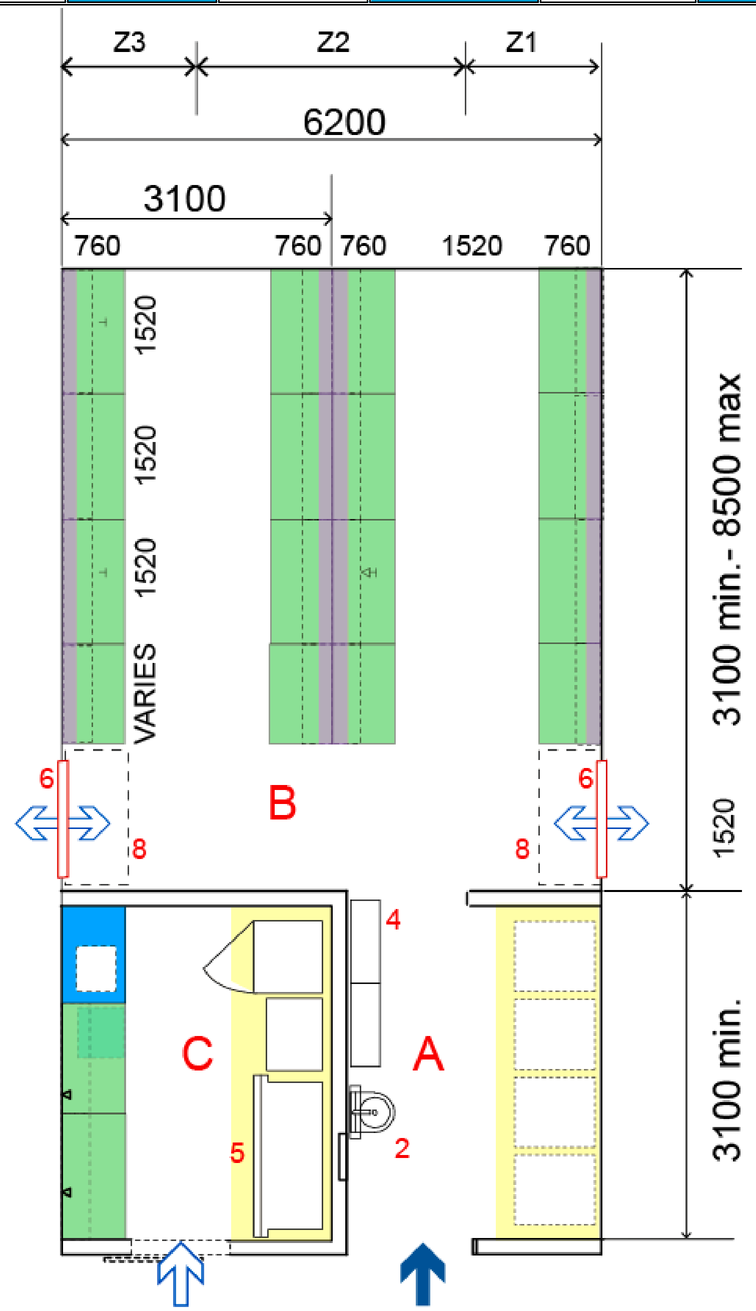
A.2.1 BT – WET/DRY

Module	BT	Lab Type	Wet/Dry				
Minimum Areas and Dimensions							
Area	20.0 M²	Length	6.2 M	Width	3.1 M	Height	2.7 M



A.2.2 BT – DRY

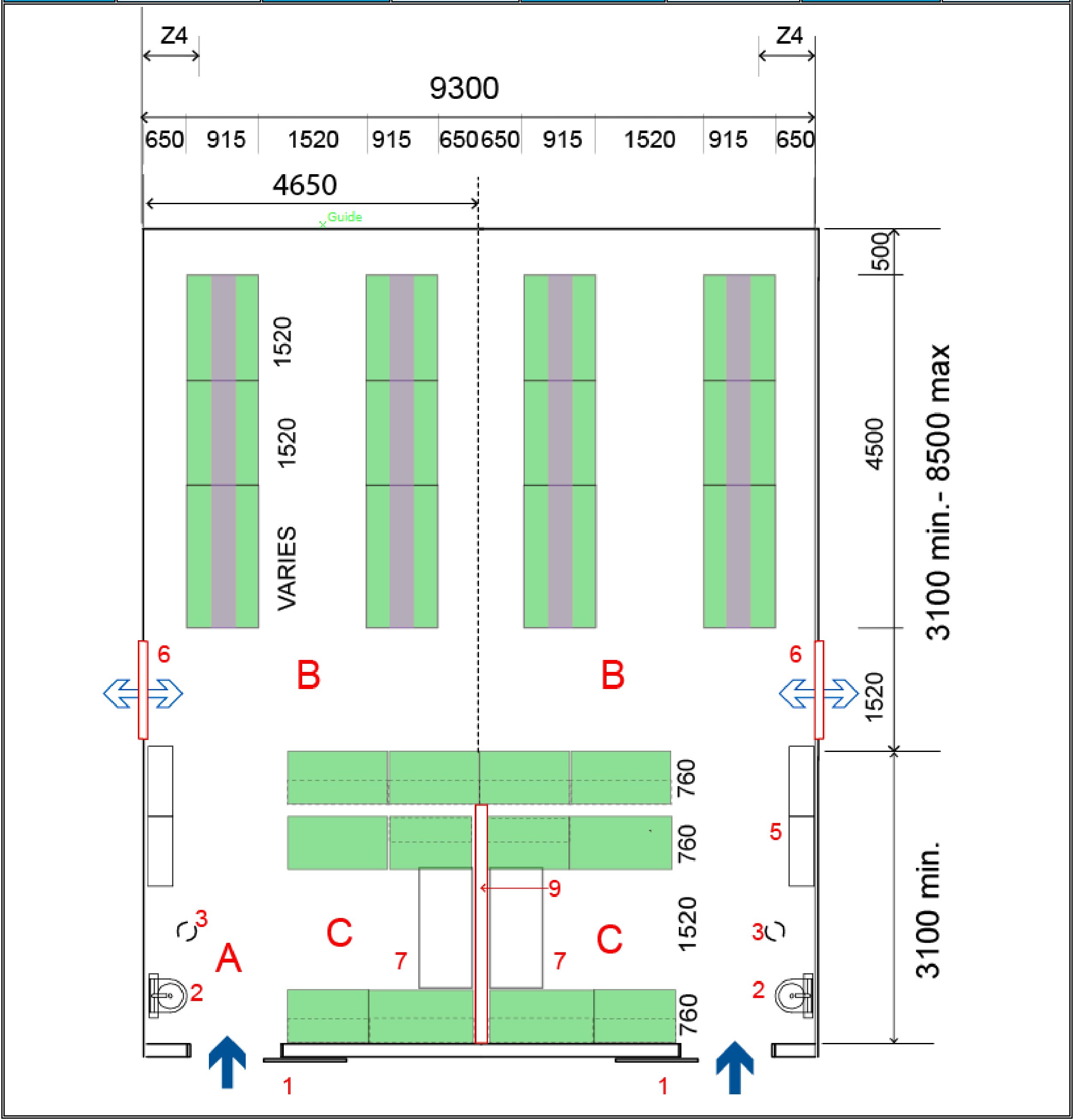
Module	BT	Lab Type	Dry				
Minimum Areas and Dimensions							
Area	20.0 M²	Length	6.2 M	Width	3.1 M	Height	2.7 M



A.3 INSTRUMENT (I)

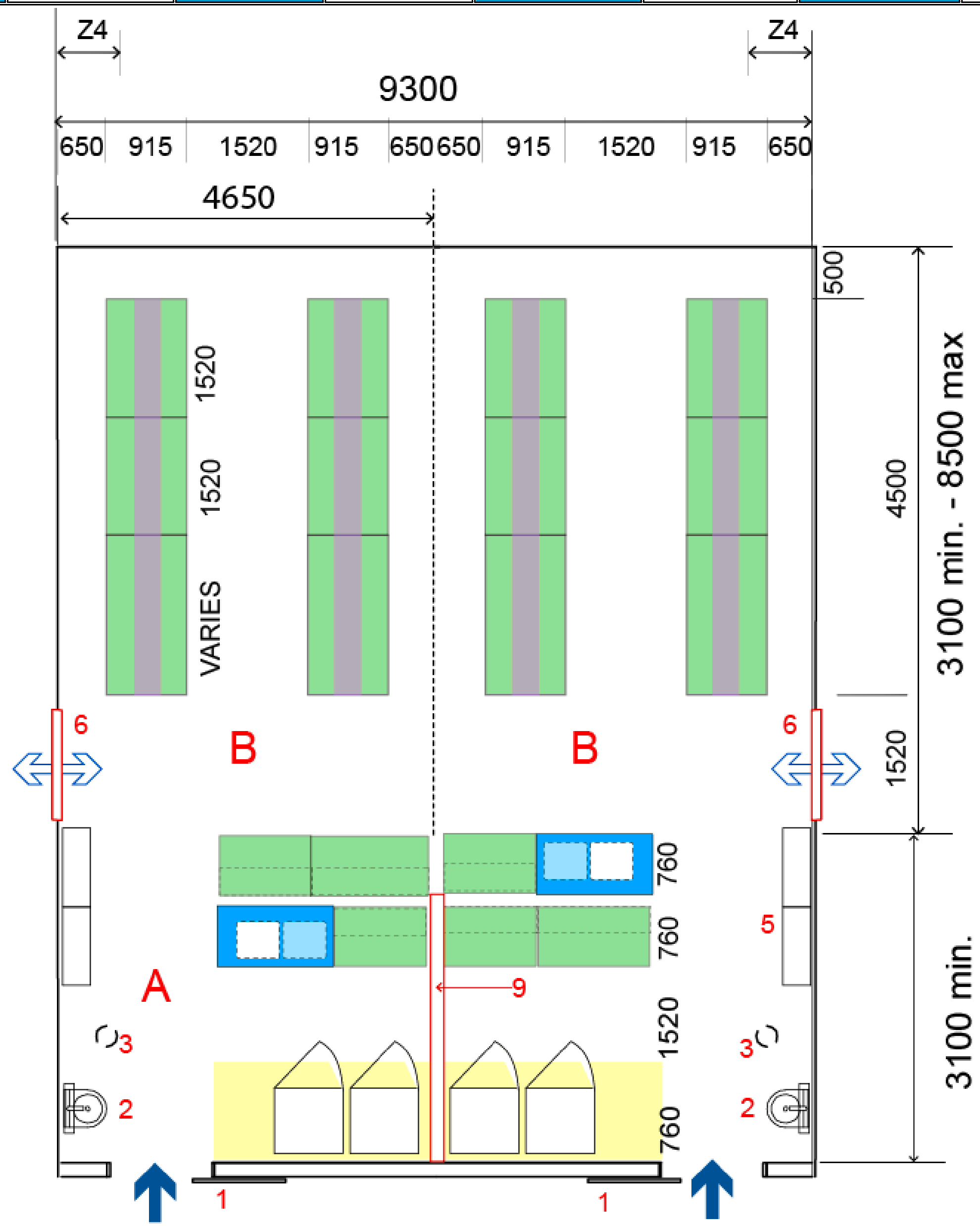
A.3.1 I – DRY

Module		I		Lab Type		Dry	
Minimum Areas and Dimensions							
Area	30.0 M²	Length	6.2 M	Width	4.65 M	Height	2.7 M



A.3.2 I – WET/DRY

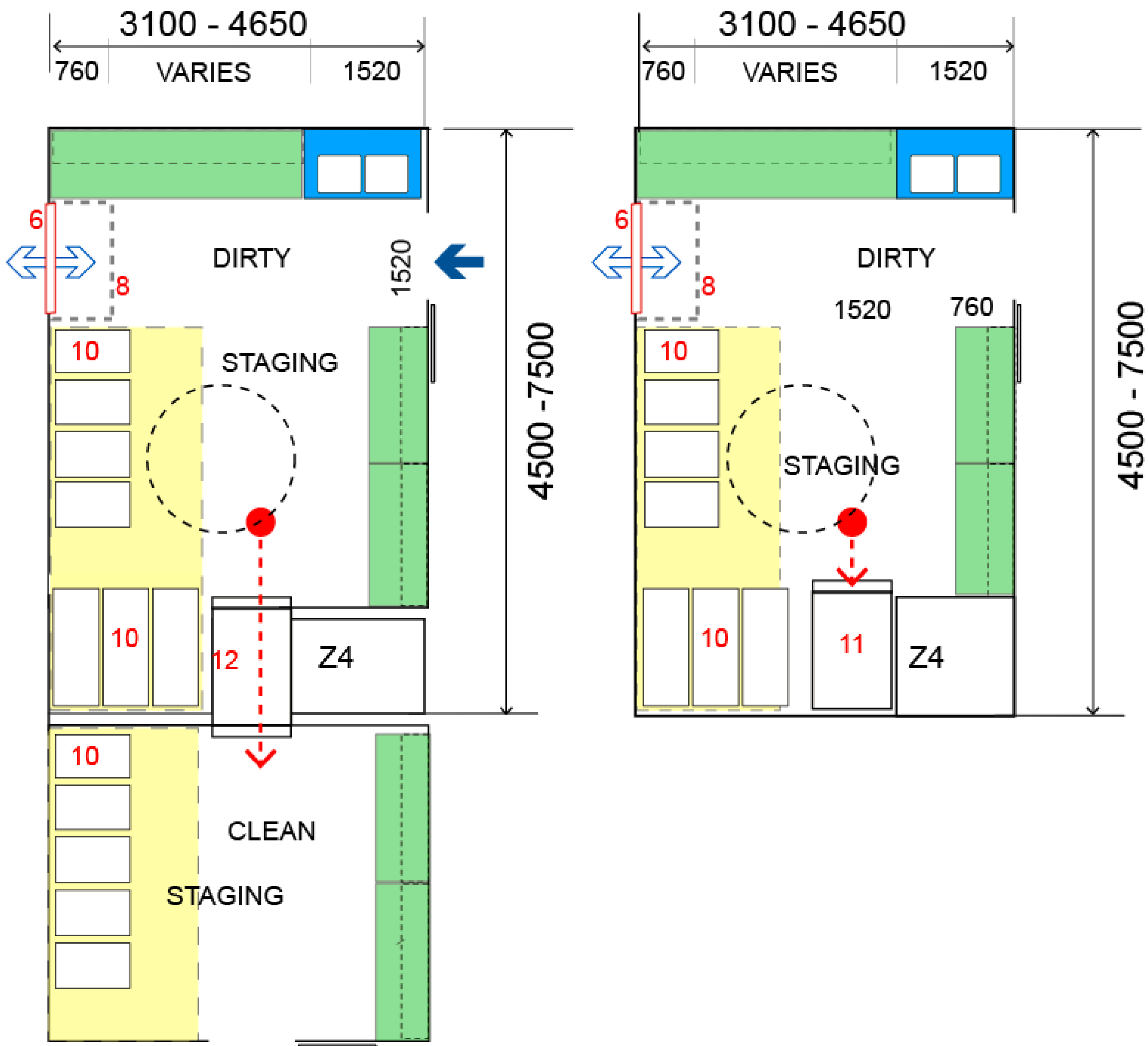
Module	I	Lab Type	Wet/Dry				
Minimum Areas and Dimensions							
Area	30.0 M²	Length	6.2 M	Width	3.1 M	Height	2.7 M



A.4 SUPPORT (SU)

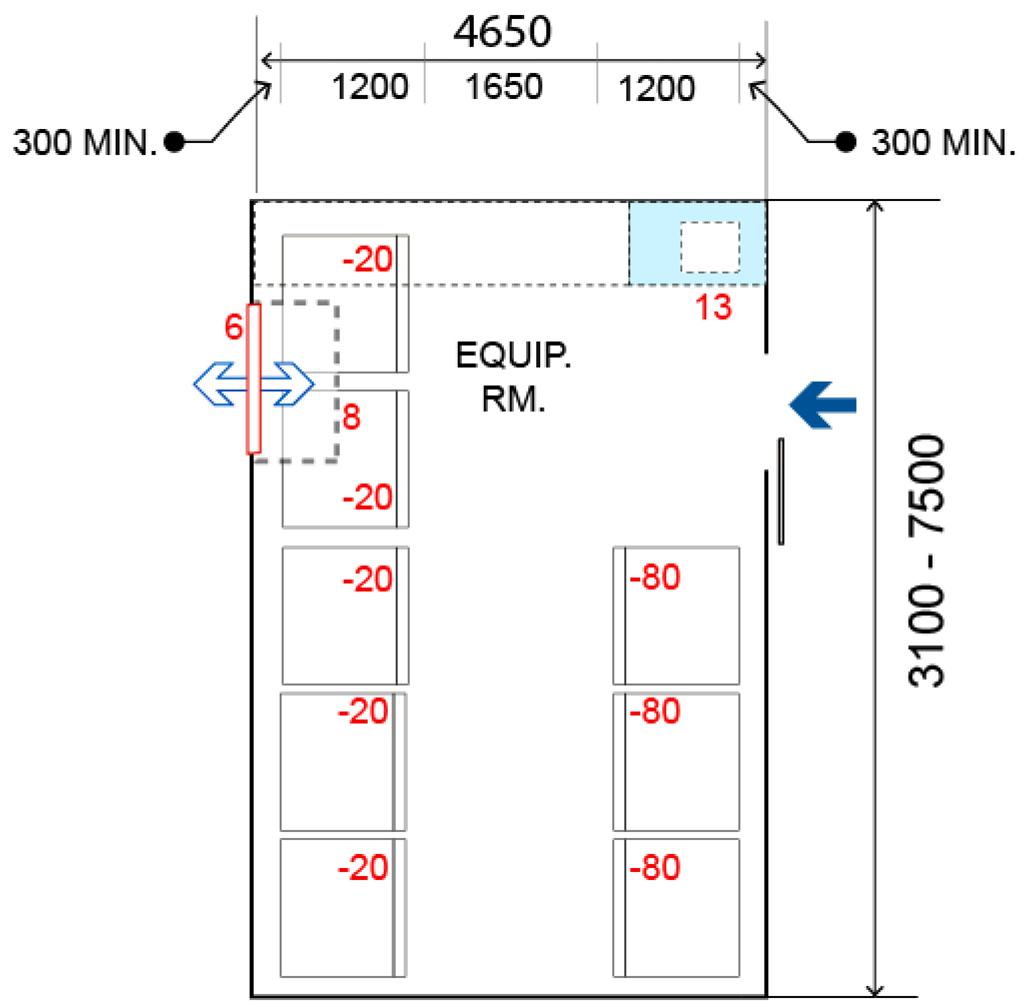
A.4.1 SU- WET

Module		SU		Lab Type		Wet	
Minimum Areas and Dimensions							
Area	15.0 M²	Length	4.5 M	Width	3.1 M	Height	2.7 M



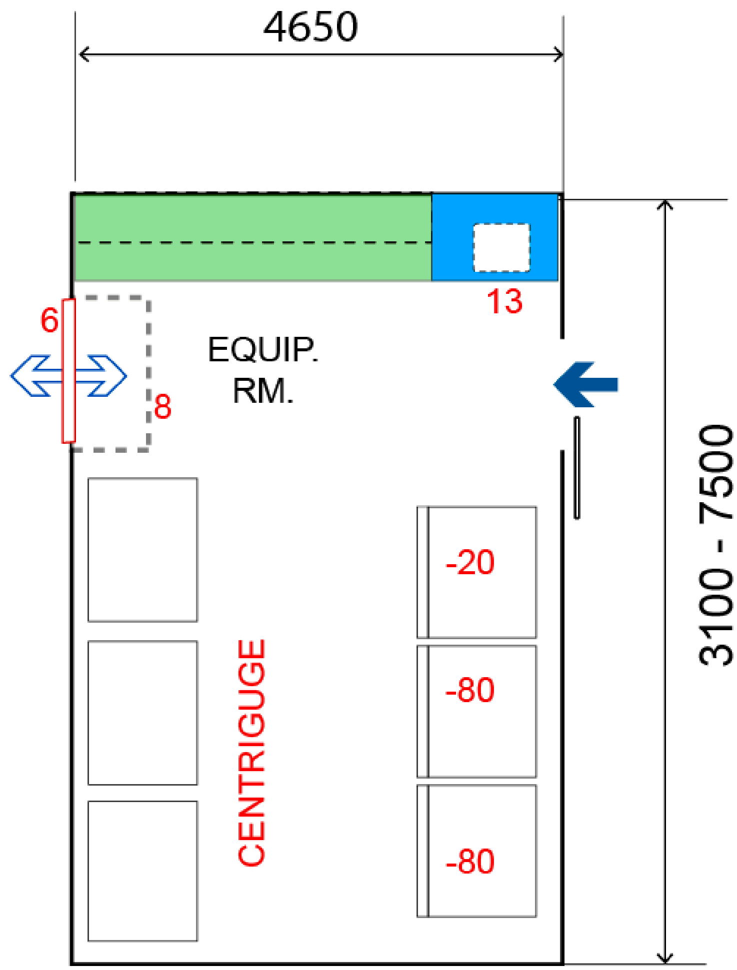
A.4.2 SU – DRY

Module	SU	Lab Type	Dry				
Minimum Areas and Dimensions							
Area	12.0 M²	Length	3.1 M	Width	4.65 M	Height	2.7 M



A.4.3 SU – WET/DRY

Module		SU	Lab Type		Wet/Dry			
Minimum Areas and Dimensions								
Area	12.0 M²	Length	3.1 M	Width	4.65 M	Height	2.7 M	



SU-SUPPORT WET/DRY

B. DEFINITIONS

Fields Sub-Fields	Definitions
Anatomy	The study of form and function, in plants, animals, and other organisms, or specifically in humans
Cardiovascular system	Circulates the blood with the heart, arteries and veins
Digestive system	Processes food with the mouth, esophagus, stomach and intestines
Endocrine system	Communicates within the body using hormones
Urinary system	Eliminates wastes from the body
Immune and Lymphatic system	Defends against disease-causing agents. The lymphatic system is extracts, transports and metabolizes lymph, the fluid found in between cells. (includes the lymphatic system)
Integumentary system	Aids in fluid retention and protection from the external environment
Musculoskeletal system	Moves the body with muscles acting on the skeleton
Nervous system	Collects, transfers and processes information with the brain and nerves
Reproductive system	Enables reproduction with the sex organs
Respiratory system	Exchanges gases with the lungs and trachea
Biochemistry	The study of the chemical processes and reactions required for life to exist and function, usually a focus on the cellular level
Biomolecules	**Carbohydrates** are made from monomers called monosaccharaides; Some of these monosaccharaides include glucose ($C_6H_{12}O_6$), fructose ($C_6H_{12}O_6$), and deoxyribose ($C_5H_{10}O_4$). **Proteins** are very large molecules – macro-biopolymers – made from monomers called amino acids. **Lipids** are usually made from one molecule of glycerol combined with other molecules. In triglycerides, the main group of bulk lipids, there is one molecule of glycerol and three fatty acids. **Nucleic acids** are the molecules that make up DNA, an extremely important substance that all cellular organisms use to store their genetic information. The most common nucleic acids are deoxyribonucleic acid and ribonucleic acid.

Bioengineering	The study of biology through the means of engineering with an emphasis on applied knowledge and especially related to biotechnology
Biological systems engineering	A broad-based engineering discipline with particular emphasis on biology and chemistry.
Biomedical engineering	Biomedical technology, Biomedical diagnostics, Biomedical therapy, Biomechanics, Biomaterials.
Genetic engineering	Synthetic biology, Horizontal gene transfer.
Bioprocess engineering	Bioprocess design, Biocatalysis, Bioseparation, Bioinformatics, Bioenergy
Cellular engineering	Cell engineering, Tissue engineering, Metabolic engineering.
Biomimetics	The use of knowledge gained from reverse engineering evolved living systems to solve difficult design problems in artificial systems.
Biomechanics	The study of the mechanics of living beings, with an emphasis on applied use through prosthetics or orthotics
Sport biomechanics	In sports biomechanics, the laws of mechanics are applied in order to gain a greater understanding of athletic performance and to reduce sport injuries as well.
Continuum biomechanics	The mechanical analysis of biomaterials and biofluids is usually carried forth with the concepts of continuum mechanics
Bio-fluid mechanics	Under certain mathematical circumstances, blood flow can be modeled by the Navier–Stokes equations.
Biotribology	The main aspects of Contact mechanics & tribology are related with friction, wear and lubrication.
Comparative biomechanics	The application of biomechanics to non-human organisms, whether used to gain greater insights into humans (as in physical anthropology) or into the functions, ecology and adaptations of the organisms themselves.
Injury Biomechanics	The study of injury mechanisms following trauma to develop a greater understanding human tolerance to injury, to engineer enhanced safety countermeasures and to mitigate the occurrence of serious injury in society.

Biomedical Research	The study of the human body in health and disease
Aging	Ageing in humans refers to a multidimensional process of physical, psychological, and social change
Behavioral health	The interdisciplinary field concerned with the development and integration of behavioral and bio-medical science, knowledge and techniques relevant to health and illness and the application of this knowledge and these techniques to prevention, diagnosis, treatment and rehabilitation
Cellular biology	The study of cells – their physiological properties, their structure, the organelles they contain, interactions with their environment, their life cycle, division and death.
Molecular biology	Molecular biology chiefly concerns itself with understanding the interactions between the various systems of a cell, including the interactions between the different types of DNA, RNA and protein biosynthesis as well as learning how these interactions are regulated.
Cancer	Known medically as a malignant neoplasm, it is a broad group of diseases involving unregulated cell growth. In cancer, cells divide and grow uncontrollably, forming malignant tumors, and invading nearby parts of the body.
Diabetes	It is a group of metabolic diseases in which a person has high blood sugar, either because the pancreas does not produce enough insulin, or because cells do not respond to the insulin that is produced
Endocrinology	It is a branch of biology and medicine dealing with the endocrine system, its diseases, and its specific secretions called hormones, the integration of developmental events proliferation, growth, and differentiation (including histogenesis and organogenesis) and the coordination of metabolism, respiration, excretion, movement, reproduction, and sensory perception depend on chemical cues, substances synthesized and secreted by specialized cells.
Epigenetics	It is the study of mitotically or meiotically heritable changes in gene expression or cellular phenotype, caused by mechanisms other than changes in the underlying DNA sequence
Epidemiology	It is the study (or the science of the study) of the patterns, causes, and effects of health and disease conditions in defined populations. It is the cornerstone of public health, and informs policy decisions and evidence-based medicine by identifying risk factors for disease and targets for preventive medicine.
Genetics	It is the science of genes, heredity, and variation in living organisms. Genetics concerns the process of trait inheritance from parents to offspring, including the molecular structure and function of genes, gene behavior in the context of a cell or organism (e.g. dominance and epigenetics), gene distribution, and variation and change in populations (such as through Genome-Wide Association Studies).
Cytogenetics	A branch of genetics that is concerned with the study of the structure and function of the cell, especially the chromosomes

Genomics	It is a discipline in genetics that applies recombinant DNA, DNA sequencing methods, and bioinformatics to sequence, assemble, and analyze the function and structure of genomes (the complete set of DNA within a single cell of an organism).
Neuroendocrinology	It is the study of the extensive interactions between the nervous system and the endocrine system, including the biological features of the cells that participate, and how they functionally communicate
Neuroscience	It is the scientific study of the nervous system, an interdisciplinary science that collaborates with other fields such as chemistry, computer science, engineering, linguistics, mathematics, medicine and allied disciplines, philosophy, physics, and psychology.
Pharmacology	It is the branch of medicine and biology concerned with the study of drug action,[2] where a drug can be broadly defined as any man-made, natural, or endogenous (within the body) molecule which exerts a biochemical and/or physiological effect on the cell, tissue, organ, or organism.
Preventive medicine	Preventive medicine consists of measures taken to prevent diseases rather than curing them or treating their symptoms. This contrasts in method with curative and palliative medicine, and in scope with public health methods (which work at the level of population health rather than individual health). Occupational medicine operates very often within the preventive medicine.
Psychopharmacology	In psychopharmacology, researchers are interested in any substance that crosses the blood–brain barrier and thus has an effect on behavior, mood or cognition. Drugs are researched for their physiochemical properties, physical side effects, and psychological side effects. Researchers in psychopharmacology study a variety of different psychoactive substances that include alcohol, cannabinoids, club drugs, psychedelics, opiates, nicotine, caffeine, psychomotor stimulants, inhalants, and anabolic-androgenic steroids. They also study drugs used in the treatment of affective and anxiety disorders, as well as schizophrenia.
Public Health	It is "the science and art of preventing disease, prolonging life and promoting health through the organized efforts and informed choices of society, organizations, public and private, communities and individuals." It is concerned with threats to health based on population health analysis.
Tissue Engineering	It is the study of using a combination of cells, engineering and materials methods, and suitable biochemical and physio-chemical factors to improve or replace biological functions.
Virology	It is the study of viruses; submicroscopic, parasitic particles of genetic material contained in a protein coat. It focuses on the following aspects of viruses: their structure, classification and evolution, their ways to infect and exploit host cells for reproduction, their interaction with host organism physiology and immunity, the diseases they cause, the techniques to isolate and culture them, and their use in research and therapy.

Biology	Biology is a natural science concerned with the study of life and living organisms, including their structure, function, growth, evolution, distribution, and taxonomy
Cytopathology	A branch of pathology that studies and diagnoses diseases on the cellular level.
Dermatology	A branch of medicine dealing with the skin and its diseases
Developmental biology	The study of the processes through which an organism forms, from zygote to full structure
Embryology	The study of the development of embryo (from fecundation to birth)
Endocrinology	The study of the system of glands, including biosynthesis, storage, chemistry, biochemical and physiological function of hormones and with the cells of the endocrine glands and tissues that secrete them.
Epidemiology	A major component of public health research, studying factors affecting the health of populations
Epigenetics	The study of heritable changes in gene expression or cellular phenotype caused by mechanisms other than changes in the underlying DNA sequence
Genetics	The study of genes and heredity
Hematology	The study of blood and blood - forming organs. (also known as Haematology)
Histology	The study of cells and tissues, a microscopic branch of anatomy
Immunology	The study of all aspects of the immune system in all organisms
Integrative biology	The study of whole organisms
Metabolism	The study of chemical reactions that occur in living organisms, including digestion and the transport of substances into and between different cells
Microbiology	The study of microscopic organisms (microorganisms) and their interactions with other living things
Molecular biology	The study of biology and biological functions at the molecular level, some cross over with biochemistry
Neurobiology	The study of the nervous system, including anatomy, physiology and pathology
Oncology	The study of cancer processes, including virus or mutation oncogenesis, angiogenesis and tissues remoldings
Parasitology	The study of parasites, their hosts, and their relationships.
Pathology	The precise study and diagnosis of disease, and the causes, processes, nature, and development of disease
Parasitology	The study of parasites and parasitism
Pharmacology	The study and practical application of preparation, use, and effects of drugs and synthetic medicines
Physiology	The study of the functioning of living organisms and the organs and parts of living organisms
Psychobiology	The study of the biological bases of psychology

Serology	The study of plasma serum and other bodily fluids.
Structural biology	A branch of molecular biology, biochemistry, and biophysics concerned with the molecular structure of biological macromolecules
Synthetic Biology	Research integrating biology and engineering; construction of biological functions not found in nature
Toxicology	The study of the adverse effects of chemicals on living organisms
Zoonosis	The study of infectious diseases that are transmitted between species
Biotechnology	A new and sometimes controversial branch of biology that studies the manipulation of living matter, including genetic modification and synthetic biology. In medicine, modern biotechnology finds promising applications in such areas as drug production, pharmacogenomics, gene therapy, genetic testing (or genetic screening): techniques in molecular biology detect genetic diseases. To test the developing fetus for Down syndrome, Amniocentesis and chorionic villus sampling can be used.
Pharmacogenomics	Is the study of how the genetic inheritance of an individual affects his/her body's response to drugs
Pharmaceutical products	Most traditional pharmaceutical drugs are relatively small molecules that bind to particular molecular targets and either activate or deactivate biological processes. Small molecules are typically manufactured through traditional organic synthesis, and many can be taken orally. In contrast, Biopharmaceuticals are large biological molecules such as proteins that are developed to address targets that cannot easily be addressed by small molecules.
Genetic testing	Genetic testing involves the direct examination of the DNA molecule itself. A scientist scans a patient's DNA sample for mutated sequences.
Gene therapy	Gene therapy may be used for treating, or even curing, genetic and acquired diseases like cancer and AIDS by using normal genes to supplement or replace defective genes or to bolster a normal function such as immunity.
Cloning	Cloning involves the removal of the nucleus from one cell and its placement in an unfertilized egg cell whose nucleus has either been deactivated or removed.

Filer Engineering Ltd.

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July 11, 2013

National Water Research Institute
Canada Centre for Inland Waters
867 Lakeshore Road
P.O. Box 5050
Burlington, ON L7R 4A6

Attn: Mr. Matt Wager
Via: e-mail

Subject: **Revised C.C.I.W. Administration Laboratory Central Exhaust System Study**

Sir,

We have been pleased to discuss this project with you and we herewith submit the Engineering Study for the Administration Laboratory central exhaust systems.

We have included the calculations and estimates for the potential energy savings for alterations to the air handling and exhaust systems. A schematic design and cost estimate have been included.

We will be pleased to review this report with you at your convenience.

Sincerely,

D.S.Filer, P.Eng.LEED AP
Mechanical Engineer
encl.

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C.C.I.W. Administration Laboratory Central Exhaust System Study

July 2013

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Revised C.C.I.W. Administration Laboratory Central Exhaust System Study

INTRODUCTION

Filer Engineering Ltd. was retained to provide a study for new Administration laboratory exhaust systems. Supply and exhaust airflows and conceptual design sketches are required.

This report prepared by Filer Engineering Ltd. (FEL) is intended for the exclusive use of the Canada Centre for Inland Waters (C.C.I.W.).

Neither FEL nor C.C.I.W. assume any liability by other parties for the use of this report or for the use of any information disclosed in this report, or for drawings developed resulting from the use of this report.

The report does not address environmental issues including but not limited to, the existence, of asbestos, radon gas, lead paint, urea formaldehyde, toxic or flammable chemicals, water or airborne illness or disease, mould or fungi.

This report provides a summary of conclusions and opinions based on a review of the building systems drawings and specifications. All equipment capacities suggested in this report are preliminary only and further detailed load calculations are required for detailed engineering sizing.

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Revised C.C.I.W. Administration Laboratory Central Exhaust System Study

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Revised C.C.I.W. Administration Laboratory Central Exhaust System Study

0.0 EXECUTIVE SUMMARY

.1 Report Purpose

The purpose of this report is to complete an Engineering Study for the upgrading of the C.C.I.W. Administration Laboratory fume hood and exhaust air handling systems. This review will include the supply air handling systems and the estimated energy and greenhouse gas emission regulations from a system upgrade for variable flow exhaust and supply air systems. (Including energy recovered from exhaust air streams.)

A schematic design concept and cost estimate is presented for the recommended system alterations.

.2 Background

The C.C.I.W. Administration laboratory supply and exhaust systems have undergone some alterations since installation in 1970, but are largely still constant air flow systems.

.1 Supply fans are fitted with variable frequency drives

.2 Exhaust fans for fume hoods have a dedicated exhaust duct and are fitted with variable frequency drives. Exhaust fans for exhaust arms, bench top enclosures and canopy hoods are all constant volume fans.

.3 Supply systems do not return laboratory return air.

.4 Labs with fume hoods are connected to individual exhaust fans. Bench top exhausts, canopy hood exhausts and exhaust arms can be interconnected throughout multiple floors.

.5 Digital controls for new terminal dual duct units have been installed with some variable air volume controls as conversions are made, lab by lab.

The supply air systems operate in near constant flow air flows, even with the installed VAV controls. It is required to have the exhaust and supply air systems to operate in variable flow modes for energy savings. Existing conditions for the supply fan systems are Dual Duct North (DDN; System #27) and Dual Duct South (DDS; System #28):

DDN + DDS: Occupied 48-52 Hz on the VSDs.

DDN + DDS: Unoccupied 40-44 Hz on the VSDs

Revised C.C.I.W. Administration Laboratory Central Exhaust System Study

.3 **Recommendations**

1. The speed of the control action for the fume exhaust, general exhaust and the supply air flows must be similar in order to avoid over or under pressurization.
2. The general exhaust for the Labs should be connected into a new fume exhaust system and may be connected into the existing fume exhaust ductwork if the velocities and pressure drops allow.
3. New Roof top high plume fume exhaust fans should be installed at the Penthouse level with four identical fans providing standby protection in case of fan failure. The fans are typically suction pressure controlled in order to provide a constant pressure for the individual Lab exhaust valves or dampers to modulate against.
4. Individual Lab fume hoods and general exhausts are required to have control dampers or valves to modulate to correct for changes in fume hood face velocities and /or lab pressure and volumetric flow offsets.
5. Labs require VAV control with fast acting damper actuators calibrated venturis or cross flow sensors to measure air flows and to modulate quickly in response to fume hoods sash position changes or room temperature changes.
6. The existing DDN and DDS supply fan and coil systems will remain as existing. The proposal is to add a heat recovery coil at each system. The glycol loop will be required to pump between the exhaust plenum coils on the roof, to the third level mechanical room. This piping connection will be an extensive piping loop. The supply air fan systems should be equipped with a heat recovery coil and glycol loop to exchange exhaust heat to the outdoor air stream.
7. Current Lab Wing return fans should no longer be required to act as return /exhaust units. This service will be handled by the new fume hood exhaust system. The current fans can remain in place.
8. New equipment should have a lifespan of 30 to 50 years.
9. At least one of the fume hood exhaust fans should be powered on emergency power as per MD 15128 item 6.11.4.

10. Existing auxiliary air ductwork risers should be utilized for lab general exhaust conveyance to the penthouse.

11. The Configuration of the proposed exhaust fan and high plume fan discharge should be modeled by Computational Flow Dynamics (CFD) of the exhaust air stream and intake air streams to ensure the fan plume is acceptable to eliminate re-entrainment of exhaust streams into the fresh air intakes located on the Third floor Mechanical room level. A specialty CFD consultant is required to complete this work after the preliminary design parameters and selections are made.

.4 Greenhouse Gas Reduction

.1 Annual greenhouse gas reduction of 322,624 kgCO_2e per year is predicted.

.5 Cost Estimate

.1 The estimated cost for the Fume Exhaust System upgrade is $ 5,200,000.00.

.2 Estimated Annual Energy Savings are: $ 170,116.00

.3 Simple Payback = $ 5,200,000.00 / $ 170,116.00

= 30.5 years

Revised C.C.I.W. Administration Laboratory Central Exhaust System Study

1.0 Report Purpose

The purpose of this report is to complete an Engineering Study for the upgrading of the C.C.I.W. Administration laboratory research wing fume hood and exhaust systems air handling systems. This review will include the supply air handling systems and the estimated energy and greenhouse gas emission regulations from a system upgrade for variable flow exhaust and supply air systems.

A schematic design concept and cost estimate is presented for the recommended system alterations.

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Revised C.C.I.W. Administration Laboratory Central Exhaust System Study

2.0 **Background**

2.1 Documents Reviewed

The documents reviewed for the preparation of this report include the following:

1. Design AutoCAD background drawings for the floor plans for CCIW exported from CCIW, REVIT model.

2. Original CCIW design Mechanical drawings dated June and October 1969.

2.2 Reference Standards

1. CSA (Canadian Standards Association)

   .1 CSA-Z316.5-04 (Reaffirmed 2009) Fume Hoods and Associated Exhaust Systems.

2. ANSI/AIHA (American National Standards Institute/American Industrial Hygiene Association)

   .1 ANSI/AIHA Z9.5 – 2012; American National Standard: Laboratory Ventilation

3. ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers)

   .1 110-1995; Method of Testing Performance of Laboratory Fume Hoods

   .2 2000 ASHRAE Handbook – HVAC Systems and Equipment

   .3 Guideline 1-1996; The HVAC Commissioning Process

4. Government of Canada

   .1 Canada Occupational Health and Safety Regulations, SOR/86-304

5. National Research Council Canada

   .1 National Building Code of Canada, 1995

   .2 National Fire Code of Canada, 1995

6. NFPA (National Fire Protection Association)

   .1 45 (2011); Standard on Fire Protection for Laboratories Using Chemicals

7. Public Works and Government Services Canada

   .1 Real Property Branch MD15128 – 2008 Minimum Guidelines for Laboratory Fume Hoods

8. USA OSHA

   .1 29 CFR Part 1910.1450, Subpart Z: Appendix A, Occupational Safety and Health Standards

9. Ontario OHSA Regulation 833 – Control of Exposure to Biological or Chemical Agents.

10. National Institutes of Health (USA Department of Health and Human Services) Policies and Guidelines Fume Hood Requirements and Testing July 2010.

2.3 Design Basis

Many of the relevant design and Code Standards relating to Laboratory ventilation have undergone substantial changes within the past 2 years. References to standards that date from the year 2009 and earlier will provide incorrect design bases for references.

The most relevant change that has been made is the reduction in the number of standards providing guidance on minimum Lab air change rates. The number of room air changes taking place within one hour was a standard method of sizing Lab supply and exhaust systems.

Many of the Standards do not issue updates more frequently than once every 5 to 6 years. As such, there is a circular referral pattern in these standards that can only be clarified by reviewing all of the most current standards. For the preparation of this report, we have purchased all of the current design standards and present a listing of the relevant information below.

The primary design considerations for Laboratory design from the design standards above are:

.1 Fume hood face velocities should be maintained between 60 FPM and 150 FPM (NFPA-45) with the most predictable containment range stated in ANSI Z9.5 3.3.1 as 80 to 100 FPM for most functioning fume hoods with relatively low risk. At the time of this report preparation, this is the only prescriptive design flow that remains in the Reference Standards listed above. The Standards used to base the design minimums on NFPA-45 as per item 5) below however this minimum has been removed from the 2011 NFPA-45.

.2 Cross drafts within the vicinity of the fume hoods shall be a maximum of 30% of the face velocity.(ASHRAE and NFPA-45)

.3 Laboratories shall be held at a negative pressure with respect to adjacent spaces and/or corridors. (ANSI Z9.5 and OSHA)

.4 Momentary fluctuations in laboratory pressure are allowed during alterations in fume hood sash positions (NFPA-45). Stabilization of fume hood flow and Lab air flows to occur within 3 seconds of sash position alteration.

.5 Older standards called for minimum fume hood flows are to be 25 cfm/FT2 of deck area (NFPA-45-2004). This flow rate was required to be maintained as a minimum during unoccupied periods and on a standard fume hood was equivalent to 160 fpm face velocity at minimum sash height. This design standard has been removed from the current NFPA-45-2011.

.6 No minimum air change rates are specified in the latest codes since each laboratory exhaust rate is to be determined by the contaminants and hazards in the individual room. OSHA 29 CFR Part 1910.1450 App A C1.f states that "… 4 - 12 room air changes/hour is normally adequate general ventilation if local exhaust systems such as fume hoods are used as the primary method of control." OSHA 29 CFR 1910-1450 App A is the only current standard that has a reference for a minimum room air change rate.

.7 Laboratory air shall be maintained at a negative pressure at 47.2 L/s per doorway to the adjacent corridor.

.8 Past laboratory standards for general lab ventilation were 6 to 12 air changes per hour (prudent practices). ASHRAE Applications gives a range of 6 to 10 occupied air changes for general ventilation.

.9 NFPA-45 (2000) stated unoccupied minimum ventilation rates of 4 air changes, with occupied rates over 8 air changes, this requirement was removed from the latest version of NFPA-45 (2011 edition).

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NFPA-45,2011 under item A. 8.4.7 now requires that,

" Laboratory fume hood containment can be evaluated using the procedures contained in ASHRAE 110, Method of Testing Performance of Laboratory Fume Hoods. Face velocities of 0.4 m/sec to 0.6 m/sec (80 ft/min to 120 ft/ min) generally provide containment if the hood location requirements and laboratory ventilation criteria of this standard are met.
In addition to maintaining proper fume hood face velocity, fume hoods that reduce the exhaust volume as the sash opening is reduced should maintain a minimum exhaust volume to ensure that contaminants are diluted and exhausted from a hood. The chemical fume hood exhaust airflow should not be reduced to less than the flow rate recommended in ANSI/AIHA Z9.5, Laboratory Ventilation."

.10 The U.S. National Institutes of Health design policy and guidelines state:

.1 A minimum air change rate for labs as 6 air changes regardless of cooling load shall be met even when the fume hood operates in the minimum exhaust air rate position.

.2 The Face velocity of low flow fume hoods should never be below 0.41 m/s (80 fpm)

.3 Auxiliary air type fume hoods shall not be used in any N.I.H. facilities

.11 CSA Z316-5-2009 does not state any ventilation minimum flows, but requires fume hood testing to meet ASHRAE 110. CSA references the ANSI Z9.5 Standard however the current CSA Z316.5 Code (R2009) references the 2003 ANSI standard which has been superseded by the 2012 issue.

.12 Public Works Canada Standard MD-15128,2008 states a VAV fume hood flow response time of 3 seconds to return to ±10% of face velocity flow during sash potion changes. The standard refers to the minimum fume hood flow rate listed by NFPA-45-2004 in item 5 above.(127 L/s/m2 of deck area).

.13 OHSA in Ontario under Regulation 833, item 4, calls for every employer to take the required measures to limit the exposure of workers to the Time Weighted Average Exposure Value (TWAEV) and the Short Term Exposure Value (STEV). In the absence of prescriptive minimum design requirements that used to be found in NFPA-45 and ANSI Z9.5. It is the responsibility of the owner to ensure the TWAEV levels are not exceeded.

Revised C.C.I.W. Administration Laboratory Central Exhaust System Study

.14 OSHA General Industry Standard 29 CFR 1910.106 requires a minimum air change rate of 6 ACH in chemical Storage rooms. In the past, this standard has been used for laboratories as well.

.15 The current set of Standards and Codes above all refer to the current ANSI Z9.5-2012 Standard for Laboratory ventilation system design and performance.

The ANSI Z9.5, 2003 version of the Standard under section 3.3.1 called for, *"The mechanism that controls the exhaust fan speed or damper position to regulate the hood exhaust volume shall be designed to ensure a minimum exhaust volume in constant volume systems equal to the larger of 50 cfm/ft of hood width, or 25 cfm/ft2 of hood work surface area, except where a written hazard characterization indicates otherwise, or if the hood is not in use."*

This prescriptive flow rate requirement has been removed from the current 2012 ANSI Z9.5. .Now the Standard requires under item 3.3.1 that, *"Hood containment shall be verified as appropriate for the hazard being controlled."*

The 2003 version required that under 6.5.4.2 *"For most operations, 10 seconds will be an acceptable time to achieve the desired area pressurization but a Hazard Evaluation should be conducted to determine the acceptable time."* This requirement is still applicable in the 2012 Standard under Item 6.3.5.2.

Under the current Z9.5 2012 Standard, item 3.3.2 requires, *"that the flow rate of Constant Volume hoods and the minimum flow rate of Variable Air Volume hoods shall be sufficient to prevent hazardous concentrations of contaminants within the laboratory fume hood. In addition to maintaining proper hood face velocity, laboratory hoods shall maintain a minimum exhaust volume to ensure that contaminants are properly diluted and exhausted from a hood."*

In the 2012 Standard ANSI Z9.5 item 5.3.3 requires, "*Supply systems shall meet the technical requirements of the laboratory work and the requirements of the current version of ANSI/ASHRAE Standard 62.1."*

For performance testing, ANSI Z9.5- 2012 under item 6.3.4.2 VAV Hood Performance Tests requires; *"A response time of < 3 sec. after the completion of the sash movement is considered acceptable for most operations. Faster response times may improve hood containment following the sash movement."*

.16 ASHRAE 62.1-2010, Ventilation for Acceptable Indoor Air Quality specifies a ventilation rate of 10 cfm / person plus a room flushing rate of 0.18 cfm/ft2. This air flow is divided by the mixing efficiency of the air distribution system in order to arrive at the final ventilation rate requirement. In a standard Laboratory with 30 ft2 per person occupancy and a 9 foot ceiling, this is the equivalent of 0.6 cfm/ft2 outdoor air or 4.0 air changes per hour. So, in general, for a lab with a small exhaust rate, conformance to ASHRAE 62.1-2010 can be met by a 100% outdoor air ventilating system operating at 4 ACH. This ventilation rate will not provide high flows for purging of a spill event in the Lab.

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2.4 Observations and Existing Construction

.1 The existing Administration laboratories occupy the 4th to 7th floors at CCIW and general are integrated into the core of the ring corridor on each floor. A total of 134 rooms have been reviewed.

.2 The structure is reinforced concrete with masonry corridor walls up to each floor deck.

.3 Demising walls between laboratories were originally non-structural movable partitions. Some of these walls have been reconstructed with a fire resistant steel stud and drywall assembly with full height walls. Air flow between Labs is only restricted by lay-in ceiling tiles and grids and the porous demising wals.

.4 Most labs have lay-in-tile ceilings with some drywall ceiling spaces.

.5 The building is un-sprinklered with standpipe 2 ½” and 1 ½” cabinets on each floor.

.6 The central core service ways contains the plumbing and piping and drainage services and the fume hood exhaust risers to the penthouse.

.7 Individual fume hood exhaust risers can be transite, stainless steel, plastic or galvanized steel material and terminate in the penthouse with approximately 149 individual exhaust fans.

Existing Penthouse Exhaust Fan Count:

	North Side	South Side
Variable Air Volume Flow	57	33
Constant Air Volume Flow	22	22

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.8 High pressure supply ductwork appears to be in good serviceable condition and is operating under +2.0” to + 3.0” W.C. pressure to the dual duct boxes.

.9 There are no fire dampers in the exhaust air risers as required under NFPA-45, 2012.

.10 Exhaust air risers vary in diameter and some have numerous offsets enroute to the penthouse fans. A complete mapping and tagging of all existing risers is required prior to design work initiation.

.11 A total of 104 existing fume hoods in 64 laboratories are currently in use.

.12 Of the total 104 existing fume hoods, 67 are of the original auxiliary air type fume hoods. The auxiliary air supply system has been removed. The original fume hoods remain. These hoods have no sash air foil or overhead baffles to control room air flow into the fume hood. It is recommended to remove and replace these fume hoods with modern variable flow style fume hoods.

.13 A total of 175 constant volume exhaust points in 52 rooms have bench tops, exhaust canopies or exhaust arms. Theses items are calculated at 100 cfm per exhaust. The total exhaust is 17,500 cfm (8,260 L/s) and an attempt should be made to reduce these exhaust points. The only reason to provide these exhaust points is for heat generating devices or non-toxic fume generating devices. Other equipment or processes requiring exhaust should be located within fume hoods.

.14 18 rooms have no fume hoods or constant exhaust points and may use slow acting general exhaust air dampers to match the supply air flow damper response speed.

.15 Fume hood labs should have fast acting general exhaust dampers to match the fast acting fume hood exhaust dampers response speed to face velocity changes.

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.16 Total calculated exhaust flow is 49,300 L/s (104,500 cfm) for general plus fume hood exhaust.

.17 Total calculated required supply air flow is 54,584 L/s (115,644 cfm).

.18 The existing general exhaust systems run down in chases to the third floor fans. For a roof mounted exhaust system, additional general exhaust riser capacity is required. It is proposed to utilize the original remaining auxiliary air supply ducts for this purpose. Confirmation of all duct sizes, pressure classifications and leakage classes is required during the design phase.

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2.5 Exhaust Systems and Controls

The individual fume hood exhaust fans were originally single speed blowers with on/off control at the starters in the Penthouse. Many of the fans are still original however the starters for many have been replaced with Variable Frequency Drives (VFDs) with fume hood sash position sensors and face velocity controllers.

Due to the nature of the VFD drives and the current control sequences, the speed of control movement and stability have not been quantified. It is believed that the current flow control loops may function within the range of speed specified by ANSI Z9.5. Further testing is required to verify response times.

The original Lab supply air flow used dual duct terminal units and were constant flow to match the original constant flow exhaust systems. The Dual duct terminal have largely been replaced with new Nailor units and the controls actuators installed to provide variable flow control over the supply air flows. Half (4^{th} and 5^{th} floors) of the VAV mixing boxes serving Labs in all have new Nailor dual duct mixing boxes. The other half (6^{th} and 7^{th} floors) have original pneumatically operated constant volume boxes.

The Lab general exhaust systems are still constant flow ceiling grilles with ducts connected to the Mechanical room return / exhaust fans. Originally, the return air from the Labs was utilized and returned back to the Supply fan. This system was modified to exhaust only. The Lab general exhaust is exhausted out the South side of the Mechanical room on level 3. It is proposed to install general exhaust dampers in each Lab to allow for pressure control sequences with variable flow fume hood exhaust and VAV supply air flow.

The suction capacity rating for the current exhaust ductwork is unknown. The system originally operated at a low (-1” W.C.) pressure and may not be capable or being fitted with control dampers at each lab general exhaust.

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2.6 Supply Systems

The two Level 3 Mechanical room supply systems are original to the CCIW facility. It is intended to retain the two (DDN and DDS) dual duct supply air fans, coils and temperature controls. The fans are equipped with variable speed drives that will remain. The modifications below have been made to the supply systems:

.1 Supply fan motors were fitted with VFDs and two supply air pressure sensors control the supply fan speed to maintain duct static pressure as VAV terminal units slave back.

.2 On flow, the return air flow from the Return /exhaust fan was blanked off and now is exhausted.

.3 The Mechanical room air is returned to the Supply fan systems.

.4 The original auxiliary supply air systems for original fume hoods have been removed.

.5 The outdoor air from the East Wall louvers flows to the supply fan systems, is filtered and preheated by a glycol coil. The air flows through blow-through coils for the cold and hot decks and is fed up to the Lab levels via round duct risers in chases at the North and South ends of the building.

.6 The current supply fan system should be modulating back on flow with the VAV terminal units and the control sequence that is used in the retrofitted Labs calls for 6 air changes (ACH) of ventilation air during occupied periods and 3 air changes during unoccupied.

.7 Currently, the reduction in laboratory supply air flow is not observed when lowering a fume hood sash. Current (June 6, 2013) fan speed drive readings indicate that the supply fan drives do not lower the fan speed to a large degree during the unoccupied periods.

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Read from the fan speed drives:

June 6, 2013	Occupied		Unoccupied	
	DDN	DDS	DDN	DDS
A	61	50	52.5	44
kW	35.5	35	31	24.5
Hz	49	51	45	45
Calculated Fan Kw	58.2	47.7	50.1	42.0

Calculated Fan Kw = (Amps x Voltage x 1.73 x Power Factor) / 1000

.8 Currently, there is no heat recovery from the fume hood exhaust systems for pre-heating of the ventilation air streams.

.9 Many of the 6th and 7th floor original constant volume pneumatically operated boxes fail to open, leading to increased flow rate on the supply fans. It is suspected that a substantial reduction in supply air energy would be experience after the replacement of all original supply boxes.

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2.7 Laboratory Design Requirements

The purpose of the Laboratory general ventilation systems are to replace exhausted air and to provide temperature, humidity, filtered air of adequate air quality without creating drafts at chemical fume hoods.

Ventilation systems designers are not able to subscribe one fixed air change rate for all Laboratories to provide low risk protection for workers using varied chemicals and biological agents. Knowledge of the individual chemical agents being used and the assumption of adequately performing fume hoods and Standard Operating Procedures by Staff are required.

Fume Hoods are designed and manufactured to meet the Scientific Equipment and Furniture Association (SEFA) standards. The SEFA 1-2006 refers to ANSI Z9.5 for the fume hood airflow requirements and ASHRAE 110 for the testing of fume hoods.

From a review of the current Design Standards, Codes and Testing requirements, it is clear that in the past 10 years, the Standards have moved away from prescriptive air flows and air change rates for Lab ventilation. Even the current NFPA-045 Standard has removed the historically required exhaust rate requirement of 25 cfm /ft2 of fume hood deck area and now refers to the face velocity requirement of 80 to 100 fpm fume hood face velocity as well as deferring to the current ANSI Z9.5 Standard. The current 2012 issue of ANSI Z9.5 now has no prescriptive flow rate or face velocities in the Standard and the recommended guidelines for face velocities are not mandatory parts of the standard.

Based on this summary of the current International design Standards and references, we suggest the following requirements for the modeling of the proposed exhaust and supply air systems to support the A / L Laboratories at C.C.I.W.:

1. Occupied periods shall utilize 100 fpm as the minimum fume hood face velocity.

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2. Unoccupied periods shall utilize 80 fpm as the minimum fume hood face velocity. This shall form the basis for the unoccupied air flows and will limit the downturn on the air systems. Standard operating procedure is requiring all of the lab fume hood sash positions to be lowered to minimum heights during unoccupied periods. In addition, the face velocity will be lowered from 100 fpm to 80 fpm during unoccupied periods.

3. Laboratories shall be held at a negative pressure with respect to the adjacent corridors by a volumetric flow offset of 100 cfm per doorway.

4. Supply air rates shall be calculated on the greater of the cooling air flow rate or the required make up air for the room exhaust rate.

5. Since the room make up rate is to be calculated based on maintaining the minimum fume hood face velocity, minimum air change rates are to be specified only for Labs with low exhaust rates and /or low cooling supply air requirements.

6. The Lab general exhaust dampers shall modulate to maintain the fixed volumetric offset during occupied periods.

7. Control sequences and dampers must be capable of responding to changes in fume hood sash positions within the specified ANSI Z9.5 time requirements.

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2.8 Usage Based Controls and Demand Controls

There are control systems on the Laboratory systems market that will provide additional control of fume hood exhaust systems to assist in energy reduction and lower equipment operating costs.

.1 Usage based controls provide an occupancy sensor at the front of each fume hood to provide a control signal indicating when the fume hood is be attended. The fume hood controller provides for the increase in fume hood exhaust based on the settings of the face velocity controller. In this manner, the fume hood may remain at lower face velocities even during occupied periods if the fume hood is not in active use. Additional energy savings can be accumulated by the installation of these sensors and the integrated face velocity controllers. This type of lab control is common in current laboratory design.

.2 More expensive systems such as demand controls provide specialized space sensors to indicate whether the following surrogate indicators of acceptable air quality are met. The Labs in a zone will have a series of aspirating multiplexed sensors that draw air samples from each Lab and measure such indicators such as:

.1 Carbon Dioxide
.2 Carbon Monoxide
.3 Humidity
.4 Temperature
.5 Volatile Organic Compounds (VOCs)
.6 Particulates

The sensors will compare set points and determine a control action to increase the exhaust and supply air to the particular Lab based on the offset from the set point. In this way, the Lab ventilation rates will vary from low rates up to possible purging emergency ventilation rates if there was a spill. Standard Operating Procedures for the Lab should limit the use of chemical outside of the fume hoods and the need for high air flows for purging flows should not constitute a normal Lab use requirement.

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2.9 Estimated Flow Rates and Savings

Refer to the spreadsheets in Appendix V for a summary of the modeled supply and exhaust systems flow rates.

From the data, the following observations can be made:

1. The fixed exhausts required from the bench top and canopy exhausts are substantial air flows from a total of constant flow 175 exhaust points.

2. The supply air flows range over a 60% range based on the fume hood minimum velocities.

3. The Room cooling rates require large air flows that often exceed the maximum fume hood exhaust make up rates. The typical room cooling rates are required during occupied periods for the temperature and humidity control of the rooms. The general exhaust systems will follow the required room air flows to maintain the room at negative pressure. For the purposes of modeling the airflows, typical Lab heat gain values were used to simulate Lab gains. For design purposes, these heat gains must be confirmed.

4. The modeling spreadsheet shows that total supply air rates are quite insensitive to changes in the minimum Lab air change supply rate since the basis of air flow design is either the cooling load for the Lab or meeting the minimum face velocity for the fume hoods. In this way, the spreadsheet calculations do not follow the older design method of predetermined air change rates. Conformance to the current ANSI Z9.5 - 2012. Standard is the only prescriptive design requirement.

5. Evaluation of the unoccupied periods for the year yields 32% of the time as occupied and 67% unoccupied of total hour per year including 12 hours per working day and 11 stat holidays per year.

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Air flow totals from the Appendix IV spreadsheets and current supply fan operations are:

Item	Maximum Supply Air Flow (L/s)	Minimum Unoccupied Supply Air Flow (L/s)	Exhaust Air Flow (L/s)	Minimum Unoccupied Exhaust Air Flow (L/s)
Existing Systems DDN (#27)	31,790	26,492	---	---
Existing Systems DDS (#28)	22,226	18,521	---	---
Existing Systems Total	54,016	---	---	---
Proposed Systems	54,584	20,697	49,300	18,840

6. The calculated supply airflows are based on a supply to space temperature differential of 17 Deg.F (9.4 Deg.C.) The Supply fan system cold deck must be maintained for a year round supply air dew point of at most 53 Deg.F (11.7 Deg.C) in order to provide adequate dehumidification and moisture control in the Labs. The hot deck temperature may be reset in winter with outdoor air and in the cooling season, the hot deck air will be the same conditions as outdoor air. During peak cooling seasons, approximately 24% of the supply air flow will be hot deck air to control space humidity and prevent overcooling.

7. <u>Estimated Savings</u>

Based on an estimated fan motor efficiencies listed below:

kW = P_{HP} x 0.746 / Eff.

And estimated Duty Cycle from the current speed drive outputs:

Power factor estimated at 0.96.

Existing Fan Motor Efficiencies:

150 HP	0.930 (Original)
125 HP	0.952 (Replaced)
10 HP	0.910 (Replaced)
1.5 HP	0.780 (Original)

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.1 Existing Supply Fans

DD North 150 HP

DD South 125 HP

.2 Existing Exhaust Fans

(134 Total Fans, plus two 20 HP constant volume general exhaust fans)

90 Variable Speed Fans

44 Constant Volume Fans

Estimated 1.5 HP each

Proposed four exhaust fans with 100% standby will require two operational exhaust fans at 75 HP each.

.3 Proposed Fan Powers as Per Appendix IV

Supply Fans = 2 @ 100 HP load factor

= 200 HP x 0.746 kW/HP / 0.941 (average)

= 158 kW load

Exhaust Fans = Two Fans at 75 BHP each

= 150 HP x 0.746 kW/HP / 0.95 (estimated)

= 118 kW

.4 Existing Fan System Consumption:

(kW) P = 1.73 * A * V * PF/1000

* Estimated

Fan	Period	EFF	Amps	Voltage	PF	LF (Hz/Hz)	Cal kW	Hrs/ Yr.	kWh/ Yr. /Fan	# Fans	kWh/Yr.
DDN	Occ	.930	61	575	.96	49/60	58.2	2,880	167,767	1	167,767
	Unocc	.930	52.5	575	.96	45/60	50.1	5,880	294,796	1	294,796
DDS	Occ	.952	50	575	.96	51/60	47.7	2,880	137,514	1	137,514
	Unocc	.952	44	575	.96	45/60	42.0	5,880	247,067	1	247,067
VAV Exh. Fans (90#)	Occ	.78	2.7*	208	.96	60/60*	.96	2,880	2,750	90	247,500
	Unocc	.78	2.7*	208	.96	45/60*	.96	5,880	5,642	90	507,846
CF Exh. Fans (44#)	Occ	.78	4.1	208	.96	60/60*	1.43	2,880	4,118	44	181,192
	Unocc	.78	4.1	208	.96	60/60*	1.43	5,880	8,408	44	369,969

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Fan	Period	EFF	Amps	Voltage	PF	LF (Hz/Hz)	Cal kW	Hrs/ Yr.	kWh/ Yr. /Fan	# Fans	kWh/Yr.
Gen. Exh. Fans (20HP)	Occ	.95	15.0*	575	.96	45/60*	14.3	2,880	41,184	2	82,368
	Unocc	.95	15.0*	575	.96	45/60*	14.3	5,880	84,084	2	168,168
										Total	2,404,187

.5 <u>Proposed Systems</u>

Occupied @ 32.1% of the year (Appendix V)

Occupied Consumption

= (Supply + Exhaust) kW x 8,760 Hrs/Yr x 0.321

= (158 kW + 118 kW) x 8,760 x 0.321

= 776,100 kWh

i) Fan Laws: $cfm_1 / cfm_2 = RPM_1 / RPM_2 = (HP_1 / HP_2)^{1/3}$

∴ for DDN System #27, Supply Air; Max. Flow = 27,381 L/s

Supply Air; Min. Flow = 10,519 L/s

∴ $(27,381 / 10,519) = (100 \text{ HP} / x)^{1/3}$

∴ $(2.665)^3 = 100 \text{ HP} / x$

For Unoccupied Supply Fan HP

x = 100 / 17.6 = 5.7 HP x 0.746 / 0.941

x = 4.5 kW

∴ Supply Fan Unoccupied Draw = 4.5 kW x 2 Fans

= 9.0 kW

(For estimating purposes, DDN system #27 & DDS system #28 are similar)

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ii) Exhaust Systems:

Unoccupied Fan HP: $(cfm_1 / cfm_2) = (HP_1 / HP_2)^{1/3}$

Max. Exhaust Fan #27 = 75 HP / 56 kW / 22,095 L/s

Max. Exhaust Fan #28 = 75 HP / 56 kW / 27,169 L/s

Total Max. Exhaust = 150 HP / 112 kW / 49,264 L/s

Minimum Flow = 8,192 + 10,648 L/s = 18,840 L/s

∴ Exhaust Fan Unoccupied Draw = $(HP_2 + HP_1) / (cfm / cfm)^3$

= $150 / (49{,}264 / 18{,}840)^3$

= 8.4 HP x 0.746 / 0.95

= 6.6 kW

Unoccupied Consumption:

= (Supply Fan + Exhaust Fan) Min. Flow kW x 8,760 Hrs/Yr x (1 – 0.321)

= (9.0 kW + 6.6 kW) x 8,760 Hrs/Yr x 0.671

= 91,696 kWh/Yr

iii) Possible Savings:

= (Existing Max. Flow)* – (Occupied Consumption Plus Unoccupied Consumption)

= 2,404,187 kWh/Yr – (776,100 + 91,696) kWh/Yr

= 1,536,391 kW/Yr

* Constant Consumption Flow System at estimated 80% duty cycle.

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2.10 Estimated Energy Greenhouse Gas Emission and Reductions Cost

Based on the difference in the operating hours and the maximum flow rates, the estimate Greenhouse Gas Emission Reductions for the proposed Air Systems changes are:

Estimated electrical annual consumption savings from Section 2.9 = 1,536,391 kWH per year, based on the federal greenhouse gas tracking protocols (V3.0) for conventional electricity consumption at federal facilities:
Ontario = 210 gCO_2e / kWh x 1,536,391 kWh / Yr Consumption Reduction
(Canada for Natural Gas, $1m^3$ = 1,903 g/m^3 CO_2e)
Greenhouse Gas Reduction = 322,624 $kgCO_2e$ / Yr
With: 1 Gj = 947,817 BTU

1. Refer to Appendix XIII for calculation of estimated heat recovery savings per year. Estimated cooling system energy savings = 3,580 Gj/yr less 2,544 Gj/yr = 1036 Gj/yr. Therefore net calculated heating system savings are 6,145 Gj/yr less 1,036 Gj/yr cooling = 5,110 Gj/yr heating savings.

   Energy recovery from a glycol run around loop heat recovery with the boiler plant operating on natural gas at 76.0% efficiency and gas at $0.161/m^3$ for 5,110 Gj/yr is estimated at 180,527 m^3/yr or $29,065.00 in natural gas savings.

2. Cooling savings with heat recovery are estimated at 53,188 kWh/yr. Estimated fan electrical consumption will be reduced by 1,536,391 kWh. additional glycol pump energy of 50 HP = 330,187 kWh/yr. Net savings of 1,259,392 kWh/yr at $0.112/kWh = $141,051.00 per year.

3. Demand electrical charges should not change dramatically with the new exhaust fan systems. (Current demand charges are $7.67/kW per month.)

4. Total Estimated Energy Savings:

Natural Gas	= $ 29,065.00
Electrical	= $ 141,051.00
Total	= $ 170,116.00

Revised C.C.I.W. Administration Laboratory Central Exhaust System Study

3.0 Recommendations

1. The speed of the control action for the fume exhaust, general exhaust and the supply air flows must be similar in order to avoid over or under pressurization. The speed of response and the return to control and flow stability must occur within 10 seconds and the MD 15128 Standard requires control stability within 3 seconds.

2. The general exhaust for the Labs should be connected into a new fume exhaust system and may be connected into the existing general exhaust ductwork systems with augmented duct riser capacity of the existing auxiliary air supply ductwork risers. The velocities and pressure drops and duct pressure classifications must be reviewed. Reinforcement of the existing ductwork is required.

3. New Roof top high plume fume exhaust fans should be installed at the Penthouse level with four identical fans providing standby protection in case of fan failure. The fans are typically suction pressure controlled in order to provide a constant pressure for the individual Lab exhaust valves or dampers to modulate against. Each fan plenum will be equipped with a heat recovery coil for a glycol loop system.

4. Individual Lab fume hoods and general exhausts are required to have control dampers or valves to modulate to correct for changes in fume hood face velocities and /or lab pressure and volumetric flow offsets.

5. Labs require VAV control with fast acting damper actuators and cross flow sensors to measure air flows and to modulate quickly in response to fume hoods sash position changes or room temperature changes.

6. The existing DDN and DDS supply fan and coil systems will remain as existing. The proposal is to add a heat recovery coil at each system. The glycol loop will be required to pump between the exhaust plenum coils on the roof, to the third

level mechanical room. This piping connection will be an extensive piping loop. The supply air fan systems should be equipped with a heat recovery coil and glycol loop to exchange exhaust heat to the outdoor air stream.

7. Existing Administration and Laboratory general, fume hood and constant volume exhaust should be incorporated together by the new fume hood exhaust system.

8. New equipment should have a lifespan of 30 to 50 years.

9. At least one of the fume hood exhaust fans should be powered on emergency power as per MD 15128 item 6.11.4.

10. Existing auxiliary air ductwork risers should be utilized for lab general exhaust conveyance to the penthouse.

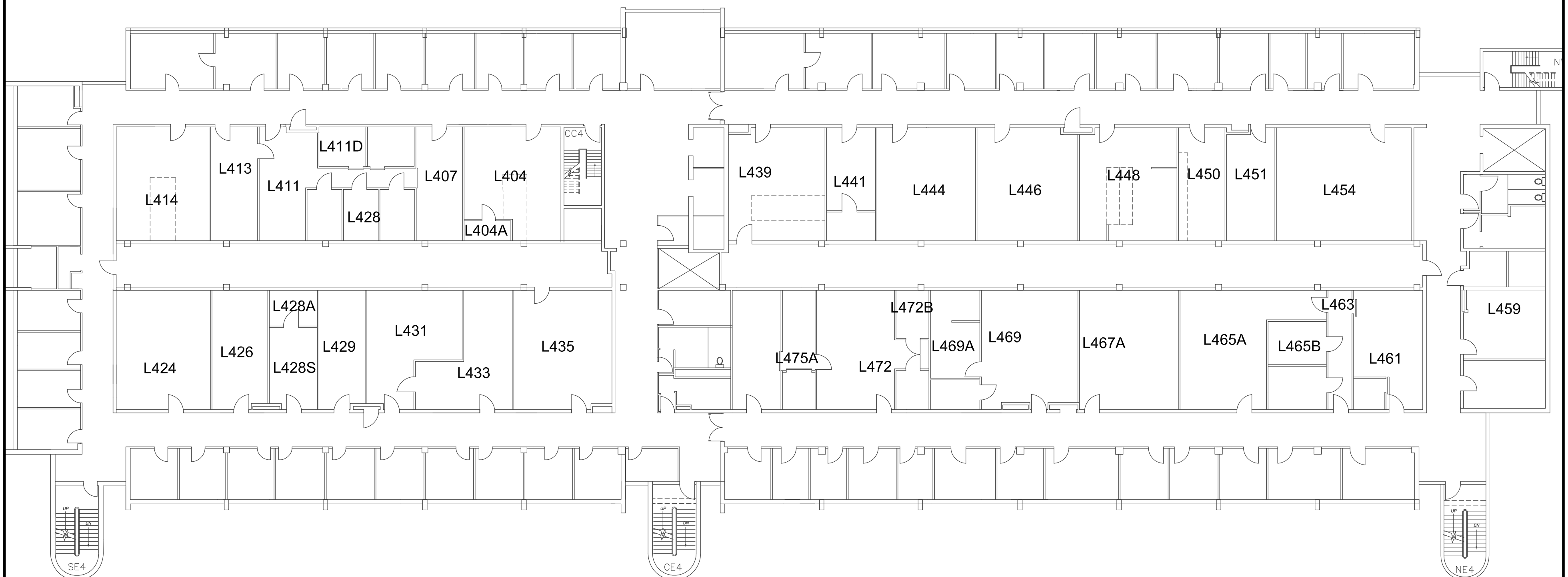
11. The Configuration of the proposed exhaust fan and high plume fan discharge should be modeled by Computational Flow Dynamics (CFD) of the exhaust air stream and intake air streams to ensure the fan plume is acceptable to eliminate re-entrainment of exhaust streams into the fresh air intakes located on the Third floor Mechanical room level. A specialty CFD consultant is required to complete this work after the preliminary design parameters and selections are made.

12. Estimated Capital Cost = $5,200,000.00
    Estimated Annual Energy Savings = $ 170,116.00
    Simple Payback = $ 5,200,000.00 / $ 170,116.00
    = 30.5 years

4.0 Appendices

APPENDIX I

Floor Plans and Key Plans



FOURTH FLOOR LABORATORY FLOOR PLAN

APPENDIX I

Filer Engineering Ltd. 1046 Botanical Drive Burlington, Ontario L7T 1V1 Fax: (905) 526-8899	CLIENT:	C.C.I.W.	SCALE: 1/32"=1'-0"	DRAWN: ARC	PROJ. # F0836
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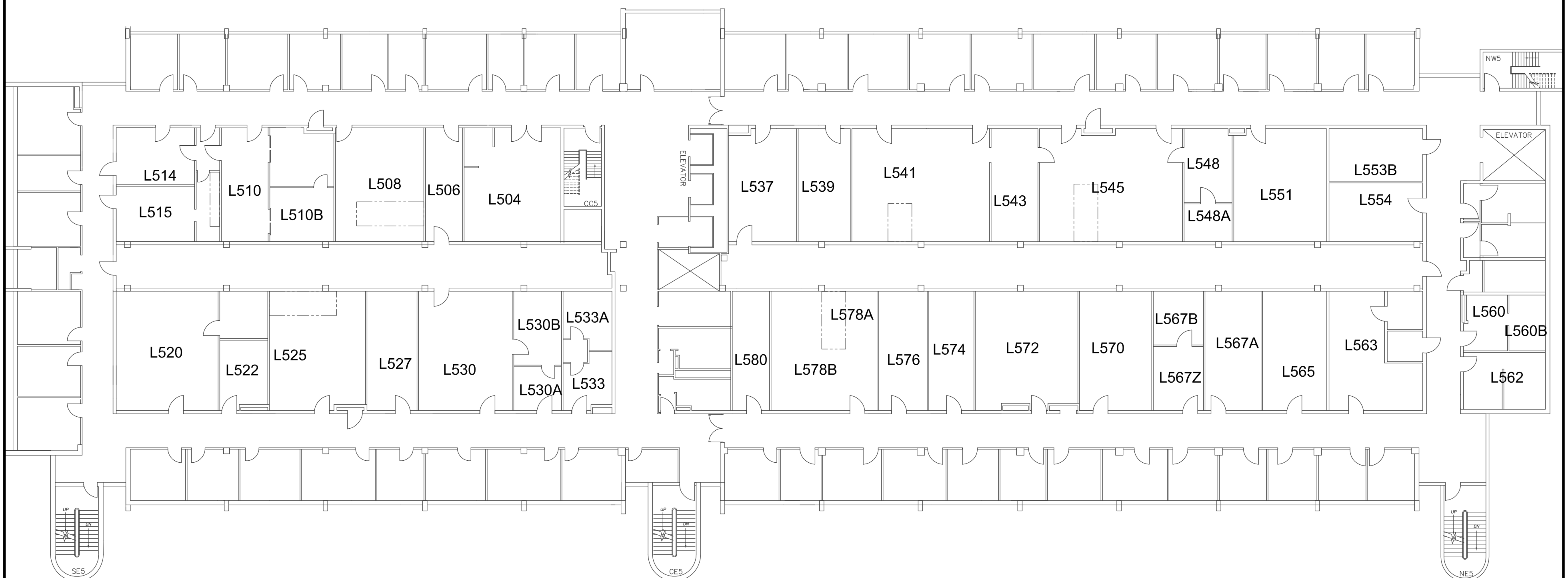

FIFTH FLOOR LABORATORY FLOOR PLAN

APPENDIX I

Filer Engineering Ltd. 1046 Botanical Drive Burlington, Ontario L7T 1V1 Fax: (905) 526-8899	CLIENT: C.C.I.W.	SCALE: 1/32"=1'-0"	DRAWN: ARC	PROJ. # F0836
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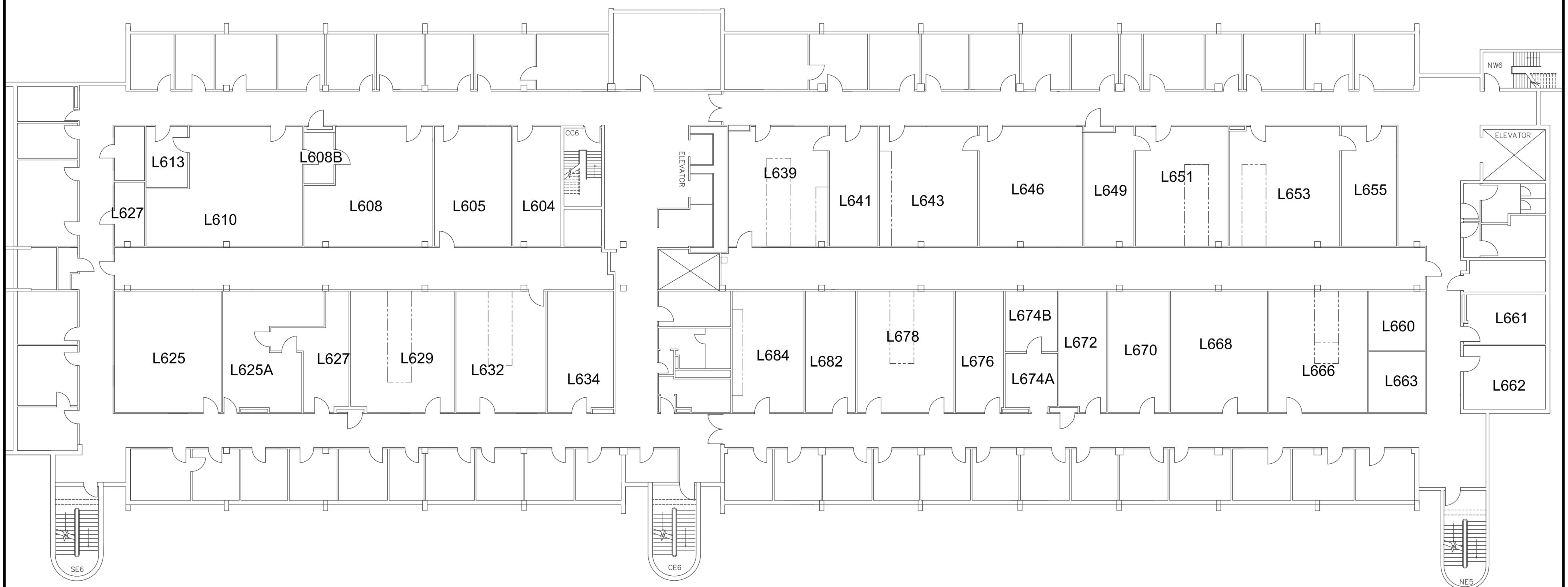
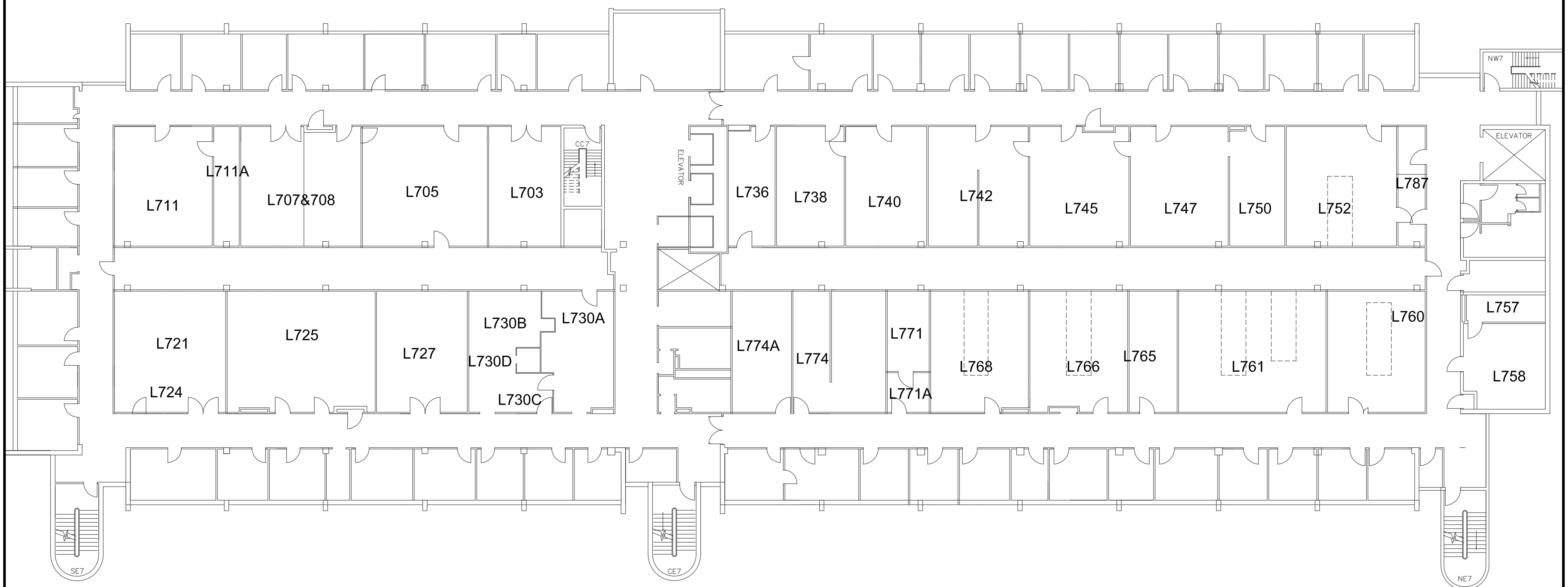


SIXTH FLOOR LABORATORY FLOOR PLAN

APPENDIX I

Filer Engineering Ltd. 1046 Botanical Drive Burlington, Ontario L7T 1V1 Fax: (905) 526-8899	CLIENT:	**C.C.I.W.**	SCALE: 1/32"=1'-0"	DRAWN: ARC	PROJ. # F0836
	PROJECT:	**LABORATORY EXHAUST FAN**	DATE: APR. 2013	CHECKED: DSF	SHEET **ESK-A.I-3**
	TITLE:	**SIXTH FLOOR FLOOR PLAN**			



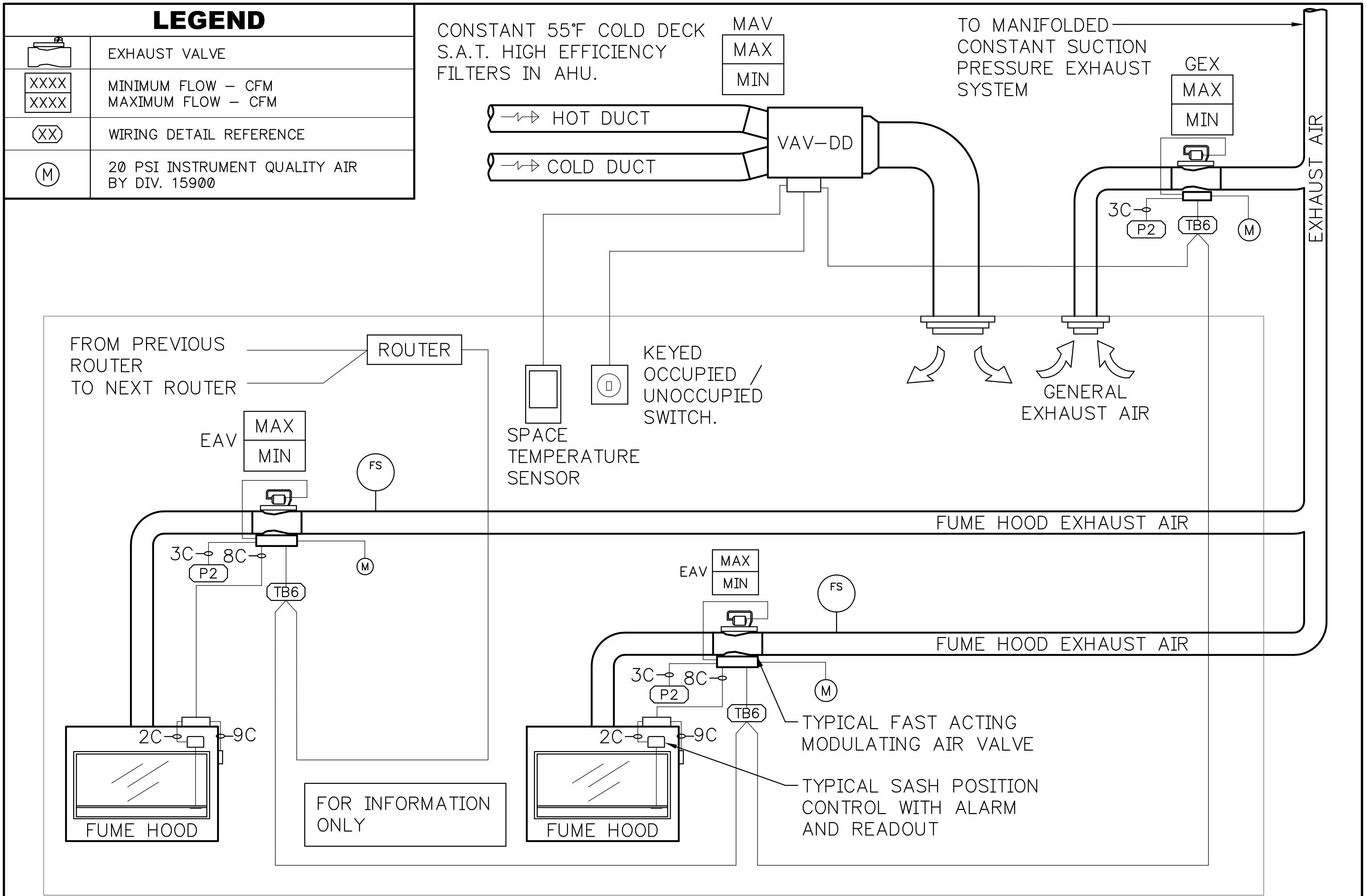
SEVENTH FLOOR LABORATORY FLOOR PLAN

APPENDIX I

Filer Engineering Ltd. 1046 Botanical Drive Burlington, Ontario L7T 1V1 Fax: (905) 526-8899	CLIENT:	C.C.I.W.	SCALE: 1/32"=1'-0"	DRAWN: ARC	PROJ. # F0836
	PROJECT:	LABORATORY EXHAUST FAN	DATE: APR. 2013	CHECKED: DSF	SHEET ESK-A.I-4
	TITLE:	SEVENTH FLOOR FLOOR PLAN			

Appendix II

Proposed Control Schematic

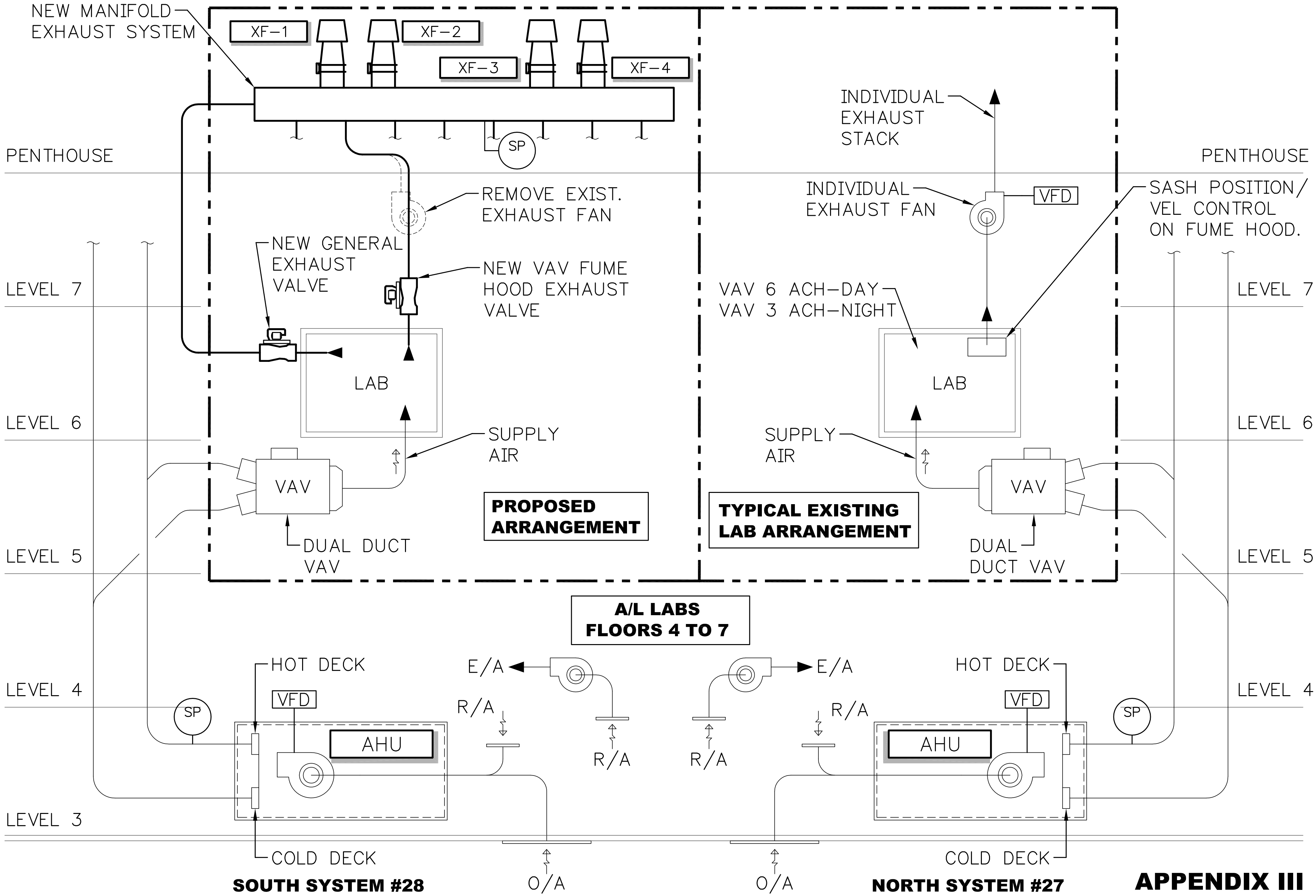


APPENDIX II

Filer Engineering Ltd. 1046 Botanical Drive Burlington, Ontario L7T 1V1 Fax: (905) 526-8899	CLIENT: **C.C.I.W.**	SCALE: N.T.S.	DRAWN: ARC	PROJ. # F0881
	PROJECT: **LABORATORY EXHAUST FAN**	DATE: APR. 2013	CHECKED: DSF	SHEET **ESK-A.II**
	TITLE: **PROPOSED CONTROL SCHEMATIC**			

APPENDIX III

Existing and Proposed Air Handling and Exhaust Systems Schematic



APPENDIX III

Filer Engineering Ltd. 1046 Botanical Drive Burlington, Ontario L7T 1V1 Fax: (905) 526-8899	CLIENT: **C.C.I.W.**	SCALE: N.T.S.	DRAWN: ARC	PROJ. # F0881
	PROJECT: **LABORATORY EXHAUST FAN**	DATE: APR. 2013	CHECKED: DSF	SHEET **ESK-A.III**
	TITLE: **PROPOSED VENTILATION SCHEMATIC**			

Revised C.C.I.W. Administration Laboratory Central Exhaust System Study

APPENDIX IV

Laboratory Air Flow and Heat Gains

Max Sash Height 450mm
Min Sash Height
Supply Air Temp 12.8 DegC
Room Temp 22.2 DegC
Corridor offset 100 cfm per door
Max VAV=Fume Hood L less 300mm times 100 fpm
Min VAV= Max Fume hood * 26%
Min GEA 47 L/s
Unocc Ht Gains= 50% Equip.Gains
Unocc Fume Hoods at 80 fpm
Corridor SA at 7.6 L/s/m2

Minimum SA ACH	6				
Occupied Corridor SA	7.60	L/s/m2			(1.5 cfm/ft2)
Min Occupied Fume Hood Face Velocity	100	fpm	or	47.2	L/s/ft2
Bench Top Exhaust	100	L/s			
Canopy Exh	100	L/s			

A/L Wing Supply Air System 27

																	Occupied												Unoccupied							
Zone Name	Labs in Zone	Room Area (sq.Ft.)	Room Volume (9' Clg) (Cu.Meter)	Qty 4' FH's	Qty 5' FH's	Qty 6' FH's	Qty 8' FH's	Qty BT's 100 L/s each	Qty CH's 100 L/s each	Qty EA's 47 L/s each	Fume Hood Valve	Exh. Valve	Gen. Exh. Valve	1ACH L/s	# of Corridor Doors	Corridor Offset L/s	Total Est Heat Gains W	Cooling Calc Supply air Reqd L/s	Max. Supply Air Equiv ACH	Max FE VAV Exhaust L/s	Min FE VAV Exhaust L/s	CAV Exhaust (BT's+CH's+EA's) L/s	Max Room Exhaust VAV + CV L/s	Min Room Exhaust VAV +CV L/s	Min Room Gen Exhaust	Min SA L/s	Max SA L/s	Max General ExhaustL/s	Total Est Heat Gains W	Cooling Calc Supply air Reqd L/s	Max. Supply Air Equiv ACH	Min FE VAV Exhaust L/s	CAV Exhaust (BT's+CH's+EA's) L/s	Min Room Exhaust VAV +CV L/s	Min SA L/s	Max General Exhaust L/s
L400Z	4th Cor S	3181	810.68											225				2246	10							2246	2246								1123	
L404Z	L404	476	121.31		1						1		1	34	1	47	3537	310	9	283	74		283	74	176	202	310	284	714	63	2	59		59	12	
L407Z	L407	235	59.89		1						1		1	17	1	47	1746	153	9	283	74		283	74	73	100	236	210	352	31	2	59		59	12	
L411Z	L413,L411,L410,L410X	1032	263.01	1		1					2	2	2	73			7669	673	9	566	147		566	147	291	438	673	525	1547	136	2	118		118	118	
L413															1	47									47			47								47
L414Z	L414	457	116.47		1						1		1	32	1	47	3396	298	9	283	74		283	74	168	194	298	271	685	60	2	59		59	12	
L424Z	L424	453	115.45	1						2	1	1	1	32	1	47	3366	295	9	212	55	94	307	150	90	192	295	193	679	60	2	44	94	139	91	
L426Z	L426	276	70.34		1						1		1	20	1	47	2051	180	9	283	74		283	74	91	117	236	210	414	36	2	59		59	12	
L428Z	L428	238	60.65										1	17	1	47	1769	155	9						148	101	155	202	357	31	2					47
L429Z	L429	235	59.89										1	17	1	47	1746	153	9						147	100	153	200	352	31	2					47
L431Z	L431	370	94.30							4		1	1	26	1	47	2750	241	9			189	189	189	47	157	241	100	555	49	2		189	189	142	
L433Z	L433	350	89.20			2		4			2	1	1	25	1	47	2601	228	9	708	184	400	1108	584	47	537	1061	524	525	46	2	147	400	547	500	
L435Z	L435	476	121.31	1							1		1	34	1	47	3537	310	9	212	55		212	55	194	202	310	302	714	63	2	44		44		
L500Z	5th Cor S	3181	810.68											225				2246	10							2246	2246								1123	
L504Z	L504	485	123.60			1				1	1	1	1	34	1	47	3604	316	9	354	92	47	401	139	114	206	354	262	727	64	2	74	47	121	74	
L506Z	L506	240	61.16		1				2		1	1	1	17	1	47	1784	156	9	283	74	200	483	274	47	226	436	210	360	32	2	59	200	259	212	
L508Z	L508	490	124.88		1	1		4			2	1	1	35	1	47	3641	319	9	637		400	1037	400	47	353	990	637	735	64	2	133	400	533	485	
L510AZ	L510A																								47											
L510BZ	L510B	224	57.09											16			1665	146	9						95	95	146	146	336	29	2					
L510Z	L510,L514,L515	678	172.79		2			3		3	2	1	3	48	3	142	5039	442	9	566	147	442	1008	589	47	447	866	419	1017	89	2	118	442	559	418	
L520Z	L520	610	155.46		2						2		1	43	1	47	4533	398	9	566	147		566	147	159	259	519	419	915	80	2	118		118	71	
L522Z	L522	170	43.32										1	12	1	47	1263	111	9						119	72	111	158	255	22	2					47
L525AZ																									47											
L525Z	L525	412	105.00										1	29	1	47	3062	269	9						222	175	269	316	618	54	2					47
L527Z	L527	240	61.16					1				1	1	17	1	47	1784	156	9			100	100	100	49	102	156	104	360	32	2		100	100	53	
L530Z	L530,L530A,L530B	737	187.83		2				4		2	1	2	52	1	47	5477	480	9	566	147	400	966	547	47	500	919	419	1105	97	2	118	400	518	471	
L533AZ	L533A	113	28.80		1						1		1	8	1	47	840	74	9	283	74		283	74	47	48	236	210	169	15	2	59		59	12	
L533BZ	L533B	110	28.03							1		1	1	8	1	47	817	72	9			47	47	47	47	47	72	72	165	14	2		47	47		
L600Z	6th Cor S	3181	810.68											225				2246	10							2246	2246								1123	
L604Z	L604	241	61.42		1						1		1	17	1	47	1791	157	9	283	74		283	74	76	102	236	210	361	32	2	59		59	12	
L605Z	L605	370	94.30		1					1	1	1	1	26	1	47	2750	241	9	283	74	47	330	121	84	157	283	210	555	49	2	59	47	106	59	
L610Z	L610,L613,L608	1443	367.75		4	2			4	4	6	2	4	102	3	142	10724	941	9	1841	479	589	2430	1067	47	926	2288	1362	2164	190	2	383	589	972	830	
L625AZ	L625A,L627	672	171.29		2	1					3		2	48	2		4995	438	9	920	239		920	239	47	285	920	681	1008	88	2	191		191	191	
L625Z	L625	479	122.07		1						1		1	34	1	47	3560	312	9	283	74		283	74	177	203	312	286	718	63	2	59		59	12	
L629Z	L629	478	121.69		3					1	3	1	1	34	1	47	3549	311	9	850	221	47	897	268	47	221	850	629	716	63	2	177	47	224	177	
L632Z	L632	482	122.84		1			4		1	1	1	1	34	1	47	3582	314	9	283	74	447	730	521	47	474	683	210	723	63	2	59	447	506	459	
L634Z	L634	236	60.17	1							1		1	17	1	47	1755	154	9	212	55		212	55	92	100	165	157	354	31	2	44		44		
L700Z	7th Cor S	3181	810.68											225				2246	10							2246	2246								1123	
L703Z	L703	248	63.31			1				1	1	1	1	18	1	47	1846	162	9	354	92	47	401	139	47	106	354	262	372	33	2	74	47	121	74	
L705Z	L705	719	183.24			1				2	1	1	1	51	1	47	5343	469	9	354	92	94	448	186	166	305	469	329	1078	95	2	74	94	168	121	
L707Z	L707,L708	613	156.10										1	43	3	142	4552	399	9						402	260	399	541	918	81	2					142
L711Z	L711	481	122.51		1					2	1	1	2	34	1	47	3572	313	9	283	74	94	378	168	83	204	330	210	721	63	2	59	94	153	106	
L724Z	L724,L721A	594	151.38							2		1	1	42	3	142	4414	387	9			94	94	94	300	252	387	434	891	78	2		94	94		
L725Z	L725	668	170.29							9		1	1	47	2	94	4966	436	9			425	425	425	47	330	436	105	1002	88	2		425	425	330	
L727Z	L727	442	112.52		1					1	1	1	1	31	2	94	3281	288	9	283	74	47	330	121	161	188	288	261	662	58	2	59	47	106	12	
L730Z	L730	585	149.09					10				2	2	41	1	47	4347	381	9			1000	1000	1000	47	953	953		877	77	2		1000	1000	953	
	Totals			4	28	10		26	10	35	42	25	48	2,165	49	2,218	132,705	20,624		12,319	3,037	5,252	17,571	8,289	4,524	18,923	27,381	12,326	26,776	2,349		2,562	5,252	7,814	10,519	378

Max SA	27381	L/s	Total # Fume Hoods	42
Min SA	10519	L/s	Total # BT and CH	71
Max Exhaust	22095	L/s	Total BT and CH flow	
Min. Exhaust	8192	L/s		

Max Sash Height 450mm
Min Sash Height
Supply Air Temp 12.8 DegC
Room Temp 22.2 DegC
Corridor offset 100 cfm per door
Max VAV=Fume Hood L less 300mm times 100 fpm
Min VAV= Max Fume hood * 26%
Min GEA 47 L/s
Unocc Ht Gains= 50% Equip.Gains
Unocc Fume Hoods at 80 fpm
Corridor SA at 10.15 L/s/m2

Minimum SA ACH	6		
Occupied Corridor SA	7.60	L/s/m2	(1.5 cfm/ft2)
Min Occupied Fume Hood Face Velocity	100 fpm or **47.2** L/s/ft2		
Bench Top Exhaust	100	L/s	
Canopy Exhaust	100	L/s	

A/L Wing Supply Air System 28

																	Occupied												Unoccupied							
Zone Name	Labs in Zone	Room Area (sq.Ft.)	Room Volume (9' Clg) (Cu.Meter)	Qty 4' FH's	Qty 5' FH's	Qty 6' FH's	Qty 8' FH's	Qty BT's	Qty CH's	Qty EA's	Fume Hood Valves	Exh. Valve	Gen. Exh. Valve	1ACH L/s	# of Corridor Doors	Corridor Offset L/s	Total Est Heat Gains W	Cooling Calc Supply air Reqd L/s	Max. Supply Air Equiv ACH	Max FE VAV Exhaust L/s	Min FE VAV Exhaust L/s	CAV Exhaust (BT's+CH's+EA's) L/s	Max Room Exhaust VAV + CV L/s	Min Room Exhaust VAV +CV L/s	Min Room Gen Exhaust L/s	Min SA L/s	Max SA L/s	Max General Exhaust L/s	Total Est Heat Gains W	Cooling Calc Supply air Reqd L/s	Max. Supply Air Equiv ACH	Min FE VAV Exhaust L/s	CAV Exhaust (BT's+CH's+EA's) L/s	Min Room Exhaust VAV +CV L/s	Min SA L/s	Max General Exhaust L/s
L499Z	**4th Cor N**	3011	767.36											**213**				**2126**								**2126**	**2126**								**1063**	
L439Z	L439	490	124.88			2		4			2	1	1	**35**	1	**47**	**3641**	**319**	**9**	**708**	**184**	400	1108	584	**47**	**537**	**1061**	**524**	**735**	**64**	**2**	**147**	400	547	**500**	
L441Z	L441	250	63.71										1	**18**	1	**47**	**1858**	**163**	**9**						**153**	**106**	**163**	**210**	**375**	**33**	**2**					**47**
L444Z	L444	495	126.15			1					1		1	**35**	1	**47**	**3679**	**323**	**9**	**354**	**92**		354	92	**165**	**210**	**323**	**278**	**742**	**65**	**2**	**74**		74	**26**	
L446Z	L446	487	124.11			1					1		1	**34**	1	**47**	**3619**	**317**	**9**	**354**	**92**		354	92	**162**	**207**	**317**	**273**	**730**	**64**	**2**	**74**		74	**26**	
L448Z	L448	500	127.43			1		4		2	1	1	1	**35**	1	**47**	**3716**	**326**	**9**	**354**	**92**	494	848	586	**47**	**539**	**801**	**262**	**750**	**66**	**2**	**74**	494	568	**521**	
L450Z	L450	228	58.11			1		4			1	1		**16**	1	**47**	**1694**	**149**	**9**	**354**	**92**	400	754	492	**47**	**445**	**707**	**262**	**342**	**30**	**2**	**74**	400	474	**426**	
L451Z	L451	225	57.34						1				1	**16**	1	**47**	**1672**	**147**	**9**			100	100	100	**47**	**96**	**147**	**94**	**337**	**30**	**2**		100	100	**53**	
L454Z	L454	673	171.52							4		1	1	**48**	1	**47**	**5001**	**439**	**9**			189	189	189	**144**	**286**	**439**	**297**	**1009**	**89**	**2**		189	189	**142**	
L459Z	L459	239	60.91											**17**	1	**47**	**1776**	**156**	**9**						**149**	**102**	**156**	**203**	**358**	**31**	**2**					**47**
L465Z	L465A,L463,L461	1181	300.98						1			2	3	**84**	3	**142**	**8777**	**770**	**9**			100	100	100	**543**	**502**	**770**	**811**	**1771**	**155**	**2**		100	100		
L467AZ	L467A	490	124.88			1					1		1	**35**	1	**47**	**3641**	**319**	**9**	**354**	**92**		354	92	**163**	**208**	**319**	**275**	**735**	**64**	**2**	**74**		74	**26**	
L469Z	L469,L469A	643	163.87			2				2	2	1	2	**46**	1	**47**	**4778**	**419**	**9**	**708**	**184**	94	802	278	**47**	**273**	**755**	**524**	**964**	**85**	**2**	**147**	94	242	**194**	
L475Z	L475,L475A,L472	916	233.44		2					2	2	1	2	**65**	2	**94**	**6807**	**597**	**9**	**566**	**147**	94	661	242	**242**	**389**	**597**	**450**	**1374**	**120**	**2**	**118**	94	212	**118**	
L599Z	**5th Cor N**	3011	767.36											**213**			**22376**	**2126**	**10**							**2126**	**2126**								**1063**	
L537	L537	338	86.14		1						1		1	**24**	1	**47**	**2512**	**220**	**9**	**283**	**74**		283	74	**117**	**144**	**236**	**210**	**507**	**44**	**2**	**59**		59	**12**	
L539	L539	235	59.89										1	**17**	1	**47**	**1746**	**153**	**9**						**147**	**100**	**153**	**200**	**352**	**31**	**2**					**47**
L545	L541,L543,L545,L548,L548A	1903	484.98	1	1	3		3			5	1	5	**135**	4	**189**	**14142**	**1240**	**9**	**1558**	**405**	300	1858	705	**292**	**808**	**1669**	**1153**	**2853**	**250**	**2**	**324**	300	624	**435**	
L551Z	L551	465	118.51					1				1	1	**33**	1	**47**	**3456**	**303**	**9**			100	100	100	**145**	**198**	**303**	**250**	**697**	**61**	**2**		100	100	**53**	
L554	L554	253	64.48										1	**18**	2	**94**	**1880**	**165**	**9**						**202**	**107**	**165**	**259**	**379**	**33**	**2**					**94**
L562Z	L562	210	53.42											**15**	1	**47**	**1558**	**137**	**9**						**136**	**89**	**137**	**184**	**314**	**28**	**2**					**47**
L565	L565	325	82.83										1	**23**	1	**47**	**2415**	**212**	**9**						**185**	**138**	**212**	**259**	**487**	**43**	**2**					**47**
L567Z	L567	161	40.95										1	**11**	1	**47**	**1194**	**105**	**9**						**115**	**68**	**105**	**152**	**241**	**21**	**2**					**47**
L567A	L567A	255	64.99							2		1	1	**18**	1	**47**	**1895**	**166**	**9**			94	94	94	**61**	**108**	**166**	**119**	**382**	**34**	**2**		94	94	**47**	
L567B	L567B	128	32.62		1						1		1	**9**			**951**	**83**	**9**	**283**	**74**		283	74	**47**	**74**	**283**	**210**	**192**	**17**	**2**	**59**		59	**59**	
L570Z	L570	370	94.30		1				2		1	1	1	**26**	1	**47**	**2750**	**241**	**9**	**283**	**74**	200	483	274	**47**	**226**	**436**	**210**	**555**	**49**	**2**	**59**	200	259	**212**	
L572Z	L572	465	118.51		1						1		1	**33**	1	**47**	**3456**	**303**	**9**	**283**	**74**		283	74	**171**	**198**	**303**	**277**	**697**	**61**	**2**	**59**		59	**12**	
L574Z	L574	235	59.89		1						1		1	**17**	1	**47**	**1746**	**153**	**9**	**283**	**74**		283	74	**73**	**100**	**236**	**210**	**352**	**31**	**2**	**59**		59	**12**	
L576Z	L576	235	59.89										1	**17**	1	**47**	**1746**	**153**	**9**						**147**	**100**	**153**	**200**	**352**	**31**	**2**					**47**
L578Z	L578	470	119.78	1			2			3	3	1	1	**33**	2	**94**	**3493**	**306**	**9**	**1062**	**276**	142	1204	418	**47**	**323**	**1109**	**786**	**705**	**62**	**2**	**221**	142	362	**268**	
L580Z	L580	235	59.89		1						1		1	**17**	1	**47**	**1746**	**153**	**9**	**283**	**74**		283	74	**73**	**100**	**236**	**210**	**352**	**31**	**2**	**59**		59	**12**	
L699Z	**6th Cor N**	3011	767.36											**213**				**2126**	**10**							**2126**	**2126**								**1063**	
L639Z	L639	503	128.09			3				1	3	1	1	**36**	1	**47**	**3735**	**328**	**9**	**1062**	**276**	47	1109	323	**47**	**276**	**1062**	**786**	**754**	**66**	**2**	**221**	47	268	**221**	
L641Z	L641	240	61.27					3				1	1	**17**	1	**47**	**1787**	**157**	**9**			300	300	300	**47**	**253**	**253**		**360**	**32**	**2**		300	300	**253**	

Zone Name	Labs in Zone	Room Area (sq.Ft.)	Room Volume (9' Clg) (Cu.Meter)	Qty 4' FH's	Qty 5' FH's	Qty 6' FH's	Qty 8' FH's	Qty BT's	Qty CH's	Qty EA's	Fume Hood Valves	Exh. Valve	Gen. Exh. Valve	*1ACH L/s*	*# of Corridor Doors*	*Corridor Offset L/s*	*Total Est Heat Gains W*	*Cooling Calc Supply air Reqd L/s*	*Max. Supply Air Equiv ACH*	*Max FE VAV Exhaust L/s*	*Min FE VAV Exhaust L/s*	*CAV Exhaust (BT's+CH's+EA's) L/s*	*Max Room Exhaust VAV + CV L/s*	*Min Room Exhaust VAV +CV L/s*	*Min Room Gen Exhaust L/s*	*Min SA L/s*	*Max SA L/s*	*Max General Exhaust L/s*	*Total Est Heat Gains W*	*Cooling Calc Supply air Reqd L/s*	*Max. Supply Air Equiv ACH*	*Min FE VAV Exhaust L/s*	*CAV Exhaust (BT's+CH's+EA's) L/s*	*Min Room Exhaust VAV +CV L/s*	*Min SA L/s*	*Max General Exhaust L/s*
L643Z	L643	489	124.52			1				2	1	1	1	**35**	1	**47**	**3631**	**318**	**9**	**354**	**92**	94	448	186	**68**	**208**	**401**	**262**	**733**	**64**	**2**	**74**	94	168	**121**	
L646Z	L646	487	124.21		1						1		1	**35**	1	**47**	**3622**	**318**	**9**	**283**	**74**		283	74	**181**	**207**	**318**	**291**	**731**	**64**	**2**	**59**		59	**12**	
L649Z	L649,L651	728	185.51		2			4			2	1	2	**52**	2	**94**	**5409**	**474**	**9**	**566**	**147**	400	966	547	**47**	**453**	**872**	**419**	**1091**	**96**	**2**	**118**	400	518	**423**	
L653Z	L653,L655	968	246.65		3			4			3	1	2	**69**	2	**94**	**7192**	**631**	**9**	**850**	**221**	400	1250	621	**47**	**526**	**1155**	**629**	**1451**	**127**	**2**	**177**	400	577	**482**	
L661Z	L661	192	48.93											**14**	1	**47**	**1427**	**125**	**9**						**129**	**82**	**125**	**172**	**288**	**25**	**2**					**47**
L662Z	L662	228	57.98							2		1	1	**16**	1	**47**	**1691**	**148**	**9**			94	94	94	**49**	**97**	**148**	**101**	**341**	**30**	**2**		94	94	**47**	
L666Z	L666	568	144.76	1				4			1	1	1	**40**	1	**47**	**4221**	**370**	**9**	**212**	**55**	400	612	455	**47**	**408**	**565**	**157**	**852**	**75**	**2**	**44**	400	444	**397**	
L668Z	L668	489	124.62	1	1					1	2	1	1	**35**	1	**47**	**3634**	**319**	**9**	**496**	**129**	47	543	176	**79**	**208**	**496**	**367**	**733**	**64**	**2**	**103**	47	150	**103**	
L670Z	L670	240	61.16		1						1		1	**17**	1	**47**	**1784**	**156**	**9**	**283**	**74**		283	74	**76**	**102**	**236**	**210**	**360**	**32**	**2**	**59**		59	**12**	
L672Z	L672	234	59.64		1			2			1	1	1	**17**	1	**47**	**1739**	**153**	**9**	**283**	**74**	200	483	274	**47**	**226**	**436**	**210**	**351**	**31**	**2**	**59**	200	259	**212**	
L674AZ	L674A	111	28.19										1	**8**	1	**47**	**822**	**72**	**9**						**94**	**47**	**72**	**119**	**166**	**15**	**2**					**47**
L674BZ	L674B	119	30.33		1						1		1	**8**			**884**	**78**	**9**	**283**	**74**		283	74	**47**	**74**	**283**	**210**	**178**	**16**	**2**	**59**		59	**59**	
L676Z	L676	239	60.96										1	**17**	1	**47**	**1778**	**156**	**9**						**149**	**102**	**156**	**203**	**359**	**31**	**2**					**47**
L678Z	L678,L680	489	124.62		1			4			1	1	1	**35**	2	**94**	**3634**	**319**	**9**	**283**	**74**	400	683	474	**47**	**379**	**589**	**210**	**733**	**64**	**2**	**59**	400	459	**365**	
L682Z	L682	240	61.16							1		1	1	**17**	1	**47**	**1784**	**156**	**9**			47	47	47	**102**	**102**	**156**	**156**	**360**	**32**	**2**		47	47		
L684Z	L684	362	92.26			1		4			1	1	1	**26**	1	**47**	**2690**	**236**	**9**	**354**	**92**	400	754	492	**47**	**445**	**707**	**262**	**543**	**48**	**2**	**74**	400	474	**426**	
L799	**7th Cor N**	3011	767.36											**213**				**2126**	**10**							**2126**	**2126**								**1063**	
L736Z	L736	219	55.81		1						1		1	**16**	1	**47**	**1628**	**143**	**9**	**283**	**74**		283	74	**67**	**93**	**236**	**210**	**328**	**29**	**2**	**59**		59	**12**	
L742Z	L738,L740, L742,L745, L747,L750	2547	648.98		1	5				10	6	3	5	**180**	6	**283**	**18924**	**1660**	**9**	**2053**	**534**	472	2525	1006	**359**	**1082**	**2242**	**1519**	**3818**	**335**	**2**	**427**	472	899	**616**	
L760Z	L760	493	125.64		1	1		6			2	1	1	**35**	1	**47**	**3664**	**321**	**9**	**637**	**166**	600	1237	766	**47**	**718**	**1190**	**472**	**739**	**65**	**2**	**133**	600	733	**685**	
L761Z	L761	736	187.62			2		8			2	1	1	**52**	1	**47**	**5471**	**480**	**9**	**708**	**184**	800	1508	984	**47**	**937**	**1461**	**524**	**1104**	**97**	**2**	**147**	800	947	**900**	
L765Z	L765	240	61.16			1					1		1	**17**	1	**47**	**1784**	**156**	**9**	**354**	**92**		354	92	**57**	**102**	**307**	**262**	**360**	**32**	**2**	**74**		74	**26**	
L766Z	L766	478	121.87		1			1			1	1	1	**34**	1	**47**	**3554**	**312**	**9**	**283**	**74**	100	383	174	**77**	**203**	**336**	**210**	**717**	**63**	**2**	**59**	100	159	**112**	
L768Z	L768	482	122.94			2	1	2		1	3	1	1	**34**	1	**47**	**3585**	**314**	**9**	**1133**	**295**	247	1380	542	**47**	**495**	**1333**	**838**	**723**	**63**	**2**	**236**	247	483	**436**	
L771	L771	180	45.95											**13**	1	**47**	**1340**	**118**	**9**						**124**	**77**	**118**	**165**	**270**	**24**	**2**					**47**
L774AZ	L774A	261	66.39		1						1		1	**18**	1	**47**	**1936**	**170**	**9**	**283**	**74**		283	74	**84**	**111**	**236**	**210**	**391**	**34**	**2**	**59**		59	**12**	
L774Z	L774	481	122.53			2		9			2	1	1	**34**	1	**47**	**3573**	**313**	**9**	**708**	**184**	900	1608	1084	**47**	**1037**	**1561**	**524**	**721**	**63**	**2**	**147**	900	1047	**1000**	
	Totals	**25,346**	**6,460**	**4**	**25**	**30**	**3**	**67**	**4**	**33**	**62**	**33**	**66**	**1,794**	**55**	**2,596**	**143,608**	**16,849**	**425**	**16,072**	**4,179**	**6,786**	**22,857**	**10,964**	**4,311**	**16,180**	**27,203**	**14,583**	**28,976**	**2,542**		**3,343**	**6,786**	**10,128**	**10,178**	**519**

Max SA	**27203**	**L/s**	Total # Fume Hoods	62
Min SA	**10178**	**L/s**	Total # BT and CH	104
Max Exhaust	**27169**	**L/s**	Total BT and CH flow	
Min. Exhaust	**10648**	**L/s**		

APPENDIX V

Administration Wing System Totals

ADMINISTRATION LAB WING
SYSTEM TOTALS

		Flow (l/s)	Estimated Static Pressure	Estimated Fan Horse Power (HP)	Estimated Fan KW
Supply Air System #27	Maximum	27,381	7.0"	100	75
	Minimum	10,519			
Supply Air System #28	Maximum	27,203	7.0"	100	75
	Minimum	10,178			
Maximum Supply Air Total		**54,584**			

	Total Number of Fume Hoods	Total BenchTop & Canopy Hoods	Total Benchtop & Canopy Hood Flow (l/s)
Supply Air System #27	42	36	3600
Supply Air System #28	62	71	7100

Exhaust Air System #27	Maximum	22,095	5.0"	120	99
	Minimum	8,192			
Exhaust Air System #28	Maximum	27,169	5.0"	120	99
	Minimum	10,648			
Maximum Exhaust Air Total		**49,264**			

Maximum Exhaust Air = Maximum Room Exhaust + Minimum Room General Exhaust
Minimum Exhaust Air = Minimum Room Exhaust + Maximum General Exhaust

APPENDIX VI

Administration Wing Operating Hours

ADMINISTRATION LAB WING
OPERATING HOURS

Total	Annual	%
Occupied	2,880	32.9
Unoccupied	5,880	67.1

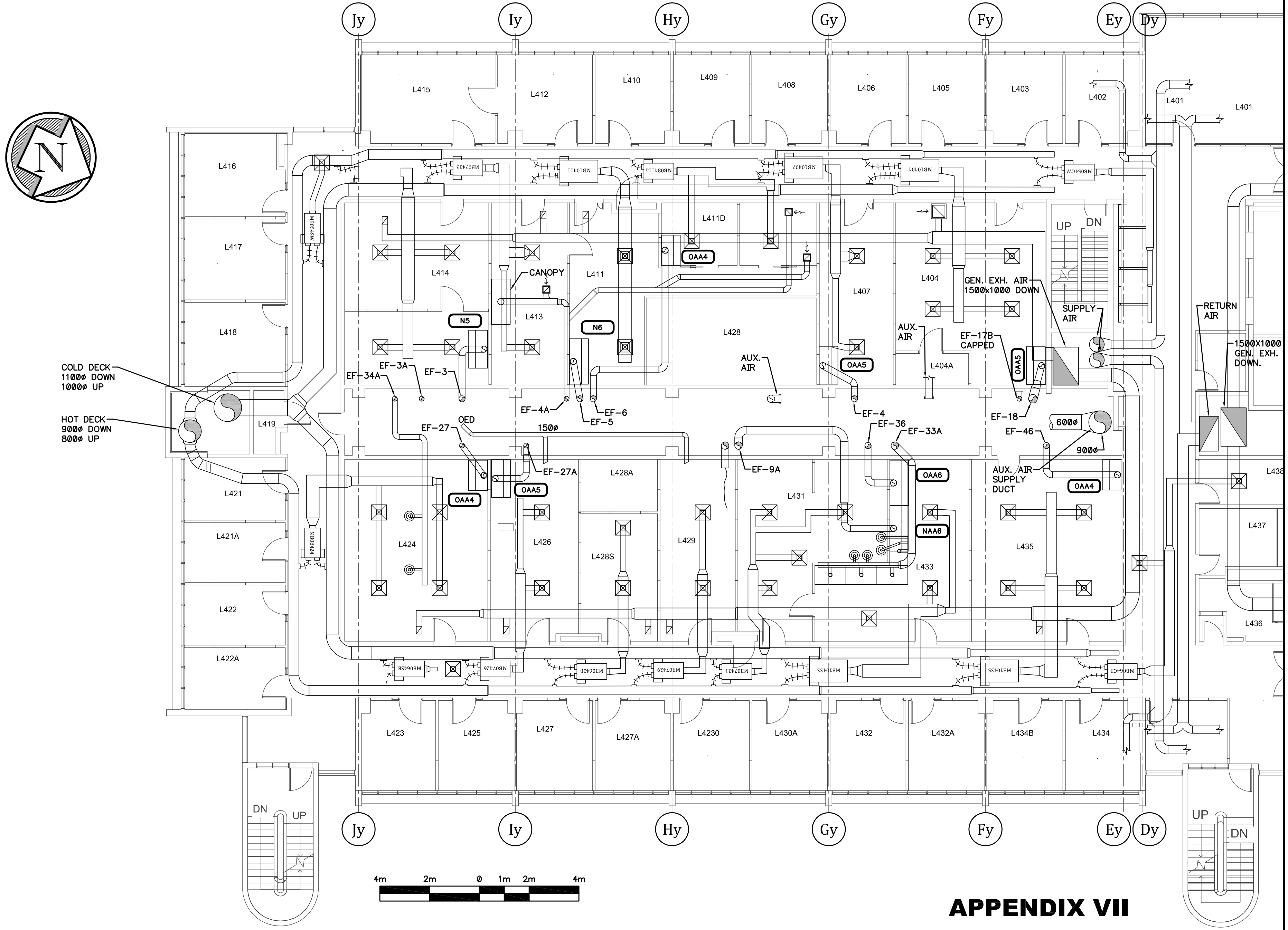
Stat Days	11
Stat Hours	**264**

# Weekends	52
Hours/Weekend	48
Annual Weekend Hours	**2,496**

Unoccupied (18:00-6:00) Weekday Hours	12
Annual Unoccupied Weekday Hours	3,120

APPENDIX VII

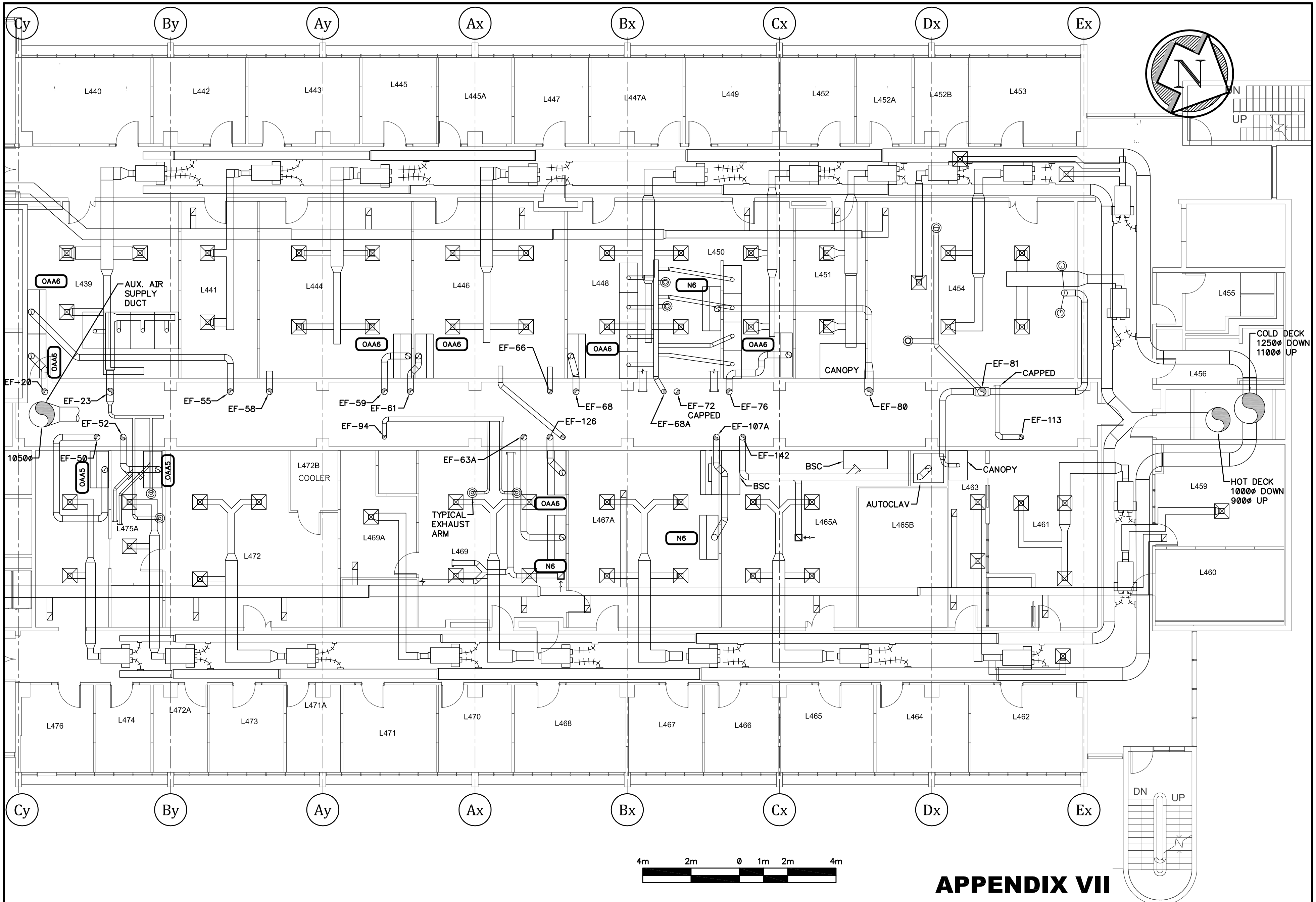
Existing Ductwork Systems



APPENDIX VII

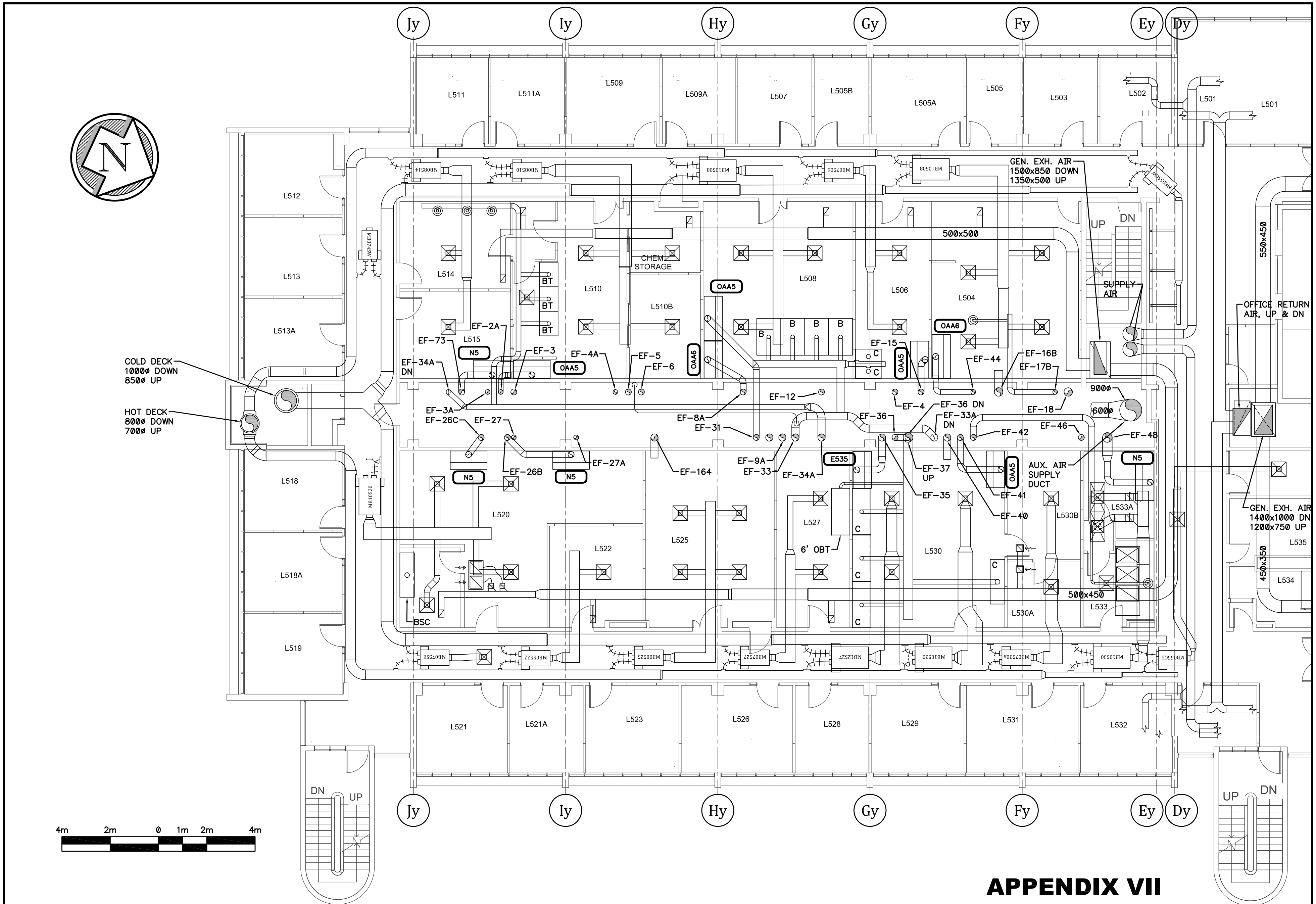
Filer Engineering Ltd.	CLIENT:	C.C.I.W.
1046 Botanical Drive, Burlington, Ontario, L7T 1V1, Fax: (905) 526-8899	PROJECT:	LABORATORY EXHAUST SYSTEM
	TITLE:	FOURTH FLOOR (SOUTH) PLAN

SCALE:	DRAWN:	PROJ. #
N.T.S.	ARC	F0881
DATE:	CHECKED:	SHEET
MAY 2013	DSF	ESK-4S



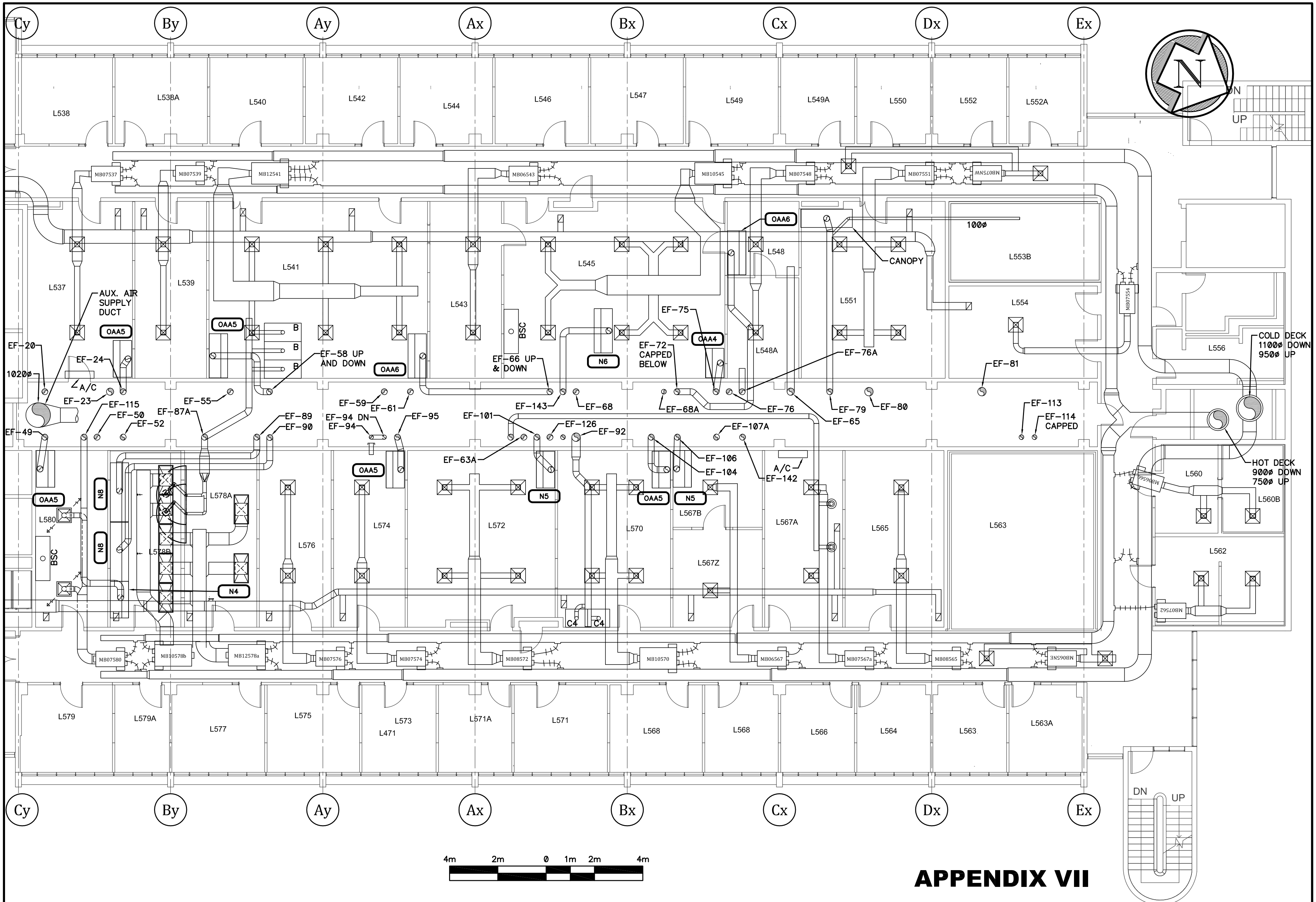
APPENDIX VII

Filer Engineering Ltd. 1046 Botanical Drive Burlington, Ontario L7T 1V1 Fax: (905) 526-8899	CLIENT: **C.C.I.W.**	SCALE: N.T.S. / DRAWN: ARC / PROJ. #: F0881
	PROJECT: **LABORATORY EXHAUST SYSTEM**	DATE: MAY 2013 / CHECKED: DSF / SHEET: **ESK-4N**
	TITLE: **FOURTH FLOOR (NORTH) PLAN**	



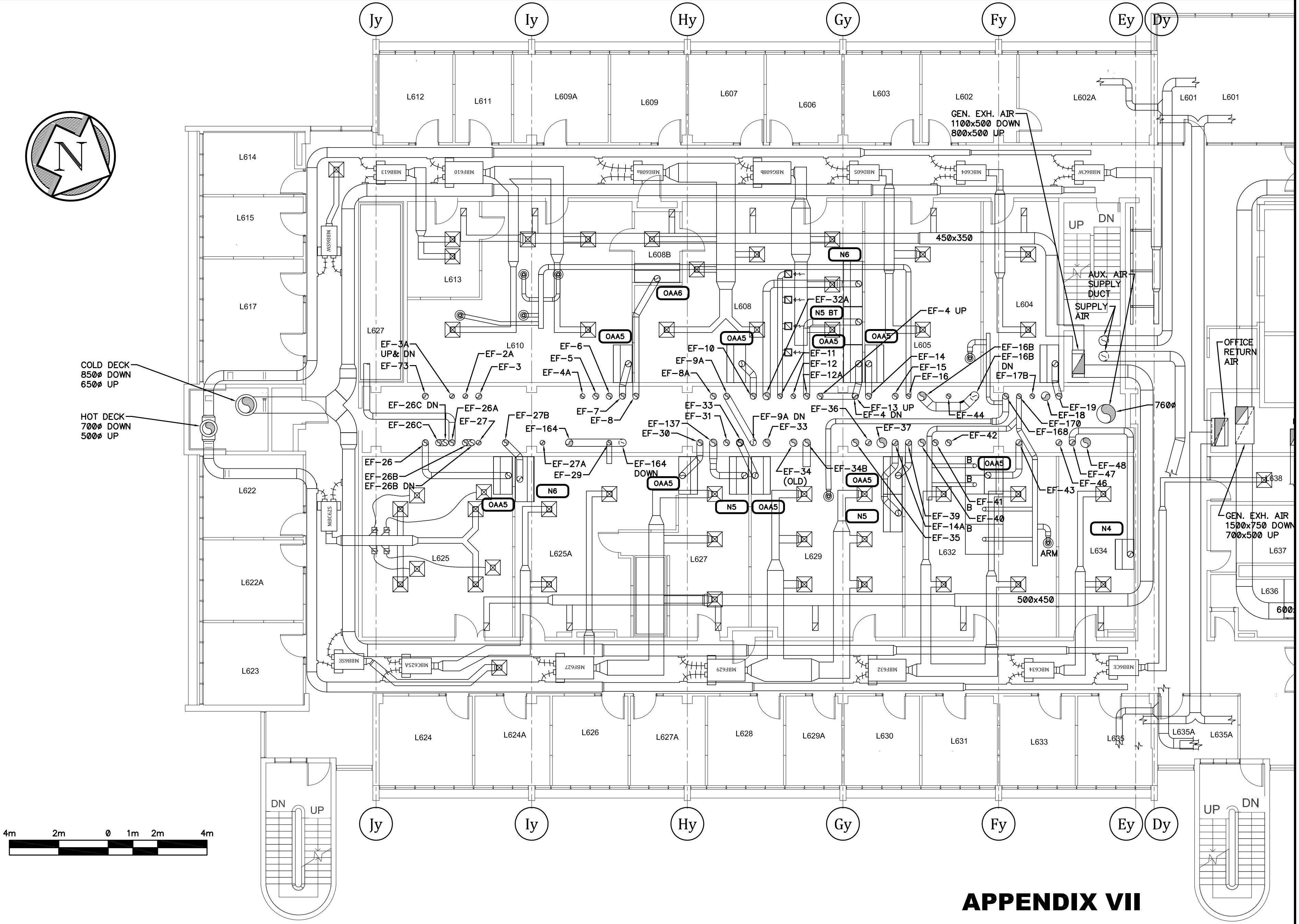
APPENDIX VII

Filer Engineering Ltd. 1046 Botanical Drive Burlington, Ontario L7T 1V1 Fax: (905) 526-8899	CLIENT: **C.C.I.W.**	SCALE: N.T.S.	DRAWN: ARC	PROJ. # F0881
	PROJECT: **LABORATORY EXHAUST SYSTEM**			
	TITLE: **FIFTH FLOOR (SOUTH) PLAN**	DATE: MAY 2013	CHECKED: DSF	SHEET **ESK-5S**



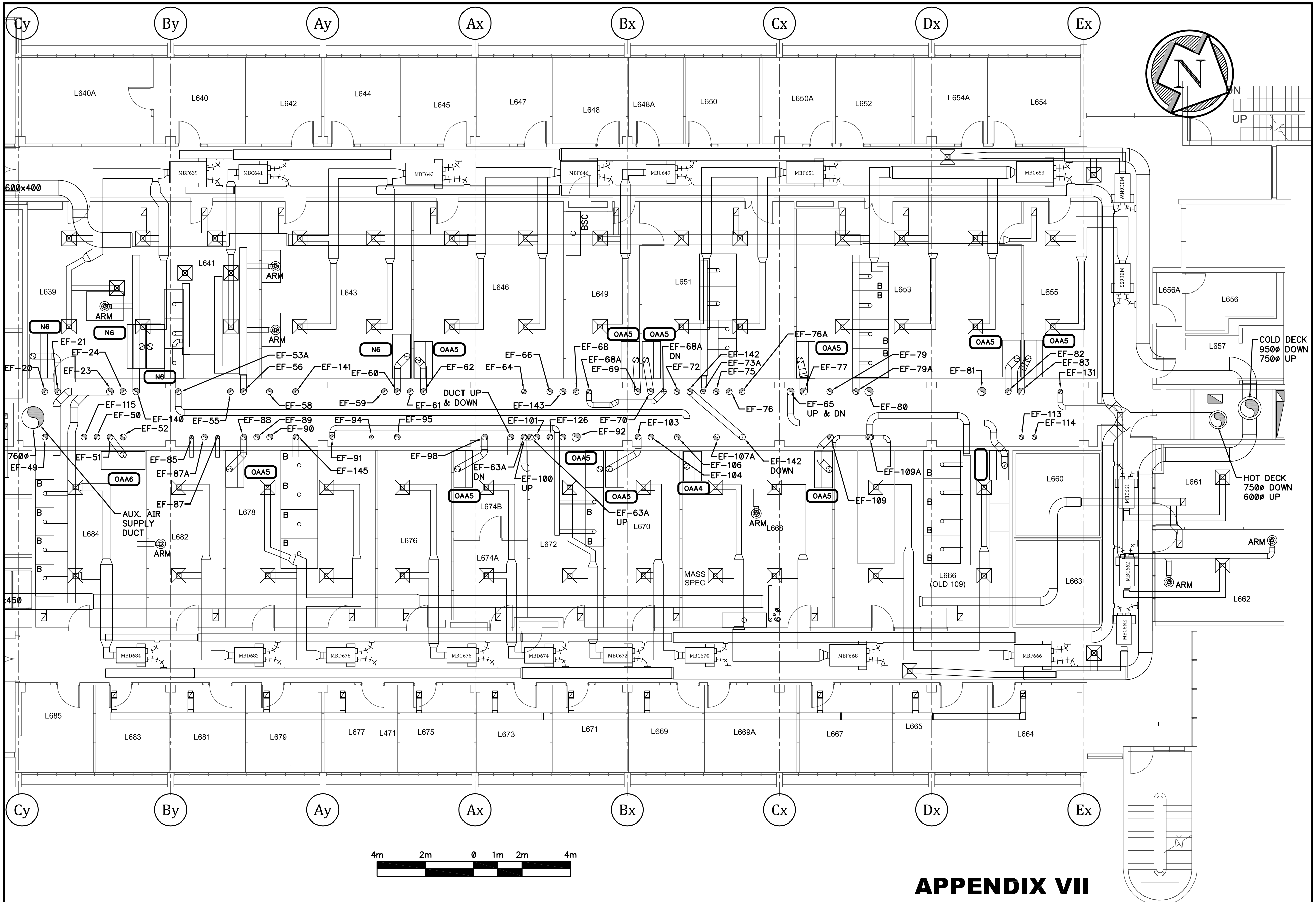
APPENDIX VII

Filer Engineering Ltd. 1046 Botanical Drive Burlington, Ontario L7T 1V1 Fax: (905) 526-8899	CLIENT: **C.C.I.W.**	SCALE: N.T.S. / DRAWN: ARC / PROJ. #: F0881
	PROJECT: **LABORATORY EXHAUST SYSTEM**	DATE: MAY 2013 / CHECKED: DSF / SHEET: **ESK-5N**
	TITLE: **FIFTH FLOOR (NORTH) PLAN**	



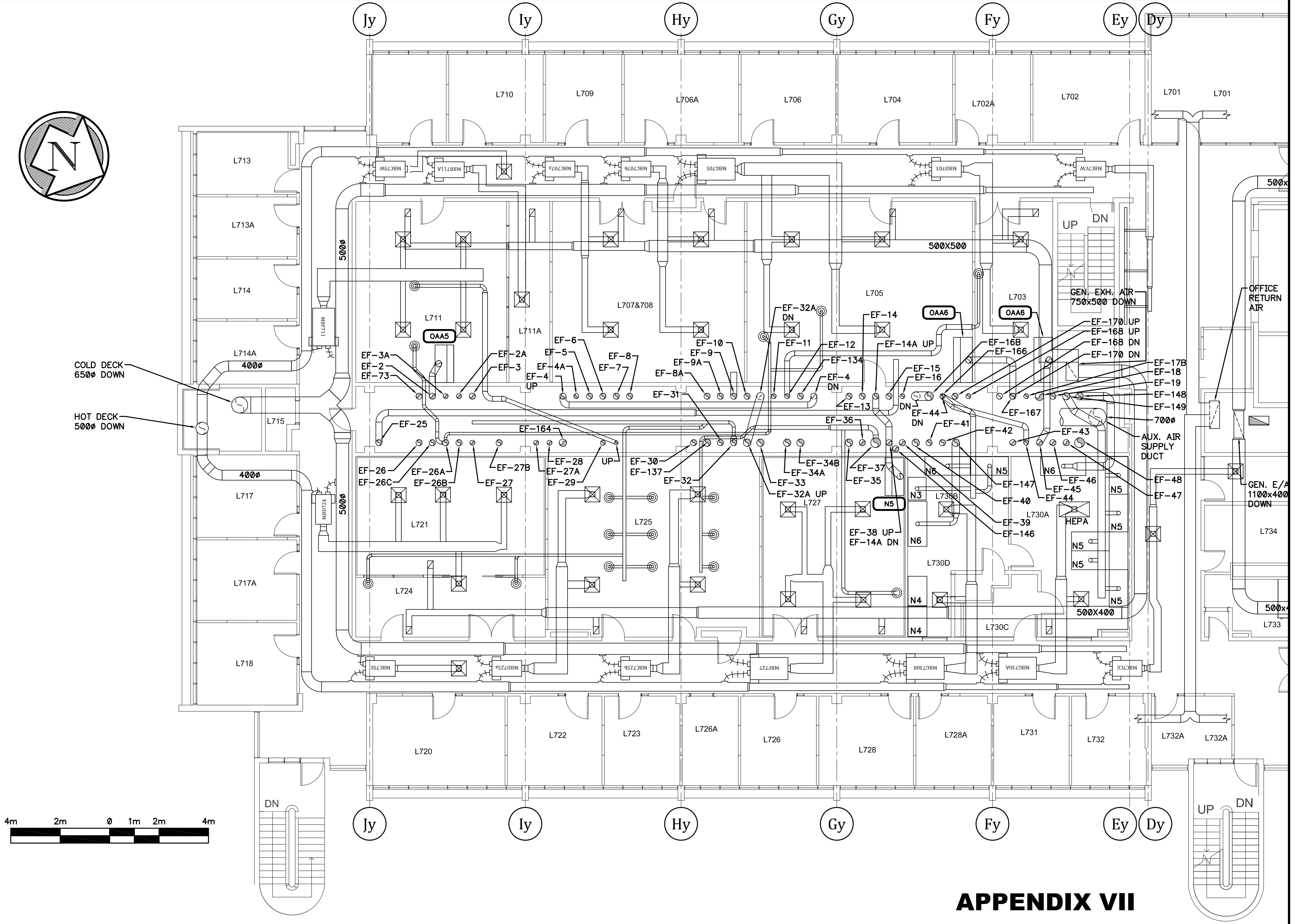
APPENDIX VII

Filer Engineering Ltd.	CLIENT: **C.C.I.W.**	SCALE: N.T.S.	DRAWN: ARC	PROJ. # F0881
1046 Botanical Drive Burlington, Ontario L7T 1V1 Fax: (905) 526-8899	PROJECT: **LABORATORY EXHAUST SYSTEM**	DATE: MAY 2013	CHECKED: DSF	SHEET **ESK-6S**
	TITLE: **SIXTH FLOOR (SOUTH) PLAN**			



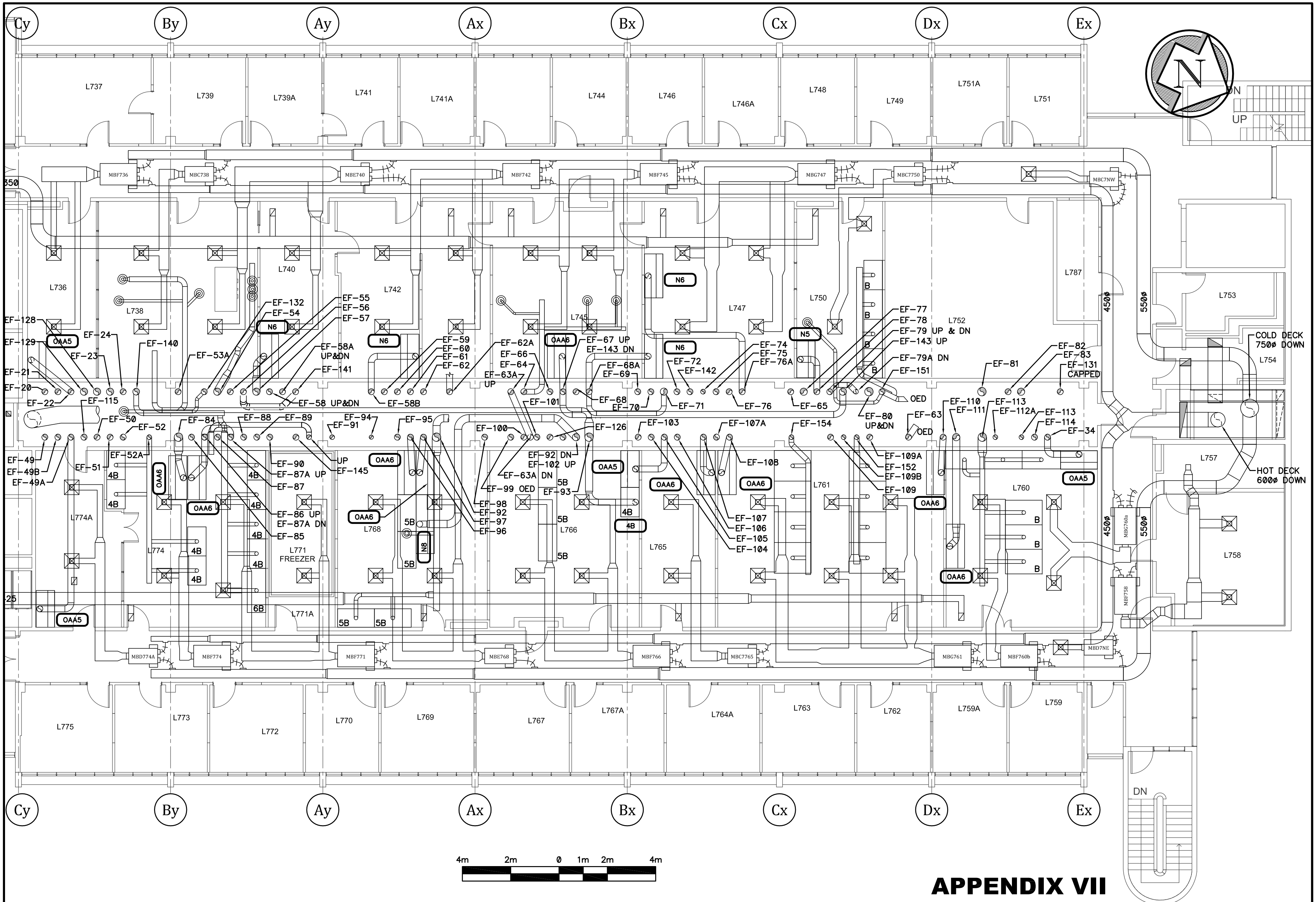
APPENDIX VII

Filer Engineering Ltd. 1046 Botanical Drive Burlington, Ontario L7T 1V1 Fax: (905) 526-8899	CLIENT: **C.C.I.W.**	SCALE: N.T.S.	DRAWN: ARC	PROJ. # F0881
	PROJECT: **LABORATORY EXHAUST SYSTEM**	DATE: MAY 2013	CHECKED: DSF	SHEET **ESK-6N**
	TITLE: **SIXTH FLOOR (NORTH) PLAN**			



APPENDIX VII

Filer Engineering Ltd. 1046 Botanical Drive Burlington, Ontario L7T 1V1 Fax: (905) 526-8899	CLIENT: **C.C.I.W.**	SCALE: N.T.S.	DRAWN: ARC	PROJ. # F0881
	PROJECT: **LABORATORY EXHAUST SYSTEM**	DATE: MAY 2013	CHECKED: DSF	SHEET **ESK-7S**
	TITLE: **SEVENTH FLOOR (SOUTH) PLAN**			



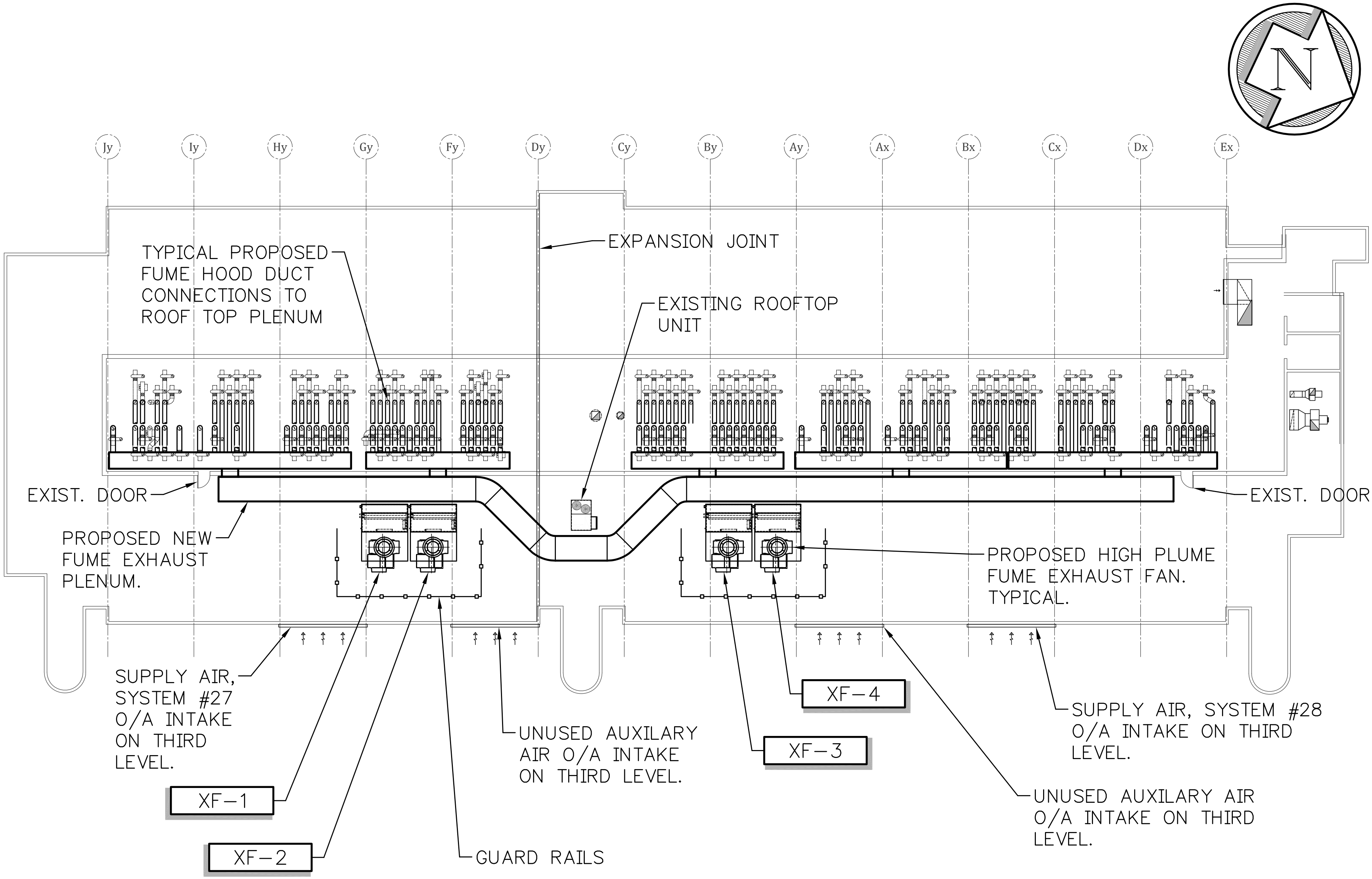
APPENDIX VII

Filer Engineering Ltd.
1046 Botanical Drive
Burlington, Ontario
L7T 1V1
Fax: (905) 526-8899

CLIENT:	C.C.I.W.	SCALE: N.T.S.	DRAWN: ARC	PROJ. # F0881
PROJECT:	LABORATORY EXHAUST SYSTEM	DATE: MAY 2013	CHECKED: DSF	SHEET ESK-7N
TITLE:	SEVENTH FLOOR (NORTH) PLAN			

APPENDIX VIII

Proposed Exhaust System Roof Plan

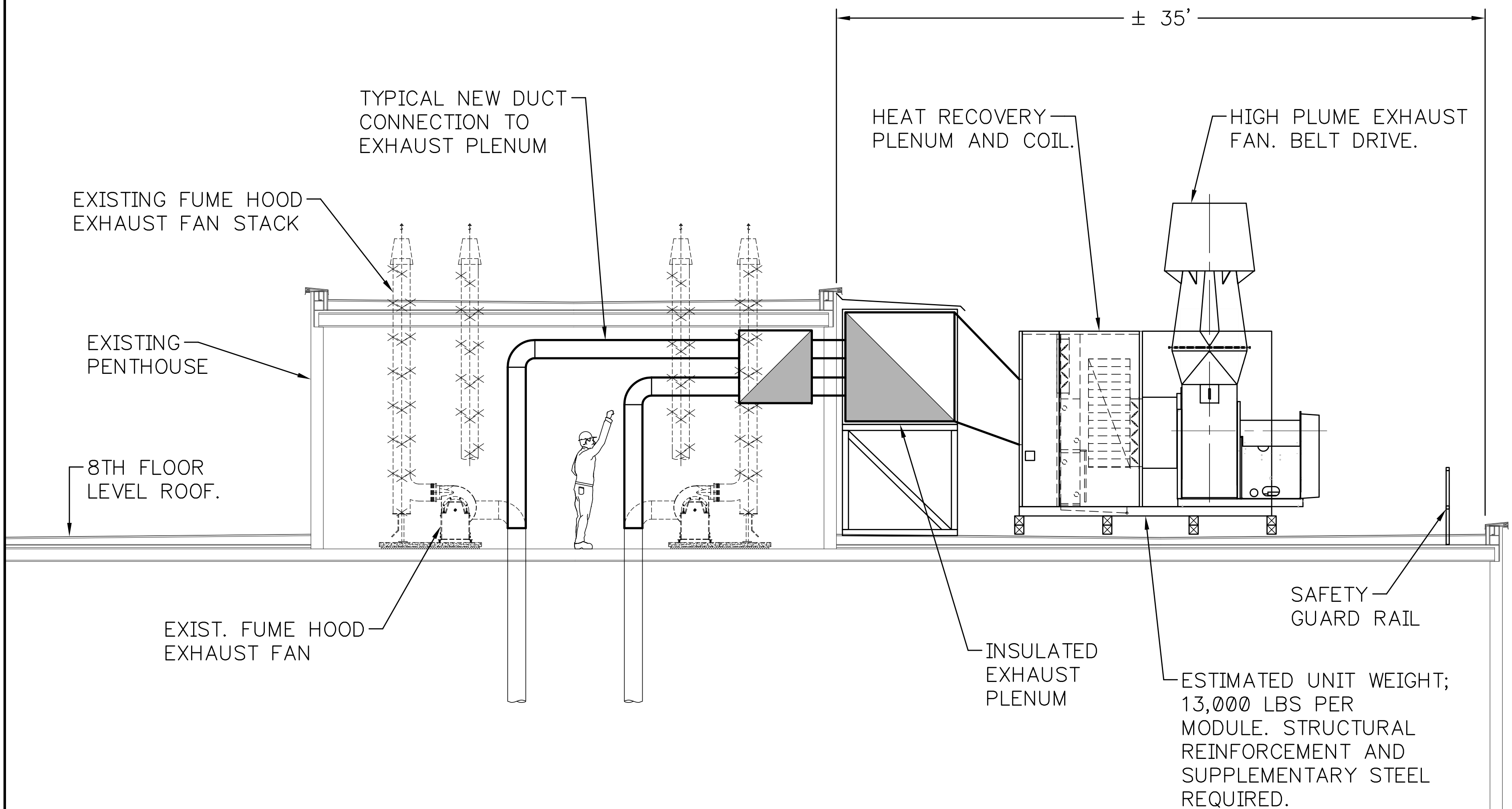


APPENDIX VIII

Filer Engineering Ltd. 1046 Botanical Drive, Burlington, Ontario L7T 1V1, Fax: (905) 526-8899	CLIENT: **C.C.I.W.**	SCALE: N.T.S.	DRAWN: ARC	PROJ. # F0881
	PROJECT: **LABORATORY EXHAUST FAN**	DATE: JUNE 2013	CHECKED: DSF	SHEET **ESK-A.VIII**
	TITLE: **PROPOSED EXH. SYSTEM ROOF PLAN**			

APPENDIX IX

Proposed Roof Section



APPENDIX IX

Filer Engineering Ltd.
1046 Botanical Drive
Burlington, Ontario
L7T 1V1
Fax: (905) 526-8899

CLIENT:	C.C.I.W.	SCALE: N.T.S.	DRAWN: ARC	PROJ. # F0881
PROJECT:	LABORATORY EXHAUST FAN	DATE: JUNE 2013	CHECKED: DSF	SHEET ESK-A.IX
TITLE:	ROOF SECTION			

Revised C.C.I.W. Administration Laboratory Central Exhaust System Study

APPENDIX X

Cost Estimate

Filer Engineering Ltd.

1046 Botanical Drive
Burlington, Ontario L7T 1V1

Tele: (905) 526-7411
Fax: (905) 526-8899

Canada Centre for Inland Waters
Fume Exhaust Schematic Design

Date: June 2013
Project No.: F0881

Item	Division / Description	Unit	Rate	Total
1.0	**Division 1 - General Requirements**			
1.1	Allowances			
1.2	Cutting and Patching			$25,000
1.3	Temporary Utilities			$15,000
1.4	Cleaning			$20,000
	Sub-total - Division 1			**$60,000**
2.0	**Division 2- Sitework**			
2.1	Crane Rental			$25,000
	Sub-Total - Division 2			**$25,000**
3.0	**Division 3 - Concrete**			
3.1	Cast in place concrete - Roof Curbs & Supports			$30,000
	Sub-Total - Division 3			**$30,000**
4.0	**Division 4 - Masonry**			
4.1	Concrete Masonry Units			$10,000
	Sub-Total - Division 4			**$10,000**
5.0	**Division 5 - Metals**			
5.1	Structural Steel			$65,000
5.2	Seismic Design , Equipment and Ductwork Supports			$85,000
	Sub-Total - Division 5			**$150,000**
7.0	**Division 7 - Thermal and Moisture Protection**			
7.1	Board Insulation - Roof Plenums C/W Mastic			$25,000
7.2	Modified Bituminous Roofing - Roofing Repairs (Main Roof)			$80,000
7.3	Fireproofing - Structural Steel			$10,000
7.4	Penthouse Roof Sleeve Repairs			$25,000
	Sub-Total - Division 7			**$140,000**
8.0	**Division 8 - Doors and Windows**			
8.1	Steel Doors and Frames			$10,000
	Sub-Total - Division 8			**$10,000**

Filer Engineering Ltd.

1046 Botanical Drive
Burlington, Ontario L7T 1V1

Tele: (905) 526-7411
Fax: (905) 526-8899

Item	Division Description	Unit	Rate	Total
9.0	**Division 9 - Finishes**			
9.1	Gypsum Board			$20,000
9.2	Acoustical Ceilings			$20,000
9.3	Painting			$10,000
	Sub-Total - Division 9			**$50,000**
15.0	**Division 15 - Mechanical**			
15.1	Plumbing- offsets of existing services			$15,000
15.2	Piping Insulation- Glycol lines			$45,000
15.3	Piping- Glycol, Valving and Pumps			$125,000
15.4	Fume Hood Ductwork	$1,200	67	$80,400
15.5	General Exhaust Ductwork			$65,000
15.6	Fume Hood Air Valves	$1,800	104	$187,200
15.7	General Exhaust Air Valves	$1,600	134	$214,400
15.8	Replacement Fume Hoods (replace 67 original Auxiliary Air Hoods)	$6,000	67	$402,000
15.9	New General Exhaust ductwork risers to Penthouse	$15,000	2	$30,000
15.10	Supply Air handler Coil Piping - Heat Recovery	$8,000	2	$16,000
15.11	Constant Volume Exhaust Ductwork	$400	134	$53,600
15.12	Roof Plenums- Exhaust Duct Connections	$5,000	4	$20,000
15.13	Connections to Plenums	$300	150	$45,000
15.14	Plenum supports	$1,000	25	$25,000
15.15	Removal of Existing Fume Exhaust Fans - Transite Material Disposal and Labour	$2,500	134	$335,000
15.16	Roof Exhaust Fans: FRP High Plume - Belt Drive, Heat Recovery Plenum- 50,000 cfm each	$127,000	4	$508,000
15.17	Supply AHU PreHeat Coils	$22,000	2	$44,000
15.18	Glycol Pumps	$12,000	2	$24,000
15.19	BAS / Room and Lab Pressure and Fume Hood Controls (Total 134 Rooms)	$2,000	134	$268,000
15.20	General Exhaust Ductwork - Reinforcement and duct sealing of existing Ducts	$28,000	4	$112,000
15.21	Fume Hood Installation	$7,000	67	$469,000
15.22	Install remaining VAV boxes	$3,000	72	$216,000
15.23				
15.24				
15.25				
	Sub-Total - Division 15			**$3,299,600**

Filer Engineering Ltd.

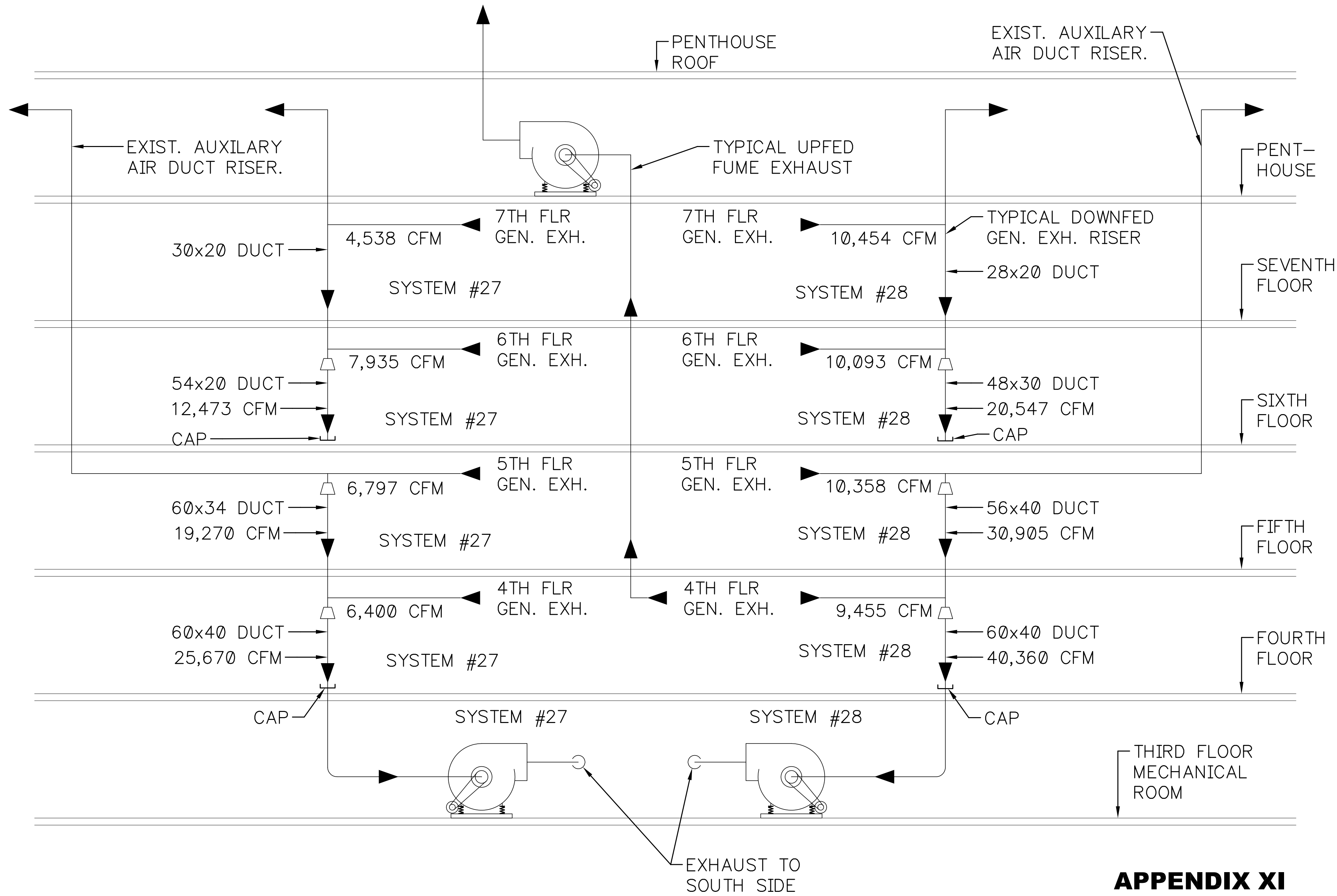
1046 Botanical Drive
Burlington, Ontario L7T 1V1

Tele: (905) 526-7411
Fax: (905) 526-8899

Item	Division Description	Unit	Rate	Total
16.0	**Division 16 - Electrical**			
16.1	Mechanical equipment power systems			$120,000
16.2	Lab Controls Power Allowance (Per Floor) 34 rooms per floor average	$2,000	136	$272,000
16.3	Removal of existing Fans (134 estimated)			$35,000
16.4	Misc. Relocation of Conduits			$25,000
16.5	New Heat Recovery Systems - Pump Power			$25,000
16.6	Fire Alarm			$10,000
16.7	Communications			$5,000
16.8	Misc. Lighting Relocations			$5,000
	Sub-Total Division 16			**$497,000**
	Totals			
	Total of All Divisions			$4,271,600
	5% Overhead and Profit			$213,580
	5% Contingency Fees			$213,580
	Sub Total			$4,698,760
	Fees Allowance			$450,000
	Grand Total			**$5,148,760**
	Excluded: Taxes Allowance			
	Project Budget Cost			**$5,200,000**

APPENDIX XI

General Exhaust Schematic



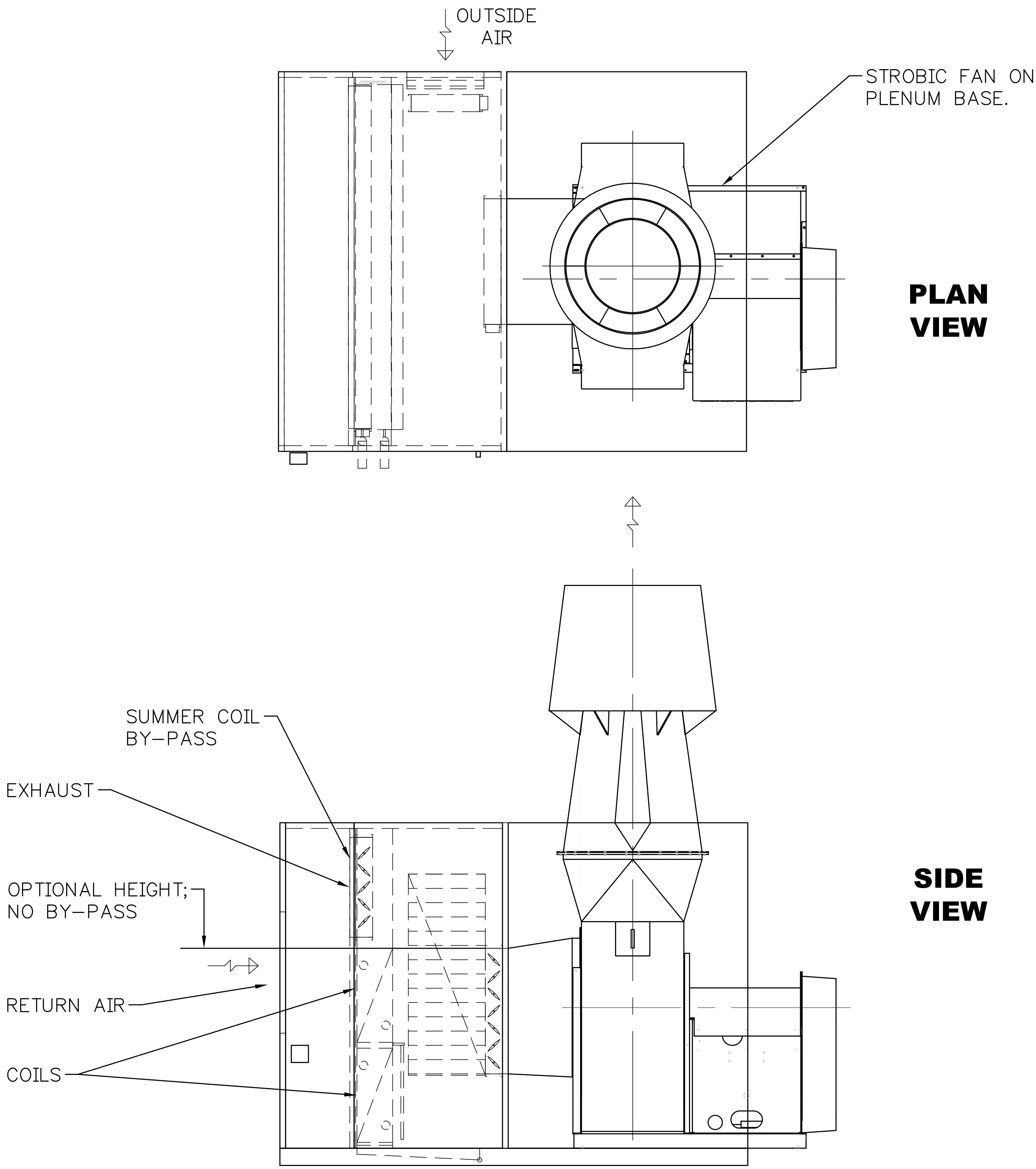
APPENDIX XI

Filer Engineering Ltd.
1046 Botanical Drive
Burlington, Ontario
L7T 1V1
Fax: (905) 526-8899

CLIENT:	C.C.I.W.	SCALE: N.T.S.	DRAWN: ARC	PROJ. # F0881
PROJECT:	LABORATORY EXHAUST FAN			
TITLE:	GENERAL EXHAUST RISER SCHEMATIC	DATE: MAY 2013	CHECKED: DSF	SHEET ESK-A.XI

APPENDIX XII

Fan and Plenum Detail



APPENDIX XII

Filer Engineering Ltd. 1046 Botanical Drive, Burlington, Ontario L7T 1V1, Fax: (905) 526-8899	CLIENT: **C.C.I.W.**	SCALE: 1:50	DRAWN: ARC	PROJECT #: F0881	SHEET
	PROJECT: **LAB EXHAUST FAN**	DATE: APR. 2013	CHECKED: DSF		**ESK-A.XII**
	TITLE: **FAN & PLENUM DETAIL**				

APPENDIX XIII

Energy Savings – Heat Recovery

CCIW Ventilation Energy Consumption

Gross Floor Area 0 Ft2

	HEATING						**COOLING**		
	Area Ft2	U value	TD/HD	BTH	BTU/hr/ft2		U value	TD/HD	BTH
Transmission									
Roof	0	0.076	80	0.00			0.076	40	0.00
Original Wall	0	0.25	80	0.00			0.25	20	0.00
Exterior Clad Walls	0	0.15	80	0.00			0.125	20	0.00
Basement	0	0.1	60	0.00			0.1	20	0.00
D.G Glass	0	0.65	80	0.00			0.65	15	0.00
S.G.Glass	0	0.9	80	0.00			0.9	15	0.00
ST Trans				0.00					0.00
Glass									
N	0						0.9	15	0.00
S	0						0.65	120	0.00
E	0						0.9	70	0.00
W	0						0.9	110	0.00
ST Solar									0.00
Total Transmission				0.00					0.00
Ventilation	114400								
Sensible	114400	1.08	80	9,884,160.00			1.08	15	1,853,280.00
Latent	114400	0.68	30	2,333,760.00			0.68	20	1,555,840.00
Infiltration	0 a/c	0	80	0.00			1253	36.6	45,859.80
Total Ventilation				**12,217,920.00**					3,409,120.00
Motor HP	275		2545	699,875.00			275	2454	674,850.00
Internal Heat Gains									
People	0						1	350	0.00
Lights	0								0.00
Equipment	0.25						3.412	75200	64,145.60
Total Internal Gains									64,145.60
Total Losses/Gains				**12,917,795.00**					**4,148,115.60**
				Losses	BTU/hr				Gains

CCIW Energy Demand Summary Existing Systems

Bin Temperature Analysis

Occupied Factor 0.8 114400 cfm
Unoccupied Factor 0.2 22286 cfm

Htg Losses	Clg Gains	OATemp	Working	Non-working	Occupied	Unoccupied	Energy Consumption	Energy Consumption	Energy Consumption
Btu/hr	Btu/hr	degF	hours/yr	hours/yr	Factor	Factor	Heating BTU	Cooling BTU	GJ/year
0.00	4,148,115.60	90	75.0		0.8			248,886,936	263
									0
				23.0		0.2		19,081,332	20
0.00	3,111,086.70	80	382.8		0.8			952,739,191	1,005
									0
				228.6		0.2		142,238,884	150
0.00	2,074,057.80	70	546.6		0.8			906,943,995	957
				731.4		0.2		303,393,175	320
1,614,724.38	1,037,028.90	60	407.0		0.8		525,754,257	337,656,610	911
				984.6		0.2	317,971,524	204,211,731	551
3,229,448.75	622,217.34	50	359.4		0.8		928,531,105	178,899,930	1,168
				798.8		0.2	515,936,732	99,405,442	649
4,844,173.13	0.00	40	484.6		0.8		1,877,989,037		1,981
				874.2		0.2	846,955,229		894
6,458,897.50	0.00	30	450.6		0.8		2,328,303,371		2,456
				1021.2		0.2	1,319,165,225		1,392
8,073,621.88	0.00	20	249.8		0.8		1,613,432,596		1,702
				502.8		0.2	811,883,416		857
9,688,346.25	0.00	10	141.4		0.8		1,095,945,728		1,156
				344.2		0.2	666,945,756		704
11,303,070.63	0.00	0	31.8		0.8		287,550,117		303
				111.0		0.2	250,928,168		265
12,917,795.00	0.00	-10	2.2		0.8		22,735,319		24
				13.6		0.2	35,136,402		37
Total Hrs/yr			**3131.2**	**5633.4**					0
Domestic Water	Htg usgpm	0	3131.2		0.8		0		0
	usgpm	0		5633.4		0.2	0		0
			TOTAL ESTIMATED EXISTING ENERGY USE				**13,445,163,981**	**3,393,457,225**	**17,765**
							BTU/yr	**BTU/yr**	**GJ/year**
							14,184.65	**3,580.10**	
							GJ/yr	**GJ/yr**	

NWRI Ventilation Energy Consumption VAV Supply Air Flow with 40 DegF Temp Rise(peak)
With Exhaust Heat Recovery 40% (Sensible Only) efficent

	HEATING						**COOLING**		
	Area Ft2	U value	TD/HD	BTH	BTU/hr/ft2		U value	TD/HD	BTH
Transmission									
Roof	0	0.076	80	0.00			0.076	40	0.00
Original Wall	0	0.25	80	0.00			0.25	20	0.00
Exterior Clad Wall	0	0.15	80	0.00			0.125	20	0.00
Basement	0	0.1	60	0.00			0.1	20	0.00
D.G.Glass	0	0.65	80	0.00			0.65	15	0.00
S.G.Glass	0	0.9	80	0.00			0.9	15	0.00
ST Trans				0.00					0.00
Glass									
N	0						0.9	15	0.00
S	0						0.65	120	0.00
E	0						0.9	70	0.00
W	0						0.9	110	0.00
ST Solar									0.00
Total Transmission				0.00					0.00
Ventilation	cfm								
Sensible	114400	1.08	48	5,930,496.00			1.08	10	1,235,520.00
Latent	114400	0.68	30	2,333,760.00			0.68	20	1,555,840.00
Infiltration	0 a/c	0	80	0.00			1253	27.5	34,457.50
Total Ventilation				8,264,256.00					2,825,817.50
Motor HP	0		2545	0.00			50	2454	122,700.00
Internal Heat Gains									
People	0						1	350	0.00
Lights	0								0.00
Equipment	0								0.00
Total Internal Gains									0.00
Total Losses/Gains				**8,264,256.00**					**2,948,517.50**
			Proposed heating/Existing heating				**Proposed cooling/Existing cooling**		
				63.98	%				**71.08** %

NWRI Ventilation Energy Consumption
With Exhaust Heat Recovery (Sensible Only)40% efficient
Bin Temperature Analysis

Htg Losses Btu/hr	Clg Gains Btu/hr	OATemp degF	Working hours/yr	Non-working hours/yr	Occupied Factor	Unoccupied Factor	Energy Consumption Heating BTU	Energy Consumption Cooling BTU	Energy Consumption GJ/year
0.00	2,948,517.50	90	75.0		0.8			176,911,050	187
				23.0		0.2		13,563,181	14
0.00	2,211,388.13	80	382.8		0.8			677,215,499	714
									0
				228.6		0.2		101,104,665	107
0.00	1,474,258.75	70	546.6		0.8			644,663,866	680
				731.4		0.2		215,654,570	228
1,033,032.00	737,129.38	60	407.0		0.8		336,355,219	240,009,325	608
				984.6		0.2	203,424,661	145,155,517	368
2,066,064.00	442,277.63	50	359.4		0.8		594,034,721	127,163,663	761
				798.8		0.2	330,074,385	70,658,273	423
3,099,096.00	0.00	40	484.6		0.8		1,201,457,537	0	1,268
				874.2		0.2	541,845,945	0	572
4,132,128.00	0.00	30	450.6		0.8		1,489,549,501		1,571
				1021.2		0.2	843,945,823		890
5,165,160.00	0.00	20	249.8		0.8		1,032,205,574		1,089
				502.8		0.2	519,408,490		548
6,198,192.00	0.00	10	141.4		0.8		701,139,479		740
				344.2		0.2	426,683,537		450
7,231,224.00	0.00	0	31.8		0.8		183,962,339		194
				111.0		0.2	160,533,173		169
8,264,256.00	0.00	-10	2.2		0.8		14,545,091		15
				13.6		0.2	22,478,776		24
Total Hrs/yr			3131.2	5633.4					0
Domestic Water	Htg usgpm	0	3131.2		0.8		0		0
	usgpm	0		5633.4		0.2	0		0
			TOTAL PROPOSED SYSTEM ENERGY USE				**8,601,644,251**	**2,412,099,608**	**11,619**
			With Exhaust Air Energy Recovery				**BTU/yr**	**BTU/yr**	**GJ/year**
							9,074.73	**2,544.77**	
							GJ/yr	**GJ/yr**	
			Proposed Energy Use/Existing Energy Use				**63.98%**	**71.08%**	**65.41%**
			(With Exhaust Heat Recovery)				**9,074.73**	**2,544.77**	
							GJ/yr	**GJ/yr**	
			Possible Energy Savings from Air-to-Air Heat Recovery						**6,145**
									GJ/yr

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