CONTROLS

General

The control system for the new YLW Kelowna Airport Expansion will be a full direct digital control (DDC) system capable of monitoring all equipment, providing remote dial-out, and capable of energy saving scheduling and setback sequences. All control valves and damper actuators will be low voltage electric units to avoid the requirement for an air compressor. The new DDC will be BACNet compatible to allow communication with the existing Airport Base Building control system. The intent is to provide a coordinated control system operable from a single operator work station.

The control system will be provided with an operator's workstation complete with intuitive operator graphics to allow ease of operation of the systems. The control system will provide full PID control of each system which will be tuned during the commissioning process. The control system will also have trending and energy management capabilities to ensure energy use is monitored.

FIRE PROTECTION AND LIFE SAFETY PROTECTION

Fire Protection

The facility will be fully sprinklered throughout with exposed sprinkler heads in common areas. Fire extinguishers will be located in flush mounted cabinets located at exits and intermediate locations where required.

SUSTAINABILITY CONSIDERATIONS

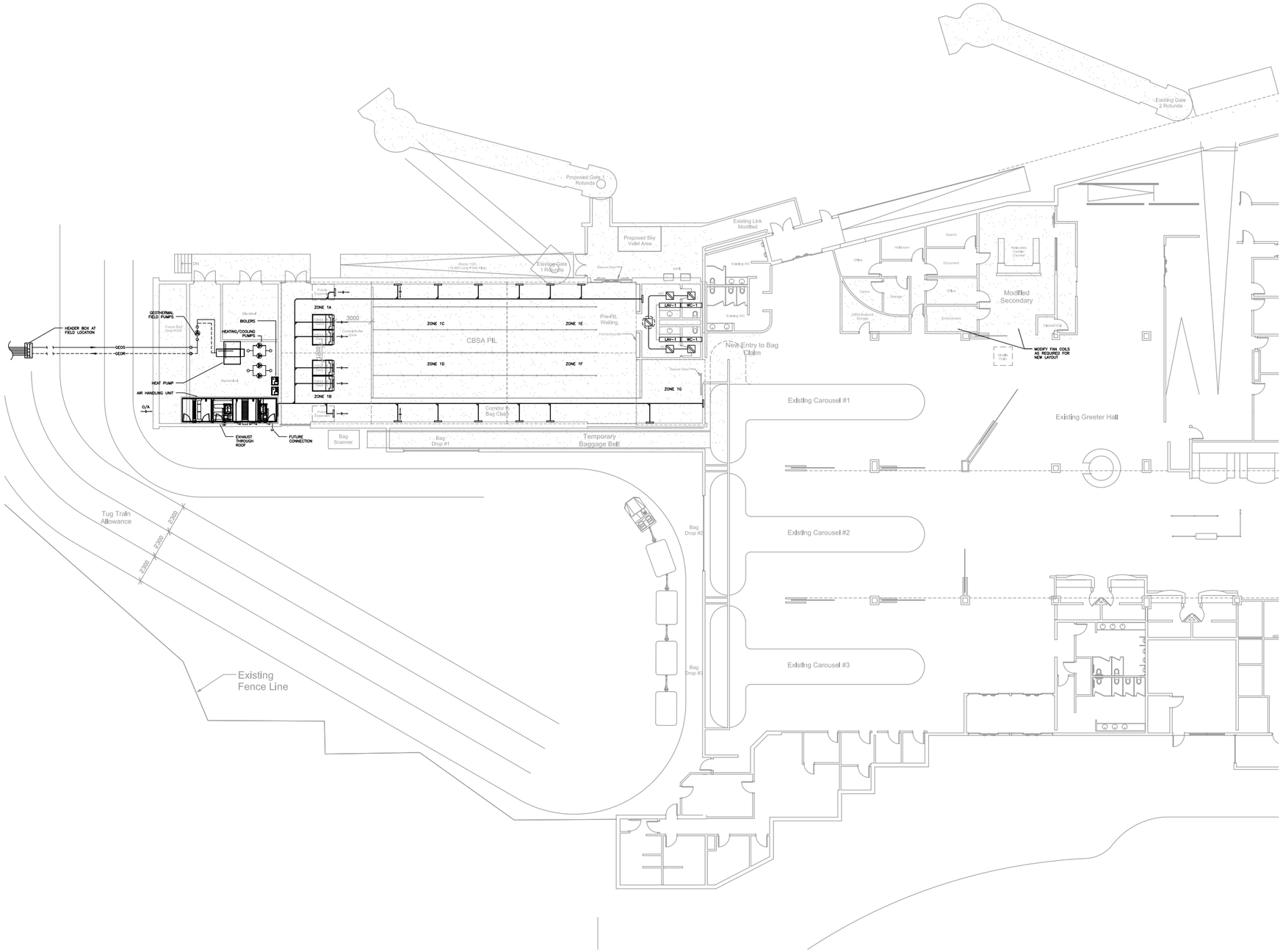
Mechanical Sustainable initiatives for this facility to meet City of Kelowna and YLW goals are as follows:

- Incorporation of total energy heat recovery wheels on the air handling systems.
- Ground Source Geothermal Heat Pumps
- Central water cooled chillers.
- Low flow plumbing fixtures
- High efficiency condensing boilers
- Cooling and Heating slabs located in large open areas.
- Variable speed drives on all variable hydronic loops.
- Occupancy sensors in variable occupancy rooms.
- Reduced air flow volumes in unoccupied times.
- Displacement ventilation to provide better ventilation effectiveness and provide extended free-cooling hours.
- Use of thermal mass and night purge cycles in the large open areas such as baggage claim areas and holding areas.

DRAWINGS

Mechanical Drawings

Preliminary mechanical drawings provide general layout information, mechanical room layouts, and general routing of mechanical services.



1 MAIN FLOOR NORTH VENTILATION PLAN
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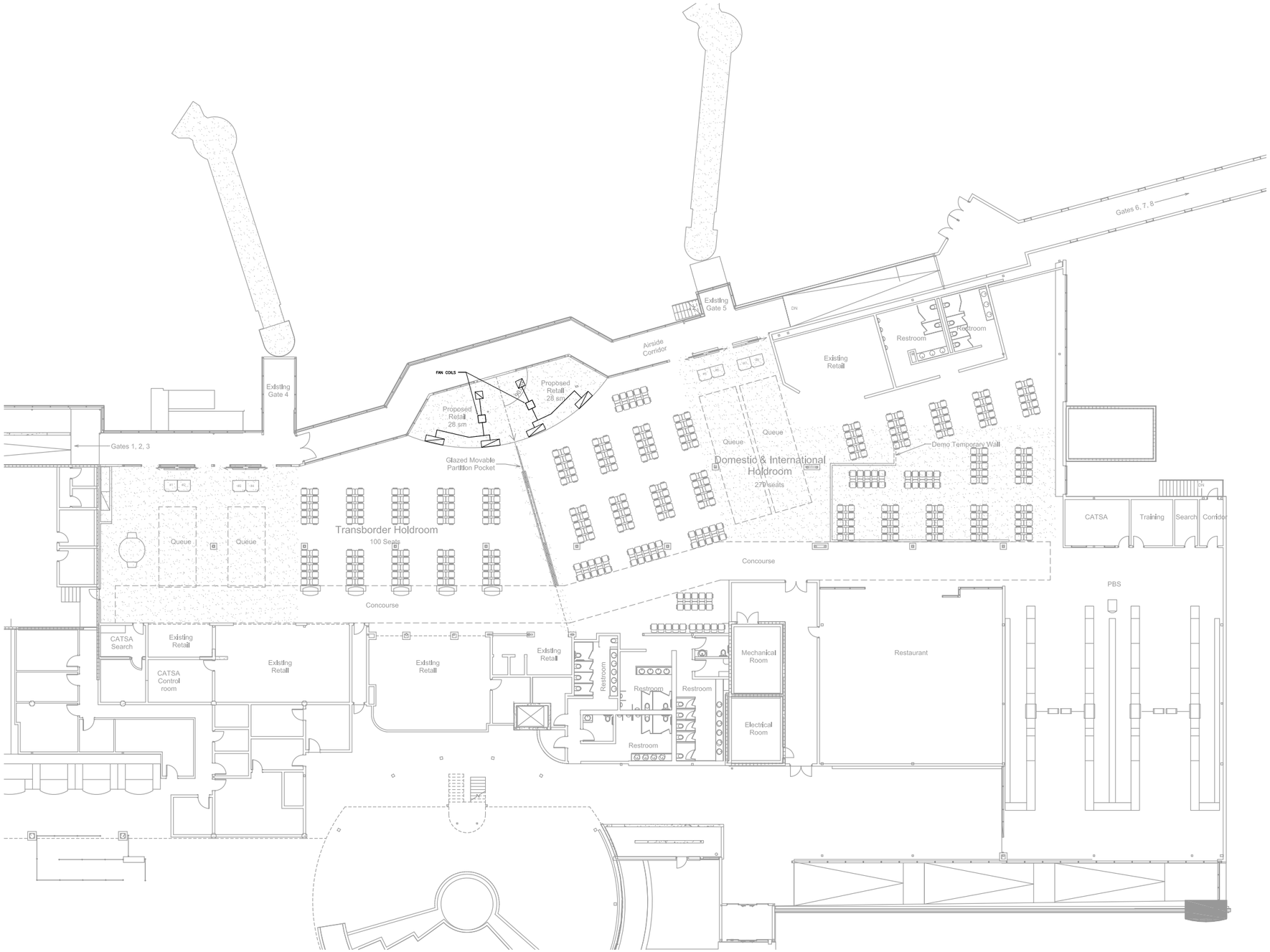
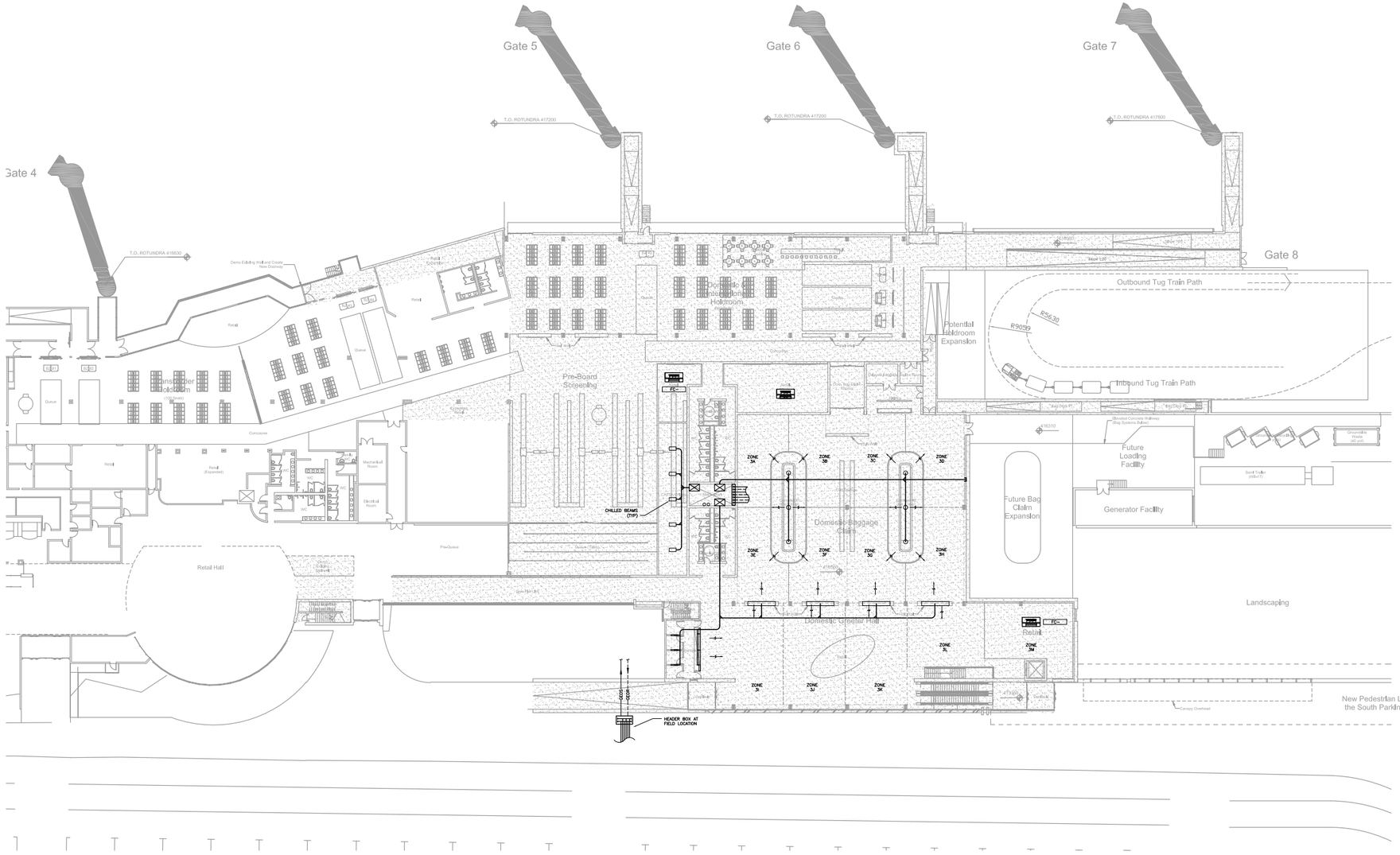


1 MAIN FLOOR SOUTH - VENTILATION PLAN
1 : 100

2 MAIN FLOOR - GENERATOR ROOM
1 : 200

1 MAIN FLOOR VENTILATION PLAN
1 : 200



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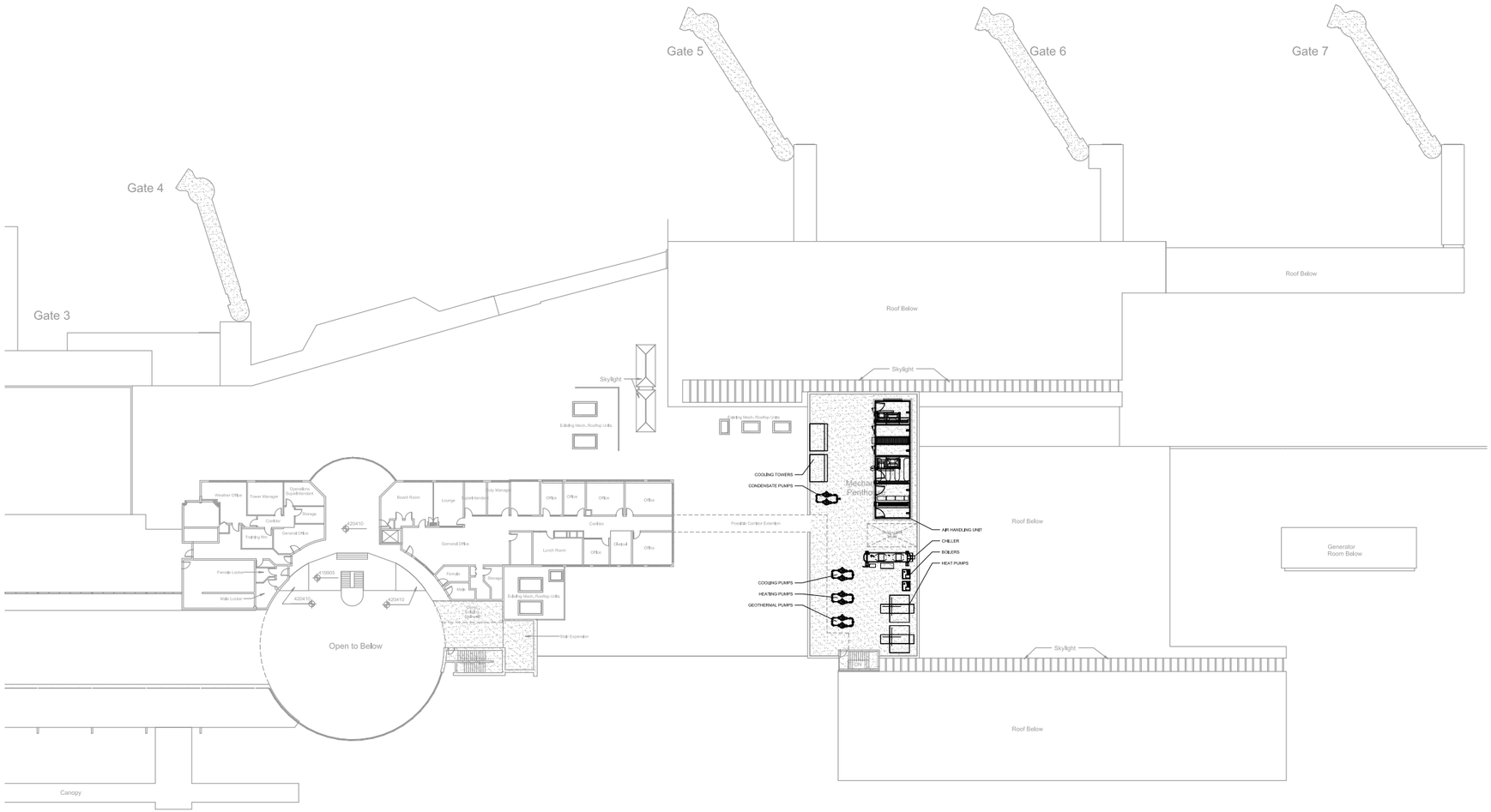

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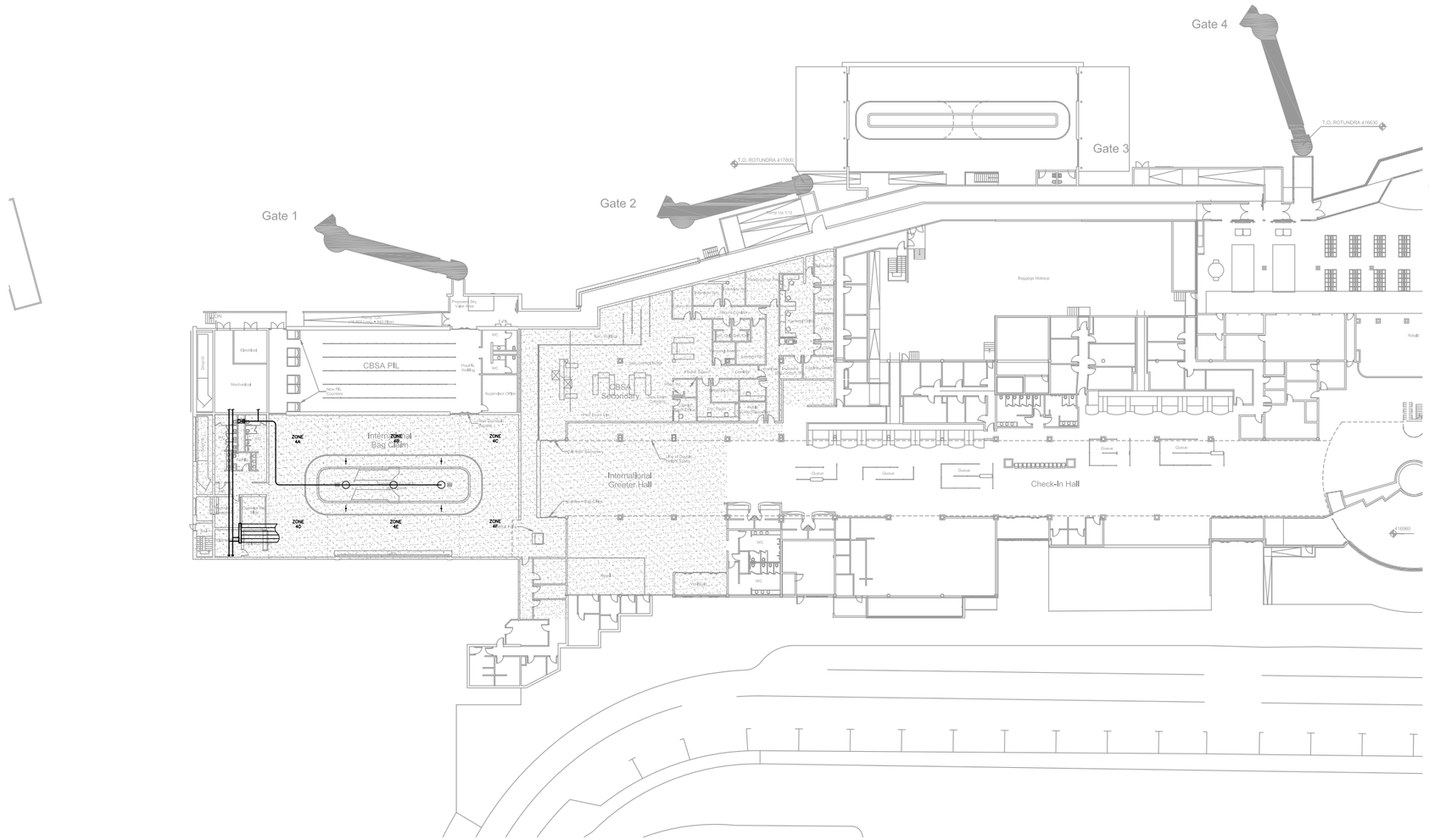

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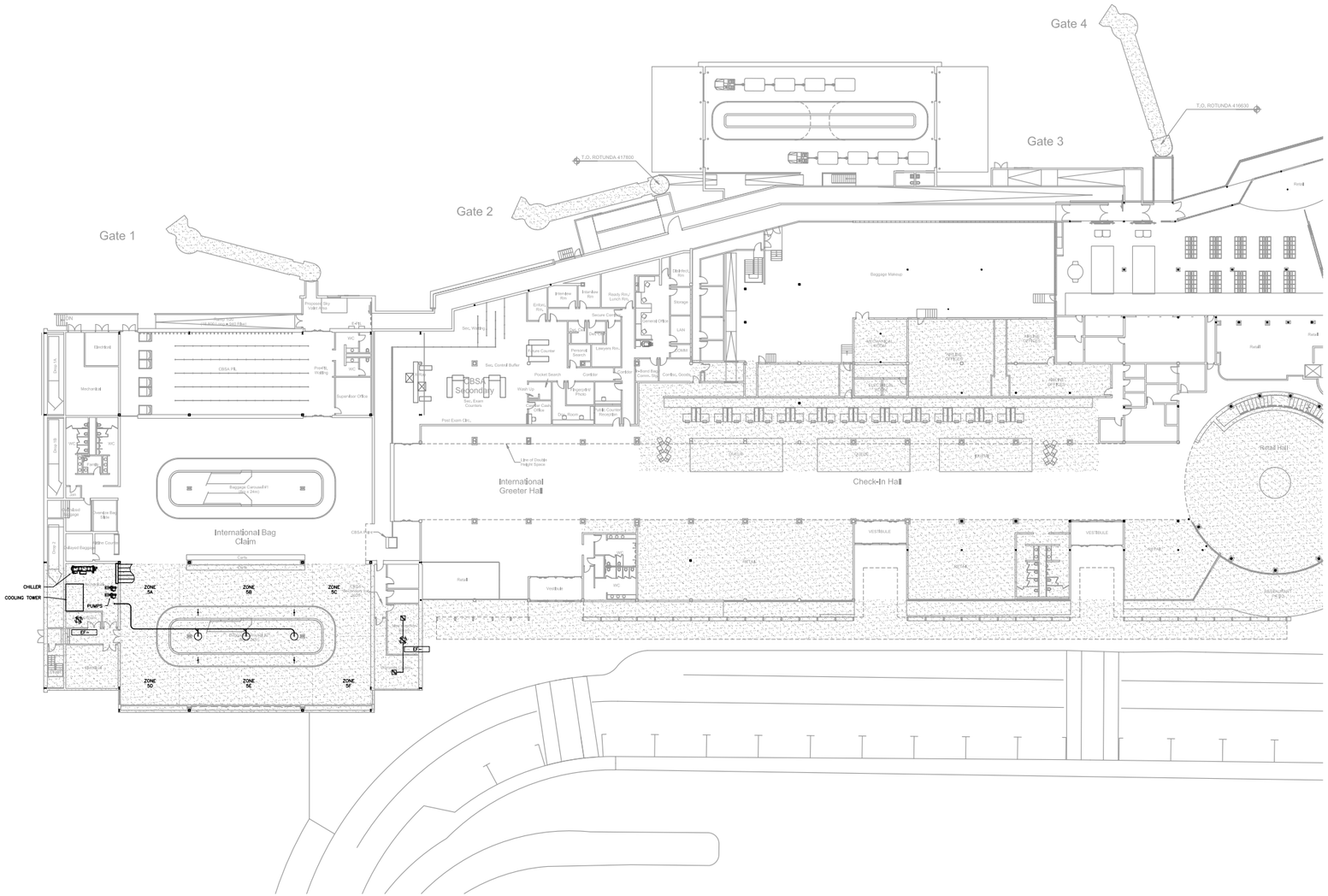

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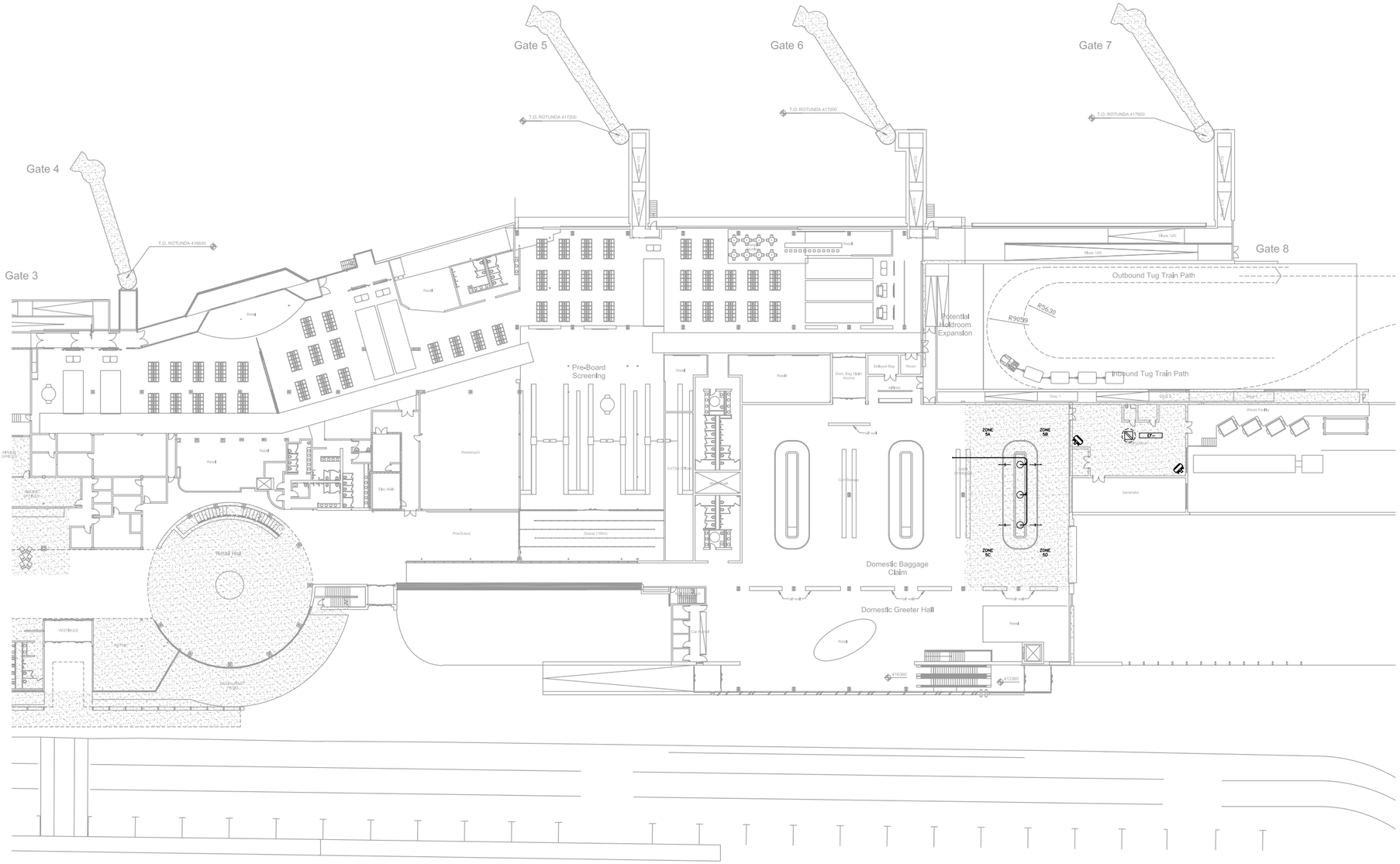


1 MAIN FLOOR SOUTH - VENTILATION PLAN
1 : 200

9.0 ELECTRICAL SYSTEMS

INTRODUCTION

This report outlines the early design strategies for power distribution, lighting, fire alarm, communication and security systems at the Kelowna Airport Terminal Building (ATB). The general design philosophy is to provide higher electricity system reliability, superior lighting, future proofing with an extensible data network, sustainability through “right-sizing” and a high degree of maintainability. Consistency in lighting design, lighting control, fire alarm safety and security will be achieved between new and renovated spaces. After review by the Kelowna Airport and the City of Kelowna, this report is intended to form the basis for the further development of the detailed design.

PERFORMANCE CRITERIA

The design will use current technology while giving due consideration to safety, ease of maintenance, energy efficiency, and cost. The electrical design will utilize affordable sustainability criterion where they can be applied to lower the carbon footprint of the project, enhance maintainability and improve the experiences of both the traveling public and staff. The equipment, light fixtures, and other electrical components specified will be based on readily available, standardized products.

Codes and Regulations

- The design for the Kelowna Airport renovation and expansion will be in accordance with the British Columbia and National Building Codes. In addition, illumination level requirements for the interior will be comply with IESNA and IATA recommended practices.
- Security systems will be designed in accordance with CATSA, CBSA and Airport Authority requirements.
- Fire Alarm systems will be designed in accordance with the Building Code and will be verified to CAN/ULC-S537 (Verification of Fire Alarm Systems) standards.

DESIGN CONDITIONS AND PHASING

Design Goals

The following design goals will be incorporated into electrical systems designs for the ATB:

- Provide emergency power to all ATB operations.
- Reduce energy consumption from lighting substantially. The amount of power savings that can be achieved have been documented in the Dialog Energy Audit report.
- Minimize electrical system disruptions and shutdowns. Airport operations must be maintained during air operations hours.
- Integrate the quality and sustainability of electrical options chosen for new construction into renovated areas. There should be no jarring changes in lighting, control, safety systems or power availability between similar functional areas in the ATB at the conclusion of the project. Lighting systems upgrades in areas not directly affected by construction as outlined in phases 1 - 4 will be under a separate contract.
- Improve the operational safety of the fire alarm system and ensure that the quality of devices, wiring and annunciation is uniformly high throughout the ATB. All older fire alarm systems will be replaced.

Phasing

The ATB expansion and renovation will be accomplished in 5 phases. The first 4 phases form the basis of design through to the year 2016. A fifth phase which would encompass planning through to 2025 is included in order to provide context.

Phasing diagrams, with notes, have been provided as sketches in an addendum with this electrical report. They immediately follow the report text.

From an electrical standpoint, key phasing milestones are as follows:

Phase 1

- All new, lower power lighting in new construction areas with new power, fire alarm and comms to suit the PIL requirements.
- Installation of a 1600 A cable bus from the new north electrical room to the south main electrical room. A temporary connection of the cable bus to the south main switchgear will be required.
- Undertake re-lamping, mock-ups and re-fixturing on north side of ATB to improve lighting efficiency. (Under separate contract)
- Stub out and cap a duct bank suitable for a 1600 A load from the new north electrical room to an area at least 2 meters north of the future ATB northern extents.
- Renovate lighting in domestic and international hold rooms.
- Upgrade fire alarm system with all new 2 stage, addressable system suitable for use on the full 2025 area of the ATB. Replace all old fire alarm wiring with new. Replace all analog devices with addressable devices.

Phase 2

- New 1500 KVA generator and transfer switch installed in dedicated structure.
- New 1500 KVA transformer installed to replace existing transformer
- New duct banks from new transformer to transfer switch and from transfer switch to south main electrical room
- Provide power and service to suit the new Baggage Facility from the north electrical room. Risks in building the Baggage Facility include unforeseen relocation or replacement costs for underground conduit and services that may be running through or adjacent to the new facility's footprint. Provide new Fire Alarm devices as required.
- Provide new fixturing and control strategies for lighting in the main concourse area (under separate contract).

PHASE 3

- Expand the south main electrical room to allow for relocation of telecommunications services, improve equipment access and maintainability, make room for new gear. Make permanent connection to the 1600 A cable bus.
- Provide power, lighting, comms, fire alarm for the new ATB expansion.

PHASE 4

- All new, lower power lighting in new construction areas with new power, fire alarm and comms to suit the PIL requirements.

PHASE 5

- Abandon and relocate old northwest electrical room to north electrical room to make way for new retail space.
- Add second transformer at north end along with new emergency power to allow for bridge PCA and power pack improvements. Re-balance power loading of transformers in the system. Make improvements to allow for bi-directional power transfer in ATB.

▸ SYSTEMS

Utility Supply

The ATB is currently powered from a single 1000 KVA transformer. Distribution voltage is 600 V. Average peak demand in a month is approximately 750 KVA however it can peak in the 830 KVA range during hot months and be in the 600 KVA range in off-peak months. The actual operating demand of the ATB is in the 300-500 KVA range, depending on air-side operations intensity (ie: time of day) and the time of year.

The ATB main breaker is rated at 1200 A, while the main switchgear is 1600 A rated. By phase 2, we plan to replace the main breaker with a 100% rated, 1600 A unit. This will coincide with the installation of a new 1500 KVA transformer and generator.

Late phase 1 power demand will increase load by about 100 to 150 A. Some of this demand will be offset by energy saving measures for lighting and power usage in the existing ATB space. Demand at the new baggage hall will increase power use by the end of phase 2 but this will be offset by the increased capacity of the main service.

Emergency Power

The electrical systems will feature improvements to the emergency power capacity of the ATB. This will be achieved by way of an emergency generator upgrade. The goal of the upgrade is to ensure that most equipment or Utility supply failures will not cause a sustained interruption to any ATB operations. This would include; adversely affecting the processing of arriving or departing passengers, baggage flow or arrivals and departures of aircraft from the gates.

To effect a whole ATB back-up, a new 1500 KVA generator complete with transfer switch will be installed in a purpose built building during phase 2. By phase 5, the generator building will be incorporated into the ATB expansion at the south end of the building. As part of the emergency power upgrade, the existing, end-of-life 75 KW generator that supplies emergency power for the air field lighting will be removed from service. The 125 KW generator that provides emergency power to the ATB will be re-tasked to provide air field emergency power.

There is a cost and installation risk attendant with the upgrading of the emergency power system. CEC Rule 46-108(4) requires that conductors associated with life safety systems and exit signs shall be kept entirely independent of all other conductors. This is probably not the case at the ATB given the age of the building. We would seek an advance ruling from the electrical inspection authority in advance of construction on phase 2. If the Code rule is applied literally and no grandfathering of existing systems is allowed, considerable conduit re-work and re-wiring would be required along with a second transfer switch to fulfill the requirements of the Rule.

Power

Switchgear and Distribution

A key challenge of early expansion is to provide power to the phase 1 Primary Inspection Line (PIL) addition for CBSA. None of the existing electrical rooms have adequate permanent capacity or available space to power a new north end addition. We propose the installation of a 1600 A cable bus between a new north end electrical room and the south main electrical room. As well as providing a new power feed to the north end, this cable bus will serve as a power backbone between the newer, and much longer, ATB that will exist after phase 3.

The cable bus backbone can be used to route power during unusual emergency situations. For instance, in the event of generator maintenance or failure, a temporary truck-mounted generator could be situated on the north side of the ATB and back-feed the ATB through the north electrical room. By phase 5, this cable bus becomes a key pathway for bi-directional load-sharing and shifting. An additional transformer can be added to the ATB and load could then be added from new PCA and power pack units.

Sub-Distribution

All building wiring, unless noted otherwise, will be 98% conductivity copper with minimum 600 volt insulation. Branch circuit wiring will use #12 AWG as the minimum size conductor. Wiring for receptacles will have a dedicated neutral and ground wire. Lighting circuits may utilize shared ground and neutral wires. Shared neutrals shall be minimum #10 AWG. Ground wires shall be minimum #12 AWG.

All wiring will be installed in conduit or cable tray. Electrical metallic tubing (EMT) will be used for the majority of conduit in the building. Empty conduit will have pull cables installed to facilitate future cable installations. Where cable trays and conduit pass through floors and fire-rated walls, they will be sleeved and fire-stopped.

Typically, power utilization will be as follows:

Fluorescent Lighting	347 volts
HID Lighting	347 volts
Convenience receptacles	120 volts
Motorized loads up to and including .37 kW (½ hp)	120 volts
3 Phase motorized loads greater than .37 kW (½ hp)	600 volts

Duplex receptacles will be commercial, specification grade, complete with lamicoid nametags indicating the circuit and panel number. Where possible, data, voice and power receptacles will be housed in a single, multi-device housing.

Connections for Mechanical Equipment

Motor control centers (MCCs) will be provided for the majority of mechanical equipment, complete with starters (where not integral to the equipment). Small motors (½ hp and less) will generally operate on single-Phase 120-volt power, with larger motors operating on three-Phase, 600 V power. In cases of large motor loads not controlled with variable frequency drives (VFDs), power factor correction capacitors will be incorporated.

Starters in the MCC will generally be combination starters, complete with a molded case circuit breaker, a contactor with an adjustable overload relay and single-Phase protection, holding coil, LED pilot light, HOA switch, and two normally open and one normally closed auxiliary holding contacts. Where VFDs are specified the MCC will house a molded case circuit breaker for the device, along with overload protection. Variable frequency drives will be fitted with iron core reactors where larger motor size current harmonics could impact voltage bus stability.

Hand-wash and sanitary fixtures that utilize infra-red sensing will be hardwired.

Grounding

A complete building grounding and bonding network will be provided derived from Earth Ground Electrodes as per the CEC and the requirements of the local electrical inspection authority.

Copper ground busses mounted on insulated stand-offs will be provided in each electrical closet/room and beside all voice/data patch panel racks.

Pre-Conditioned Air and 400 Hz Power

Aircraft pre-conditioned air (PCS) and 400 Hz power are currently provided from portable diesel powered units on the apron. This strategy will continue through the 2016 expansion. Peak power needed to provide stand-by PCA and power to a full complement of aircraft at the gates from bridge attached units could be in the range of an additional 400-600 KW. This would require the installation of much larger transformer during the phase 2 build (with attendant replacement of the main switchgear) or the installation of a second transformer near the north electrical room sometime during phases 2 to 4.

Dialog believes that preparing now for the staging of an additional transformer after 2016 (ie: “phase 5”) provides the most cost effective solution for expansion of the electrical system. In effect, the Phase 1-4 expansion and renovation improves internal building power reliability and capacity, while Phase 5 provides additional power expansion to service future new external power requirements.

Lighting

Interior Lighting

Lighting Power Density Targets

All spaces within the ATB will be designed to meet or exceed ASHRAE 90.1. ASHRAE 90.1 compliance is a pre-requisite of the Building Code, however exceeding the ASHRAE targets will deliver significant energy and carbon emission savings.

The target lighting average power density (LPD) is approximately 0.9 watts per square foot. Areas requiring hire visual acuity will require significantly hire lighting power but these will be offset by lower power requirements in hallways and infrequently occupied areas. In general the LPD's will be 0.6 w/ft2 for back of house or service locations, 0.6 w/ft2 for concourse areas, 0.9 w/ft2 for offices and lobbies, 1.2 w/ft2 for retail areas. The current lighting power density at the Kelowna ATB is 1.31 w/ft2; so the target LPD represents a 31.3% improvement in operational efficiency.

Lighting Strategies

Lighting strategies for typical areas of the ATB are described in the following sections. To provide an idea of the type of fixtures that can be used, a number of lighting fixture cut-sheets have been provided as an appendix to this report. Consider these fixtures as "suggested" or "typical" for the basis of design.

Mid to Lower Ceiling Lighting

Lighting in mid to lower ceiling areas will utilize suspended T5 fluorescent with Acrylic Lenses or recessed T5 troffer lighting depending on the ceiling treatment and height. T5's represent a superior feature over basic T8 lighting. Suspended fixtures will help to provide a more amenable space by utilizing indirect/direct lighting.

Daylight will be harvested using photocell devices to turn off as many luminaires in an area as possible. Photocells coupled with occupancy sensors will ensure that small space lighting is off while unoccupied.

Office and Administrative Areas

Offices, and Administrative Areas will use T5 fluorescent deep cell parabolic luminaires to control display glare. These spaces will be controlled by occupancy sensors to ensure energy conservation and by photocell where practical to harvest daylight. Illuminance levels for these spaces are targeted at 400 lux in agreement with IES levels. Provision to boost lighting levels in these spaces to 500 lux can be accommodated with the existing lighting concept.

High Bay Service Spaces

High Bay areas will use T5 High Output Fluorescent (T5HO) High Bay luminaires. These luminaires will feature clear polycarbonate sealed lenses to improve luminaire efficiency and mitigate lumen depreciation while protecting the lamps.

Central Corridors, Rotunda and Concourse Areas

The concourse and feature common areas will use T5 recessed and pendant fluorescent luminaires depending on ceiling treatments. Wall mounted linear fluorescent fixtures will be used along spaces where there is no ceiling to reduce the need for ceiling suspended high bay fixtures. Interior Light Poles may be provided in vaulted spaces to project light further into the space and provide indirect/direct lighting for aesthetic qualities. Lighting will be controlled to harvest available daylight where possible.

Exterior Lighting

Architectural details will be lit as is appropriate for the application and will be determined as the design progresses. Security lighting will be located as required in consultation with the Airport.

Exterior lighting should be controlled using a combination of daylight sensors and timers. Daylight sensors will keep the lighting off during day-lit hours, while the timers can be used to schedule lights to provide a decreased light level after normal working hours. The existing external lighting control system will be audited to determine its sufficiency. Should a new system be able to require greater efficiency and low payback period, we will recommend replacing it under separate contract as part of Operations and Maintenance Improvements.

There is currently no scope in this project for major roadway, apron or parking lot lighting upgrades. No consideration to additional external lighting beyond the immediate confines of the ATB has been considered for this report.

Emergency and Exit Lighting

Emergency lighting will be mounted in key locations to provide suitable egress lighting as per the Building Code. Exit lights will be provided as required to give exit guidance in accordance with CEC requirements. Emergency and exit lighting will be powered from the emergency generator and may also include battery packs in some areas depending on the safety requirements of the illuminated area.

Sustainable Energy Options

Solar and wind generation, were investigated for their current economics. Airport operations and prevailing wind conditions are not suitable for wind generation.

Solar energy, could be installed on site but not in an economical fashion. The Dialog energy model roadmap indicates that there are better, more economical options for reducing the carbon footprint and improving the energy efficiency of the ATB.

Fire Alarm

A new microprocessor-based, addressable, monitored, annunciated detection and fire alarm system will be installed. Annunciation for this system will be installed in the current west “main” entrance. Due to the size and strategic nature of the ATB a second annunciator should be installed for increased safety. The location of this annunciator is currently planned for an entrance to the building at the north end of the ATB.

Fire alarm initiating devices such as manual pull stations, smoke detectors and heat detectors will be located where required by Code. Signaling devices will be located throughout public, support, and service areas to give alarm signals at the decibel levels required by Code. Fire alarm sprinkler flow valves and tamper switches will be connected to the fire alarm system.

All smoke doors will close on alarm. All fans on air handling units will shut down and smoke dampers will close on alarm and the sprinkler system will be monitored.

Communications

A data /security network will be expanded in the building utilizing a CAT 6 cabling system. In addition, the existing voice network will be extended utilizing the same CAT 6 cabling. The network cabling will serve as a data network for IT equipment and can be used for the security network utilizing addressable digital security cameras. Optical fiber back-bones meeting the multimode requirements of the client Agencies and the Airport will be between communications rooms and where distance is a factor in delivering high speed data. In addition:

- A 300mm wide low voltage cable tray or basket tray system will run in corridors for use with the telephone, data and other low voltage wiring. All runs from the cable tray to zone boxes or devices will be in conduit, which will minimize mechanical damage. Cross-over points will be carefully controlled to comply with EIA/TIA standards.
- The system will be full Category 6 Cabling, outlet jacks, and terminations will be provided in accordance with EIA/TIA standards. Where older cable needs to be replaced, it will be replaced with CAT 6 cable.

Security

This system will interact with the Building Automation Systems, Lighting Controls and Fire Alarm in order to provide intrusion and lock-down protection. Additional interfaces to Agency based systems will be provided where required. It is the intent of this design to migrate new security cameras to a fully digital IP-based system. The current ATB camera system is a high quality analogue system however it will become more expensive to maintain over time and will not have the expansion flexibility of a digital system. A bridge will be required from the new digital cameras to be used in the new construction to the analogue systems's back-end. This will allow the 2 systems to work as a single system.

The Airport has indicated a preference to continue utilizing Chubb security systems and components. This would maximize the investment in security devices that are currently installed in the ATB. Security design will include the Airport's preferred vendor during the next phase of design (Design Development).

Commissioning

To ensure that all electrical systems are installed as designed and are fully operational at the time of operation, a comprehensive commissioning and start-up program will be part of the construction process. The program shall insure that the electrical systems are operational at the time of take-over and that maintenance staff is fully trained in its operation.

The commissioning process will include design analysis, installation monitoring, testing and correction of deficiencies for at the following systems:

- Electrical power and distribution, including a coordination study of the newly installed service
- Emergency lighting operation, light levels and battery packs
- Lighting and switching
- Voice and data testing to Cat 6 standards, and correction of deficiencies
- Fire Alarm Verification and Inspection
- Functional testing of security and card access systems
- Integrated systems testing involving mechanical and electrical system coordination

▶ TYPICAL INTERIOR FIXTURE TYPES

Drawing List

- Electrical Phase 1A Construction Sketch
- Electrical Phase 1B Construction Sketch
- Electrical Phase 2 Construction Sketch
- Electrical Phase 3 Construction Sketch
- Electrical Phase 4 Construction Sketch
- Electrical Phase 5 Construction Sketch

FLUORESCENT

PARABOLICS

Recessed Luminaires Parabolic

Deepcel Series 2' x 4' (DPA)

3" Deep Cells • Air Handling/Static Luminaires

Lightolier Deepcel is the industry standard 3" parabolic louver troffer with features that offer value above the industry standard. Deepcel housings have a clean white interior without holes or bends. Black painted exteriors reduce heat build-up within the lamp/ballast compartment(s) for optimum lamp and ballast efficiency. 24 cell configuration meets IES RP-1 recommended (basic) criteria for VDT areas.

Features

- Only 5" deep.
- Vertical grain on louver eliminates reflected lamp image on cross baffle.
- Spring-loaded latches.
- Mitered aluminum louver flange.
- 3 lamp, 18 cell (77.7% efficient).
- 1.6 spacing to mounting height ratio.
- Snap-in ballast cover.
- Louver has polyethylene dust guard.
- Black exterior finish for cooler ballast operation.
- 24 cell louver configuration meets IES RP-1 recommended (basic) for VDT applications (3-T8 only).
- Built-in Hold-Down clip.
- 3" deep aluminum parabolic louver.
- Available in in T8, T5 and T5HO combinations.

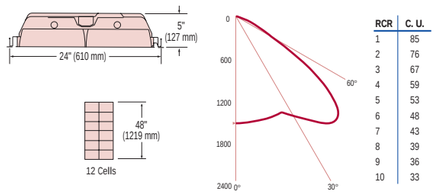
Options pages 150-156

Ballast Specify voltage (120, 277 or 347) and add suffix, e.g. 120SO.

Magnetic	Electronic	PowerSpec Dimming
T8: **OC**	T8: **SO**	T8: **PS**
	T5/T5HO: **PG**	
	3 LPB T5/T5HO: **PU**	(not avail. in 347V)
	4 LPB T5/T5HO: **PV**	

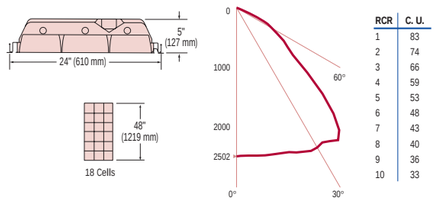
LPB : Number of lamps per ballast.
Drywall Kit For plaster frames, order Cat. No.: **FK92X4** (2' x 4').
Radio Interference Filter 120, 277 or 347 volt, 50 or 60 Hz. Suffix: **R.**
Emergency Lighting System Suffix: **O** (e.g. DPA2G12LS232120SO**O**). Emergency battery pack with charger.
(90 minutes at 15% of lumens for 1 lamp).
Louver Finish Low iridescence semi-specular is standard. Except **DPA** 24 cells : Low iridescence specular. Consult factoy for other finishes.
Air Pattern Control and Air Slot Closure For horizontal and vertical air supply and to balance return air. Suffix: **S.**
Static For static luminaires, replace **A** in the basic catalogue number by **S.**

DPA 2'x 4' — **DPA2G12LS232120SO (Data)**



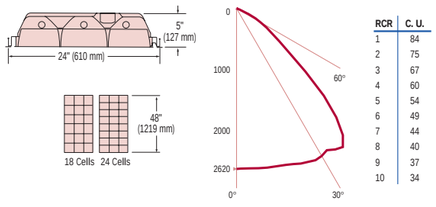
RCR	C. U.
1	85
2	76
3	67
4	59
5	53
6	48
7	43
8	39
9	36
10	33

DPA 2'x 4' — **DPA2G18LS33212003 (Data)**



RCR	C. U.
1	83
2	74
3	66
4	59
5	53
6	48
7	43
8	40
9	36
10	33

DPA 2'x 4' — **DPA2G18LP33212003 (Data)**



RCR	C. U.
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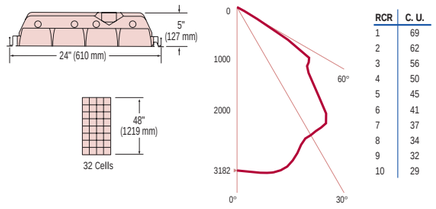
2	75
3	67
4	60
5	54
6	49
7	44
8	40
9	37
10	34

DPA 2'x 4' — **DPA2G32LS43212004 (Data)**



RCR	C. U.
1	69
2	62
3	56
4	50
5	45
6	41
7	37
8	34
9	32
10	29

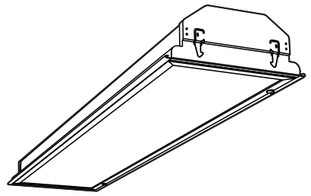
LITHONIA LIGHTING®

Catalog Number	
Notes	Type **A2**

Specification Premium T5 Troffer

SP5 1'X4'

1 or 2 Lamps



Specifications

Length: 48 (1218)
Width: 12 (305)
Depth: 4-1/2 (114)
Weight: 17 lbs (7.7 kg)

All dimensions are inches (millimeters) unless otherwise specified.

FEATURES & SPECIFICATIONS

INTENDED USE

Specification premium, high performance, static T5 luminaires provide general illumination for recessed applications; ideal for restricted plenum spaces.

ATTRIBUTES

Designed specifically for use with high-efficiency T5 lamps, electronic ballasts and rotary sockets.

CONSTRUCTION

Smooth hemmed sides and smooth, inward formed end flanges for easy handling. Lighter weight fixture allows safe, easy installation.

Standard steel door frame has superior structural integrity with premium extruded appearance and precision flush mitered corners. Steel door allows easy lens replacement without frame disassembly (for lenses up to .156" thick). Powder-painted, steel latches provide easy, secure door closure.

Superior mechanical light seal requires no foam gasketing. Integral T-bar clips secure fixture to T-bar system. Housing formed from cold-rolled steel. Acrylic shielding material 100% UV stabilized. No asbestos is used in this product.

US PATENTS: 6,210,025; 6,231,213; 6,213,625; 2,288,471.

FINISH

Five-stage iron-phosphate pretreatment ensures superior paint adhesion and rust resistance. Painted parts finished with highly reflective matte white enamel.

OPTICAL

A12 lens features reverse apex technology for superior lamp obscuration and improved visual comfort.

ELECTRICAL SYSTEM

Standard ballast is electronic programmed rapid start, thermally protected, resetting, Class P, HPF, non-PCB, UL Listed, CSA certified ballast, universal voltage and sound rated A.

Luminaire is suitable for damp locations. AWM, TFN or THHN wire used throughout, rated for required temperatures.

LISTING

Standard: UL. Optional: Canada — CSA or cUL; Mexico — NOM.

WARRANTY

Guaranteed for one year against mechanical defects in manufacture.

Specifications subject to change without notice.

ORDERING INFORMATION

For shortest lead times, configure product using **standard options (shown in bold).**
Example: SP5 G 1 54T5HO A12 MVOLT GEB10PS

SP5 — Series: **SP5**

G — Trim type:
- **G Grid**
- F Overlapping flanged

1 — Number of lamps:
- **1**
- **2**
- 3

28T5 — Lamp type:
- **28T5 28W T5 (46")**
- **54T5HO 54W T5HO (46")[1]**

- — Door frame:
- (blank) **Flush steel, white**
- FN Flush aluminum, natural
- FM Flush aluminum, matte black
- FW Flush aluminum, white
- RN Regressed aluminum, natural
- RM Regressed aluminum, matte black
- RW Regressed aluminum, white

A12 — Diffuser type:
- **A12 #12 pattern acrylic, reverse apex**
- RA125 #12 pattern acrylic, reverse apex 0.125" thick
- A12125 #12 pattern acrylic 0.125" thick
- A19 #19 pattern acrylic 0.156" thick

347 — Voltage:
- **MVOLT[2]**
- 120
- 277
- 347[3]
- Others available.

GEB10PS — Ballast:
- **GEB95 0.95 ballast factor[4,6]**
- **GEB10PS 1.00 ballast factor**
- GEB95S 0.95 ballast factor, step dimming[4,6]
- **GEB115 1.15 ballast factor[4,6]**
- GEB115S 1.15 ballast factor, step dimming[4,6]

Options:
- **EL14 Emergency battery pack[5,7]**
- **GLR Internal fast-blow fuse[5]**
- **GMF Internal slow-blow fuse[5]**
- LP835 3500K
- LPM835P Premiere 3500K[6]
- LP841 4100K
- **PWS1836 6' prewire, 3/8" dia., 18-gauge, 3 wires**
- PWS1846 6' prewire, 3/8" dia., 18-gauge, 4 wires
- JP Palletized and stretch-wrapped without individual cartons
- CSA CSA Certified
- NOM NOM Certified

NOTES:
1 For T5HO applications use GEB10PS.
2 MVOLT (120-277 volts), 50-60HZ.
3 For 347, use GEB95S or GEB10PS.
4 Use with 2-lamp only.
5 Must specify voltage 120 or 277.
6 Use with 28T5 only.
7 Not available with 3-lamp configurations.

LITHONIA LIGHTING®

FEATURES & SPECIFICATIONS

INTENDED USE

Specification premium, high performance, static T5 luminaires provide general illumination for recessed applications; ideal for restricted plenum spaces.

ATTRIBUTES

Designed specifically for use with high-efficiency T5 lamps, electronic ballasts and rotary sockets.

CONSTRUCTION

Smooth hemmed sides and smooth, inward formed end flanges for easy handling. Lighter weight fixture allows safe, easy installation.

Standard steel door frame has superior structural integrity with premium extruded appearance and precision flush mitered corners. Steel door allows easy lens replacement without frame disassembly (for lenses up to .156" thick). Powder-painted, steel latches provide easy, secure door closure.

Superior mechanical light seal requires no foam gasketing. Integral T-bar clips secure fixture to T-bar system. Housing formed from cold-rolled steel. Acrylic shielding material 100% UV stabilized. No asbestos is used in this product.

US PATENTS: 6,210,025; 6,231,213; 6,213,625; 2,288,471.

FINISH

Five-stage iron-phosphate pretreatment ensures superior paint adhesion and rust resistance. Painted parts finished with highly reflective matte white enamel.

OPTICAL

A12 lens features reverse apex technology for superior lamp obscuration and improved visual comfort.

ELECTRICAL SYSTEM

Standard ballast is electronic programmed rapid start, thermally protected, resetting, Class P, HPF, non-PCB, UL Listed, CSA certified ballast, universal voltage and sound rated A.

Luminaire is suitable for damp locations. AWM, TFN or THHN wire used throughout, rated for required temperatures.

LISTING

Standard: UL. Optional: Canada — CSA or cUL; Mexico — NOM.

WARRANTY

Guaranteed for one year against mechanical defects in manufacture.

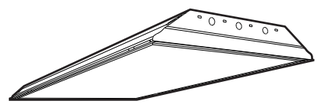
Specifications subject to change without notice.

Catalog Number	
2SP5-G-3-28T5-A12-347-GEB10PS	
Notes	Type **A3**

Specification Premium T5 Troffer

SP5 2'X4'

T5 and T5HO Lamps
2, 3 or 4 Lamps



Specifications

Length: 48 (1218)
Width: 24 (609)
Depth: 3-11/16 (94)
Weight: 22 lbs (9.9 kg)

All dimensions are inches (millimeters).

ORDERING INFORMATION

For shortest lead times, configure product using **standard options (shown in bold).**
Example: 2SP5 G 2 28T5 A12 MVOLT GEB95

2SP5	G	3	28T5	-	A12	347	GEB10PS	
Series		Number of lamps		Door frame		Voltage	Ballast	Options
2SP5		**2**		(blank) **Flush steel, white**		**MVOLT**[2]	**GEB95 0.95 ballast factor**[4,5]	1/3 One three-lamp ballast (T5HO only)
		3		FN Flush aluminum, natural		120	**GEB10PS 1.00 ballast factor**	1/4 One four-lamp ballast (T5HO only)
		4		FM Flush aluminum, matte black		277	GEB95S 0.95 ballast factor, step dimming[4,5]	**EL14 Emergency battery pack**[7,9]
Trim type		Lamp type		FW Flush aluminum, white		347[3]	GEB115 1.15 ballast factor[4,5]	**GLR Internal fast-blow fuse**[7]
G Grid		**28T5 28W T5 (46")**		RN Regressed aluminum, natural		Others available.	GEB115S 1.15 ballast factor, step dimming[4,5]	**GMF Internal slow-blow fuse**[7]
F Overlapping flanged		**54T5HO 54W T5HO (46")**[1]		RM Regressed aluminum, matte black			S5 0.95 ballast factor, SIMPLY5 system[5,6]	LP835 3500K
MT Modular fit in				RW Regressed aluminum, white				LPM835P Premiere 3500K[5]
					Diffuser type			LP841 4100K
					A12 #12 pattern acrylic, reverse apex			**PWS1836 6' prewire, 3/8" dia., 18-gauge, 3 wires**
					RA125 #12 pattern acrylic, .125" thick, reverse apex			PWS1846 6' prewire, 3/8" dia., 18-gauge, 4 wires[8]
					A12125 #12 pattern acrylic .125" thick			JP Palletized and stretch-wrapped without individual cartons
					A19 #19 pattern acrylic .156" thick			CSA CSA Certified
								NOM NOM Certified

NOTES:
1 For T5HO applications, use GEB10PS.
2 MVOLT (120-277 volts), 50-60HZ.
3 For 347V, use GEB95S or GEB10PS.
4 Available with two- or four-lamp configurations only.
5 28T5 lamps only.
6 SIMPLY5 system includes 13' S5 RELOC wiring system. Specify voltage unless HW (hardwire) or PWS1836 is ordered. For two-lamp 28T5 only.
7 Must specify voltage: 120V or 277V.
8 Use with GEB95S or GEB115S.
9 Not available with three- or four-lamp 28T5 configurations.

LITHONIA LIGHTING®

FEATURES & SPECIFICATIONS

INTENDED USE

Specification premium, high performance, static T5 luminaires provide general illumination for recessed applications; ideal for restricted plenum spaces.

ATTRIBUTES

Designed specifically for use with high-efficiency T5 lamps, electronic ballasts and rotary sockets.

CONSTRUCTION

Smooth hemmed sides and smooth, inward formed end flanges for easy handling. Lighter weight fixture allows safe, easy installation.

Standard steel door frame has superior structural integrity with premium extruded appearance and precision flush mitered corners. Steel door allows easy lens replacement without frame disassembly (for lenses up to .156" thick). Powder-painted, steel latches provide easy, secure door closure.

Superior mechanical light seal requires no foam gasketing. Integral T-bar clips secure fixture to T-bar system. Housing formed from cold-rolled steel. Acrylic shielding material 100% UV stabilized. No asbestos is used in this product.

US PATENTS: 6,210,025; 6,231,213; 6,213,625; 2,288,471.

FINISH

Five-stage iron-phosphate pretreatment ensures superior paint adhesion and rust resistance. Painted parts finished with highly reflective matte white enamel.

OPTICAL

A12 lens features reverse apex technology for superior lamp obscuration and improved visual comfort.

ELECTRICAL SYSTEM

Standard ballast is electronic programmed rapid start, thermally protected, resetting, Class P, HPF, non-PCB, UL Listed, CSA certified ballast, universal voltage and sound rated A.

Luminaire is suitable for damp locations. AWM, TFN or THHN wire used throughout, rated for required temperatures.

LISTING

Standard: UL. Optional: Canada — CSA or cUL; Mexico — NOM.

WARRANTY

Guaranteed for one year against mechanical defects in manufacture.

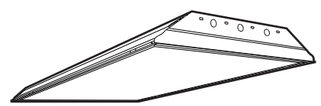
Specifications subject to change without notice.

Catalog Number	
2SP5-G-2-28T5-A12-347-GEB10PS	
Notes	Type **A4**

Specification Premium T5 Troffer

SP5 2'X4'

T5 and T5HO Lamps
2, 3 or 4 Lamps



Specifications

Length: 48 (1218)
Width: 24 (609)
Depth: 3-11/16 (94)
Weight: 22 lbs (9.9 kg)

All dimensions are inches (millimeters).

ORDERING INFORMATION

For shortest lead times, configure product using **standard options (shown in bold).**
Example: 2SP5 G 2 28T5 A12 MVOLT GEB95

2SP5	G	2	28T5	-	A12	347	GEB10PS	
Series		Number of lamps		Door frame		Voltage	Ballast	Options
2SP5		**2**		(blank) **Flush steel, white**		**MVOLT**[2]	**GEB95 0.95 ballast factor**[4,5]	1/3 One three-lamp ballast (T5HO only)
		3		FN Flush aluminum, natural		120	**GEB10PS 1.00 ballast factor**	1/4 One four-lamp ballast (T5HO only)
		4		FM Flush aluminum, matte black		277	GEB95S 0.95 ballast factor, step dimming[4,5]	**EL14 Emergency battery pack**[7,9]
Trim type		Lamp type		FW Flush aluminum, white		347[3]	GEB115 1.15 ballast factor[4,5]	**GLR Internal fast-blow fuse**[7]
G Grid		**28T5 28W T5 (46")**		RN Regressed aluminum, natural		Others available.	GEB115S 1.15 ballast factor, step dimming[4,5]	**GMF Internal slow-blow fuse**[7]
F Overlapping flanged		**54T5HO 54W T5HO (46")**[1]		RM Regressed aluminum, matte black			S5 0.95 ballast factor, SIMPLY5 system[5,6]	LP835 3500K
MT Modular fit in				RW Regressed aluminum, white				LPM835P Premiere 3500K[5]
					Diffuser type			LP841 4100K
					A12 #12 pattern acrylic, reverse apex			**PWS1836 6' prewire, 3/8" dia., 18-gauge, 3 wires**
					RA125 #12 pattern acrylic, .125" thick, reverse apex			PWS1846 6' prewire, 3/8" dia., 18-gauge, 4 wires[8]
					A12125 #12 pattern acrylic .125" thick			JP Palletized and stretch-wrapped without individual cartons
					A19 #19 pattern acrylic .156" thick			CSA CSA Certified
								NOM NOM Certified

NOTES:
1 For T5HO applications, use GEB10PS.
2 MVOLT (120-277 volts), 50-60HZ.
3 For 347V, use GEB95S or GEB10PS.
4 Available with two- or four-lamp configurations only.
5 28T5 lamps only.
6 SIMPLY5 system includes 13' S5 RELOC wiring system. Specify voltage unless HW (hardwire) or PWS1836 is ordered. For two-lamp 28T5 only.
7 Must specify voltage: 120V or 277V.
8 Use with GEB95S or GEB115S.
9 Not available with three- or four-lamp 28T5 configurations.

Fluorescent **Sheet #: SP5-2x4** STAT-230

LITHONIA LIGHTING®

Catalog Number	
2SP5-G-2-28T5-A19-347-GEB10PS	
Notes	Type
	A5

FEATURES & SPECIFICATIONS

INTENDED USE

Specification premium, high performance, static T5 luminaires provide general illumination for recessed applications; ideal for restricted plenum spaces.

ATTRIBUTES

Designed specifically for use with high-efficiency T5 lamps, electronic ballasts and rotary sockets.

CONSTRUCTION

Smooth hemmed sides and smooth, inward formed end flanges for easy handling. Lighter weight fixture allows safe, easy installation.

Standard steel door frame has superior structural integrity with premium extruded appearance and precision flush mitered corners. Steel door allows easy lens replacement without frame disassembly (for lenses up to .156" thick). Powder-painted, steel latches provide easy, secure door closure.

Superior mechanical light seal requires no foam gasketing. Integral T-bar clips secure fixture to T-bar system. Housing formed from cold-rolled steel. Acrylic shielding material 100% UV stabilized. No asbestos is used in this product.

US PATENTS: 6,210,025; 6,231,213; 6,213,625; 2,288,471.

FINISH

Five-stage iron-phosphate pretreatment ensures superior paint adhesion and rust resistance. Painted parts finished with highly reflective matte white enamel.

OPTICAL

A12 lens features reverse apex technology for superior lamp obscuration and improved visual comfort.

ELECTRICAL SYSTEM

Standard ballast is electronic programmed rapid start, thermally protected, resetting, Class P, HPF, non-PCB, UL Listed, CSA certified ballast, universal voltage and sound rated A.

Luminaire is suitable for damp locations. AWM, TFN or THHN wire used throughout, rated for required temperatures.

LISTING

Standard: UL. Optional: Canada — CSA or cUL; Mexico — NOM.

WARRANTY

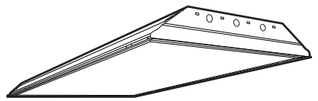
Guaranteed for one year against mechanical defects in manufacture.

Specifications subject to change without notice.

Specification Premium T5 Troffer

SP5 2'X4'

T5 and T5HO Lamps
2, 3 or 4 Lamps



Specifications

Length: 48 (1218)
Width: 24 (609)
Depth: 3-11/16 (94)
Weight: 22 lbs (9.9 kg)

All dimensions are inches (millimeters).

ORDERING INFORMATION

For shortest lead times, configure product using **standard options (shown in bold).**
Example: 2SP5 G 2 28T5 A12 MVOLT GEB95

2SP5	G	2	28T5	-	A19	347	GEB10PS	
Series		Number of lamps		Door frame		Voltage	Ballast	Options
2SP5		**2**		(blank) **Flush steel, white**		**MVOLT**[2]	**GEB95 0.95 ballast factor**[4,5]	1/3 One three-lamp ballast (T5HO only)
		3		FN Flush aluminum, natural		120	**GEB10PS 1.00 ballast factor**	1/4 One four-lamp ballast (T5HO only)
		4		FM Flush aluminum, matte black		277	GEB95S 0.95 ballast factor, step dimming[4,5]	**EL14 Emergency battery pack**[7,9]
Trim type		Lamp type		FW Flush aluminum, white		347[3]	GEB115 1.15 ballast factor[4,5]	**GLR Internal fast-blow fuse**[7]
G Grid		**28T5 28W T5 (46")**		RN Regressed aluminum, natural		Others available.	GEB115S 1.15 ballast factor, step dimming[4,5]	**GMF Internal slow-blow fuse**[7]
F Overlapping flanged		**54T5HO 54W T5HO (46")**[1]		RM Regressed aluminum, matte black			S5 0.95 ballast factor, SIMPLY5 system[5,6]	LP835 3500K
MT Modular fit in				RW Regressed aluminum, white				LPM835P Premiere 3500K[5]
								LP841 4100K
								PWS1836 6' prewire, 3/8" dia., 18-gauge, 3 wires
					Diffuser type			PWS1846 6' prewire, 3/8" dia., 18-gauge, 4 wires[8]
					A12 #12 pattern acrylic, reverse apex			JP Palletized and stretch-wrapped without individual cartons
					RA125 #12 pattern acrylic, .125" thick, reverse apex			CSA CSA Certified
					A12125 #12 pattern acrylic .125" thick			NOM NOM Certified
					A19 #19 pattern acrylic .156" thick			

NOTES:
1 For T5HO applications, use GEB10PS.
2 MVOLT (120-277 volts), 50-60HZ.
3 For 347V, use GEB95S or GEB10PS.
4 Available with two- or four-lamp configurations only.
5 28T5 lamps only.
6 SIMPLY5 system includes 13' S5 RELOC wiring system. Specify voltage unless HW (hardwire) or PWS1836 is ordered. For two-lamp 28T5 only.
7 Must specify voltage: 120V or 277V.
8 Use with GEB95S or GEB115S.
9 Not available with three- or four-lamp 28T5 configurations.

LITHONIA LIGHTING®

Catalog Number	
2SP5-G-2-28T5-A19-347-GEB10PS	
Notes	Type
	A5

FEATURES & SPECIFICATIONS

INTENDED USE

Specification premium, high performance, static T5 luminaires provide general illumination for recessed applications; ideal for restricted plenum spaces.

ATTRIBUTES

Designed specifically for use with high-efficiency T5 lamps, electronic ballasts and rotary sockets.

CONSTRUCTION

Smooth hemmed sides and smooth, inward formed end flanges for easy handling. Lighter weight fixture allows safe, easy installation.

Standard steel door frame has superior structural integrity with premium extruded appearance and precision flush mitered corners. Steel door allows easy lens replacement without frame disassembly (for lenses up to .156" thick). Powder-painted, steel latches provide easy, secure door closure.

Superior mechanical light seal requires no foam gasketing. Integral T-bar clips secure fixture to T-bar system. Housing formed from cold-rolled steel. Acrylic shielding material 100% UV stabilized. No asbestos is used in this product.

US PATENTS: 6,210,025; 6,231,213; 6,213,625; 2,288,471.

FINISH

Five-stage iron-phosphate pretreatment ensures superior paint adhesion and rust resistance. Painted parts finished with highly reflective matte white enamel.

OPTICAL

A12 lens features reverse apex technology for superior lamp obscuration and improved visual comfort.

ELECTRICAL SYSTEM

Standard ballast is electronic programmed rapid start, thermally protected, resetting, Class P, HPF, non-PCB, UL Listed, CSA certified ballast, universal voltage and sound rated A.

Luminaire is suitable for damp locations. AWM, TFN or THHN wire used throughout, rated for required temperatures.

LISTING

Standard: UL. Optional: Canada — CSA or cUL; Mexico — NOM.

WARRANTY

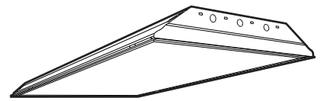
Guaranteed for one year against mechanical defects in manufacture.

Specifications subject to change without notice.

Specification Premium T5 Troffer

SP5 2'X4'

T5 and T5HO Lamps
2, 3 or 4 Lamps



Specifications

Length: 48 (1218)
Width: 24 (609)
Depth: 3-11/16 (94)
Weight: 22 lbs (9.9 kg)

All dimensions are inches (millimeters).

ORDERING INFORMATION

For shortest lead times, configure product using **standard options (shown in bold).**
Example: 2SP5 G 2 28T5 A12 MVOLT GEB95

2SP5	G	2	28T5	-	A19	347	GEB10PS	
Series		Number of lamps		Door frame		Voltage	Ballast	Options
2SP5		**2**		(blank) **Flush steel, white**		**MVOLT**[2]	**GEB95 0.95 ballast factor**[4,5]	1/3 One three-lamp ballast (T5HO only)
		3		FN Flush aluminum, natural		120	**GEB10PS 1.00 ballast factor**	1/4 One four-lamp ballast (T5HO only)
		4		FM Flush aluminum, matte black		277	GEB95S 0.95 ballast factor, step dimming[4,5]	**EL14 Emergency battery pack**[7,9]
Trim type		Lamp type		FW Flush aluminum, white		347[3]	GEB115 1.15 ballast factor[4,5]	**GLR Internal fast-blow fuse**[7]
G Grid		**28T5 28W T5 (46")**		RN Regressed aluminum, natural		Others available.	GEB115S 1.15 ballast factor, step dimming[4,5]	**GMF Internal slow-blow fuse**[7]
F Overlapping flanged		**54T5HO 54W T5HO (46")**[1]		RM Regressed aluminum, matte black			S5 0.95 ballast factor, SIMPLY5 system[5,6]	LP835 3500K
MT Modular fit in				RW Regressed aluminum, white				LPM835P Premiere 3500K[5]
								LP841 4100K
								PWS1836 6' prewire, 3/8" dia., 18-gauge, 3 wires
					Diffuser type			PWS1846 6' prewire, 3/8" dia., 18-gauge, 4 wires[8]
					A12 #12 pattern acrylic, reverse apex			JP Palletized and stretch-wrapped without individual cartons
					RA125 #12 pattern acrylic, .125" thick, reverse apex			CSA CSA Certified
					A12125 #12 pattern acrylic .125" thick			NOM NOM Certified
					A19 #19 pattern acrylic .156" thick			

NOTES:
1 For T5HO applications, use GEB10PS.
2 MVOLT (120-277 volts), 50-60HZ.
3 For 347V, use GEB95S or GEB10PS.
4 Available with two- or four-lamp configurations only.
5 28T5 lamps only.
6 SIMPLY5 system includes 13' S5 RELOC wiring system. Specify voltage unless HW (hardwire) or PWS1836 is ordered. For two-lamp 28T5 only.
7 Must specify voltage: 120V or 277V.
8 Use with GEB95S or GEB115S.
9 Not available with three- or four-lamp 28T5 configurations.

Fluorescent **Sheet #: SP5-2x4** STAT-230

CAPRI® C1
8" Diameter Compact Fluorescent

OPTION MATRIX

Catalogue Number & Lamp Designations	Ballast Options (choose one)				Radio Filter	Fuse	Emergency Options[3] (choose one)	
	Electronic		Dimming					
	120V-277V U	347V S3	120V D1	277V D2	RI	FS2[1]	Integral E[2]	Remote ER
FV13 (1) CFQ13W/G24q	•				•	•	•	•
FV18 (1) CFQ18W/G24q (1) CFM18W/GX24q	•	•	•	•	•	•	•	•
FV26/32/42 (1) CFQ26W/G24q (1) CFM26W/GX24q (1) CFM32W/GX24q (1) CFM42W/GX24q	•	•			•	•	•	•
FV26 (1) CFQ26W/G24q (1) CFM26W/GX24q			•	•	•	•	•	•
FV32 (1) CFM32W/GX24q			•	•	•	•	•	•
FV42 (1) CFM42W/GX24q			•	•	•	•	•	•

[1] FS2 fuse kits are field installed (see page 574 for details). For large projects, consult factory for information on factory installation.
[2] For use with emergency trim options only.
[3] Emergency options are not available for use with sloped ceiling systems or remodel systems.

TRIMS (For finishes see pages 578-579)

Catalogue #	Description
V83	Gold Reflector
V83SL	Gold Reflector, Self-lipped
V84	Black Reflector
V84SL	Black Reflector, Self-lipped
V85	Low Iridescent Reflector
V85SL	Low Iridescent Reflector, Self-lipped
V86	White Reflector
V86SL	White Reflector, Self-lipped
V87	Wheat Reflector
V87SL	Wheat Reflector, Self-lipped
V83E	Gold Reflector, Emergency
V84E	Black Reflector, Emergency
V85E	Low Iridescent Reflector, Emergency
V86E	White Reflector, Emergency
V87E	Wheat Reflector, Emergency
V85BE	Low Iridescent Refl., Black Baffle, Emerg.
V85WBE	Low Iridescent Refl., White Baffle, Emerg.
V85BC	Black Baffle, Clear lens Insert ♦
V85BF	Black Baffle, Fresnel lens Insert ♦
V85BP	Black Baffle, C73 Prismatic lens Insert ♦
V85B	Low Iridescent Reflector, Black Baffle
V85WB	Low Iridescent Reflector, White Baffle
V85WBC	White Baffle, Clear lens Insert ♦
V85WBF	White Baffle, Fresnel lens Insert ♦
V85WBP	White Baffle, C73 Prismatic lens Insert ♦
VW83	Gold Reflector, Single Wall Wash
VWD83	Gold Reflector, Double Wall Wash
VW85	Low Iridescent Refl., Single Wall Wash
VWD85	Low Iridescent Refl., Double Wall Wash
NEW **VW87**	Wheat Reflector, Single Wall Wash
NEW **VWD87**	Wheat Reflector, Double Wall Wash
V85C	Clear Cone, Clear lens Insert ♦
V85F	Clear Cone, Fresnel lens Insert ♦
V85P	Clear Cone, C73 Prismatic lens Insert ♦
V86C	White Splay, Clear lens Insert ♦
V86F	White Splay, Fresnel lens Insert ♦
V86P	White Splay, C73 Prismatic lens Insert ♦
V85SR10	Accommodates, 5° - 15° Slope
V85SR20	Accommodates, 16° - 25° Slope
V85SR30	Accommodates, 26° - 35° Slope
V85XB	Clear Low Iridescent Cross Baffle Reflector
NEW **V85SWR**	Shower Trim ♦

To create a catalogue number

Start with the plaster frame ▼ **CM8S**

Choose an electrical system ▼ CM8S-**FV26/32/42U**

Choose a 8" trim ▼ CM8S-FV26/32/42U-**V85SR20**-CH24[4]

[4] See page 573 for bar hanger options.

♦ Denotes cUL wet location listing. Emergency trims are dry location listed only.

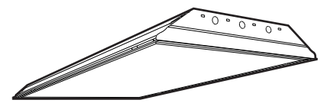
LITHONIA LIGHTING®

Catalog Number	
2SP5-G-2-28T5-A19-347-GEB10PS	
Notes	Type A8

Specification Premium T5 Troffer

SP5 2'X4'

T5 and T5HO Lamps
2, 3 or 4 Lamps



Specifications

Length: 48 (1218)
Width: 24 (609)
Depth: 3-11/16 (94)
Weight: 22 lbs (9.9 kg)

All dimensions are inches (millimeters).

FEATURES & SPECIFICATIONS

INTENDED USE

Specification premium, high performance, static T5 luminaires provide general illumination for recessed applications; ideal for restricted plenum spaces.

ATTRIBUTES

Designed specifically for use with high-efficiency T5 lamps, electronic ballasts and rotary sockets.

CONSTRUCTION

Smooth hemmed sides and smooth, inward formed end flanges for easy handling. Lighter weight fixture allows safe, easy installation.

Standard steel door frame has superior structural integrity with premium extruded appearance and precision flush mitered corners. Steel door allows easy lens replacement without frame disassembly (for lenses up to .156" thick). Powder-painted, steel latches provide easy, secure door closure.

Superior mechanical light seal requires no foam gasketing. Integral T-bar clips secure fixture to T-bar system. Housing formed from cold-rolled steel. Acrylic shielding material 100% UV stabilized. No asbestos is used in this product.

US PATENTS: 6,210,025; 6,231,213; 6,213,625; 2,288,471.

FINISH

Five-stage iron-phosphate pretreatment ensures superior paint adhesion and rust resistance. Painted parts finished with highly reflective matte white enamel.

OPTICAL

A12 lens features reverse apex technology for superior lamp obscuration and improved visual comfort.

ELECTRICAL SYSTEM

Standard ballast is electronic programmed rapid start, thermally protected, resetting, Class P, HPF, non-PCB, UL Listed, CSA certified ballast, universal voltage and sound rated A.

Luminaire is suitable for damp locations. AWM, TFN or THHN wire used throughout, rated for required temperatures.

LISTING

Standard: UL. Optional: Canada — CSA or cUL; Mexico — NOM.

WARRANTY

Guaranteed for one year against mechanical defects in manufacture.
Specifications subject to change without notice.

ORDERING INFORMATION

For shortest lead times, configure product using **standard options (shown in bold).**
Example: 2SP5 G 2 28T5 A12 MVOLT GEB95

2SP5 G 2 28T5 - A12 347 GEB10PS

Series
2SP5

Trim type
G Grid
F Overlapping flanged
MT Modular fit in

Number of lamps
2
3
4

Lamp type
28T5 28W T5 (46")
54T5HO 54W T5HO (46")[1]

Door frame
(blank) **Flush steel, white**
FN Flush aluminum, natural
FM Flush aluminum, matte black
FW Flush aluminum, white
RN Regressed aluminum, natural
RM Regressed aluminum, matte black
RW Regressed aluminum, white

Diffuser type
A12 #12 pattern acrylic, reverse apex
RA125 #12 pattern acrylic, .125" thick, reverse apex
A12125 #12 pattern acrylic .125" thick
A19 #19 pattern acrylic .156" thick

Voltage
MVOLT[2]
120
277
347[3]
Others available.

Ballast
GEB95 0.95 ballast factor[4,5]
GEB10PS 1.00 ballast factor
GEB95S 0.95 ballast factor, step dimming[4,5]
GEB115 1.15 ballast factor[4,5]
GEB115S 1.15 ballast factor, step dimming[4,5]
S5 0.95 ballast factor, SIMPLY5 system[5,6]

Options
1/3 One three-lamp ballast (T5HO only)
1/4 One four-lamp ballast (T5HO only)
EL14 Emergency battery pack[7,9]
GLR Internal fast-blow fuse[7]
GMF Internal slow-blow fuse[7]
LP835 3500K
LPM835P Premiere 3500K[5]
LP841 4100K
PWS1836 6' prewire, 3/8" dia., 18-gauge, 3 wires
PWS1846 6' prewire, 3/8" dia., 18-gauge, 4 wires[8]
JP Palletized and stretch-wrapped without individual cartons
CSA CSA Certified
NOM NOM Certified

NOTES:
1 For T5HO applications, use GEB10PS.
2 MVOLT (120-277 volts), 50-60HZ.
3 For 347V, use GEB95S or GEB10PS.
4 Available with two- or four-lamp configurations only.
5 28T5 lamps only.
6 SIMPLY5 system includes 13' S5 RELOC wiring system. Specify voltage unless HW (hardwire) or PWS1836 is ordered. For two-lamp 28T5 only.
7 Must specify voltage: 120V or 277V.
8 Use with GEB95S or GEB115S.
9 Not available with three- or four-lamp 28T5 configurations.

Fluorescent **Sheet #: SP5-2x4** STAT-230

LITHONIA LIGHTING®

Catalog Number	
SP5-G-1-28T5-A19-347-GEB10PS	
Notes	Type
	A9

FEATURES & SPECIFICATIONS

INTENDED USE

Specification premium, high performance, static T5 luminaires provide general illumination for recessed applications; ideal for restricted plenum spaces.

ATTRIBUTES

Designed specifically for use with high-efficiency T5 lamps, electronic ballasts and rotary sockets.

CONSTRUCTION

Smooth hemmed sides and smooth, inward formed end flanges for easy handling. Lighter weight fixture allows safe, easy installation.

Standard steel door frame has superior structural integrity with premium extruded appearance and precision flush mitered corners. Steel door allows easy lens replacement without frame disassembly (for lenses up to .156" thick). Powder-painted, steel latches provide easy, secure door closure.

Superior mechanical light seal requires no foam gasketing. Integral T-bar clips secure fixture to T-bar system. Housing formed from cold-rolled steel. Acrylic shielding material 100% UV stabilized. No asbestos is used in this product.

US PATENTS: 6,210,025; 6,231,213; 6,213,625; 2,288,471.

FINISH

Five-stage iron-phosphate pretreatment ensures superior paint adhesion and rust resistance. Painted parts finished with highly reflective matte white enamel.

OPTICAL

A12 lens features reverse apex technology for superior lamp obscuration and improved visual comfort.

ELECTRICAL SYSTEM

Standard ballast is electronic programmed rapid start, thermally protected, resetting, Class P, HPF, non-PCB, UL Listed, CSA certified ballast, universal voltage and sound rated A.

Luminaire is suitable for damp locations. AWM, TFN or THHN wire used throughout, rated for required temperatures.

LISTING

Standard: UL. Optional: Canada — CSA or cUL; Mexico — NOM.

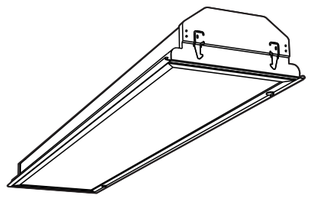
WARRANTY

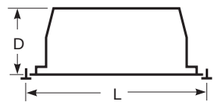
Guaranteed for one year against mechanical defects in manufacture.
Specifications subject to change without notice.

Specification Premium T5 Troffer

SP5 1'X4'

1 or 2 Lamps





Specifications

Length: 48 (1218)
Width: 12 (305)
Depth: 4-1/2 (114)
Weight: 17 lbs (7.7 kg)

All dimensions are inches (millimeters) unless otherwise specified.

ORDERING INFORMATION

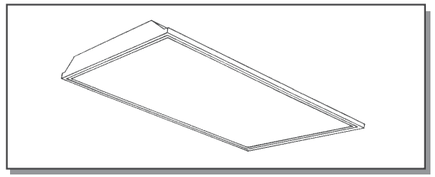
For shortest lead times, configure product using **standard options (shown in bold).**
Example: SP5 G 1 54T5HO A12 MVOLT GEB10PS

SP5	G	1	28T5	-	A12	347	GEB10PS	
Series		Number of lamps		Door frame	Diffuser type	Voltage	Ballast	Options
SP5		1		(blank) **Flush steel, white**	**A12 #12 pattern acrylic, reverse apex**	**MVOLT**[2]	**GEB95 0.95 ballast factor**[4,6]	**EL14 Emergency battery pack**[5,7]
		2		FN Flush aluminum, natural	RA125 #12 pattern acrylic, reverse apex 0.125" thick	120	**GEB10PS 1.00 ballast factor**	**GLR Internal fast-blow fuse**[5]
		3		FM Flush aluminum, matte black	A12125 #12 pattern acrylic 0.125" thick	277	GEB95S 0.95 ballast factor, step dimming[4,6]	**GMF Internal slow-blow fuse**[5]
				FW Flush aluminum, white	A19 #19 pattern acrylic 0.156" thick	347[3]	**GEB115 1.15 ballast factor**[4,6]	LP835 3500K
				RN Regressed aluminum, natural		Others available.	GEB115S 1.15 ballast factor, step dimming[4,6]	LPM835P Premiere 3500K[6]
				RM Regressed aluminum, matte black				LP841 4100K
				RW Regressed aluminum, white				**PWS1836 6' prewire, 3/8" dia., 18-gauge, 3 wires**
								PWS1846 6' prewire, 3/8" dia., 18-gauge, 4 wires
								JP Palletized and stretch-wrapped without individual cartons
								CSA CSA Certified
								NOM NOM Certified
Trim type		Lamp type						
G Grid		**28T5 28W T5 (46")**						
F Overlapping flanged		**54T5HO 54W T5HO (46")**[1]						

NOTES:
1 For T5HO applications use GEB10PS.
2 MVOLT (120-277 volts), 50-60HZ.
3 For 347, use GEB95S or GEB10PS.
4 Use with 2-lamp only.
5 Must specify voltage 120 or 277.
6 Use with 28T5 only.
7 Not available with 3-lamp configurations.

2' x 4' TG

Day-Brite® Lighting



2, 3, or 4 Lamp
T5 or T8
Prismatic Acrylic Lens

CONSTRUCTION/FINISH

- A quality low-profile troffer with specification features for NEMA "G" grid, or NEMA "F" flange ceiling types.
- 3" nominal housing depth, 3-3/16" maximum depth.
- Smooth rolled edges on all four sides for easy handling.
- Die-formed one piece housing includes stiffening embosses and provides increased rigidity.
- Housing is multi-stage phosphate treated for maximum corrosion resistance and finish coat is high reflectance baked white enamel.
- Lamp pin openings in housing ends for easier relamping (can be relamped without using openings).
- Integral baffling system to prevent light leaks.
- 2 sets of integral grid clips (wraparound and fold out) for maximum mounting flexibility.
- Integral wire hanger holes for independent wire suspension.
- Embosses with holes provided in housing end for screwing to T-bar if desired.
- On T8 models, a single lamp can be changed without disturbing other lamps or wireway cover.
- 7/8" K.O.'s provided in each end cap for through wiring.
- Factory installed access plate in housing top includes 7/8" hole with rolled edge and 7/8" K.O.

ELECTRICAL

- Class P, HPF ballasts comply with © Federal Ballast Law (Public Law 100-357,1988).
- cUL certified.
- Self-contained fluorescent emergency power packs can be incorporated.
- Rotating ring locking lampholder is standard for secure and positive retention of lamps.

ENCLOSURES

- Full "C" channel door frames for improved lens support and reduced shipping damage.
- Flat steel door frame features smooth rolled edges inside and outside.
- All door frames have mitered corners.
- All door frames use T-hinges and can be hinged and latched from either side.
- Opposable spring loaded latches are standard for easy operation and consistent retention.

CATALOG NUMBER

2				–				–		–	
WIDTH		NO. OF LAMPS			DOOR FRAME		DOOR FINISH				OPTIONS
2 – 2'		(not included)			**BLANK** – Flat Steel		**BLANK** – White Door				SI - Silverado Insert
		2			**FA** – Flat Alum.		**B** – Black Door				1/2 - One 2-lamp ballast (electronic or non-standard)
		3			**RA** – Regr. Alum.						1/3 - One 3-lamp ballast (electronic or non-standard)
		4				LENS					1/21- 2-lamp & 1-lamp ballasts (electronic or non-standard)
						01 – Pattern 12 prismatic acrylic					1/4 - One 4-lamp ballast (electronic or non-standard)
						12 – DB-12, .125" nominal					1W - 1-way gasketing, between lens & door frame
						19 – DB-19, .156" nominal					2W - 2-way gasketing, 1W + gasketing between door frame & housing
						21 – Pattern 12, .125" nominal					3W - 3-way gasketing, 2W + gasketing for field installation between housing & ceiling
						32 – 1/2" x 1/2" x 1/2" silver louver					
						36 – 1-1/2" x 1-1/2" x 1-1/2" silver louver					See section C1600-OA for other options.
FIXTURE FAMILY		LAMP TYPE/WATTAGE						VOLTAGE			
TG8 – TG8 Troffer, Grid		**28** – 28wT5 (46")						**120**			
TF8 – TG8 Troffer, Flange		**32** – 32wT8 (48")						**277**			
		54HO – 54wT5HO (46")						**347**			
								UNV – Universal voltage, 120-277			

Accessory:
FMA24 - 2' x 4' "F" mounting frame for NEMA

Job name:

Type:

C425.3-SR

189 Bullock Drive, Markham, Ontario L3P 1W4
Tel: 905-294-9570
Fax: 905-294-9811 or 1-800-268-0003
www.thomaslightingcanada.com

THOMAS LIGHTING CANADA
a Genlyte company

PINNACLE ARCHITECTURAL LIGHTING™

EDGE 4A

T5 LFL

1T5 and 2T5 RECESSED LINEAR DIRECT / Acrylic Lens

CONSTRUCTION Formed cold rolled steel housing. Highly reflective die-formed white painted steel reflector, .125" diffuse snap-in acrylic lens with matte finish, removable for lamp replacement.

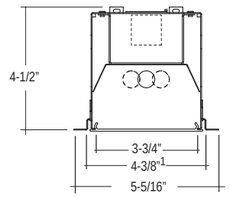
ELECTRICAL Standard programmed start UL listed Class P, T5 electronic, Sound Rated A, thermally protected, high power factor ballasts less than 10% THD, Universal voltage (120/277) with 50/60Hz operation. Through wiring with quick connects standard. Standard single circuit. Integral battery packs with remote test switch are provided with 1B and 2B options. Each ballast provided with disconnects to meet luminaire disconnect code requirement.

MOUNTING Edge is designed to install into acoustical grid and inaccessible ceilings. Specify GXG, FLF, SFS, NFN for Individual, unjoinable units (individual units will fall on-grid). Specify GX, FL, SF, NF for continuous rows (Rows fall on-grid). Consult factory for detailed installation instructions.

FINISH Standard powder-coat textured white painted finish on exposed trim, consult factory for custom colors.

LABELS UL and cUL Listed, approved for dry/damp location unless otherwise noted.

Quick Ship Product[7]



[1]Rough-in width is 4-5/8" for inacessible ceilings. Must mount through top of fixture. See installation instructions for further details. Specification Sheets should not be used for installation.

LUMINAIRE SPECIFICATION

Sample Catalog #: E4A-1T5-24'-FL-120-1C-W

E4A- 1T5__- ___'- ___- ___- __- __- ____

HOUSING	LAMPS	LENGTH	MOUNTING[1]	VOLTAGE	CIRCUITING	FINISH	OPTIONS

HOUSING
- E4A- Edge 4 recessed with Acrylic Lens

LAMPS
- 1T5- (1) T5
- 1T5HO- (1) T5HO
- 2T5- (2) T5
- 2T5HO- (2) T5HO

LENGTH

Individual Units[2]

2- 2'	T5: 1 or 2-14W	T5HO: 1 or 2-24W
3- 3'	T5: 1 or 2-21W	T5HO: 1 or 2-39W
4- 4'	T5: 1 or 2-28W	T5HO: 1 or 2-54W
6- 6'	T5: 2 or 4-21W	T5HO: 2 or 4-39W
8- 8'	T5: 2 or 4-28W	T5HO: 2 or 4-54W

Continuous Runs[3]
- xx'- Specify nominal overall row length in 1' increments

MOUNTING[1]

VOLTAGE
- 120- 120 V
- 277- 277 V
- 347- 347 V[5]
- UNV- UNV[5] (120/277)

CIRCUITING
- 1C- Single Circuit
- 2C- Dual Circuit[6]
- 1D- Single Circuit Dimming[6]
- 2D- Dual Circuit Dimming[6]
- 1B- Single Circuit with Battery Pack[6,12]
- 2B- Dual Circuit with Battery[6,12]
- 1E- Single Circuit with Emergency Circuit[6]
- 2E- Dual Circuit with Emergency Circuit[6]

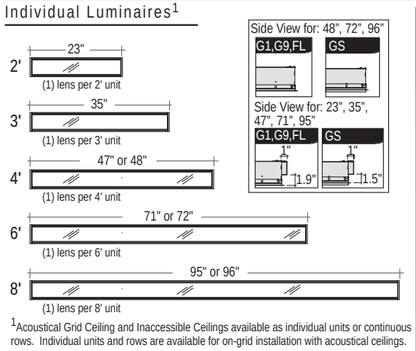
FINISH
- W- Matte White
- CC- Custom Color

OPTIONS
- QS- Quick Ship[7]
- PM- Perimeter Mount[8]
- RC- Rotating Crossbar[9]
- M___- MR16 Lamp[10]
- CP- Chicago Plenum
- CL- Illuminated Connector[11]

INDIVIDUAL UNITS (CANNOT BE JOINED)[2]		CONTINUOUS RUNS (JOINABLE)[3]	
Acoustical Grid Ceiling	Inaccessible Ceiling	Acoustical Grid Ceiling	Inaccessible Ceiling
G1G- 1" Ceiling Grid	FLF- Standard 1/2" Flange	G1- 1" Ceiling Grid	FL- Standard 1/2" Flange
G9G- 9/16" Ceiling Grid	SFS- Spackle Flange	G9- 9/16" Ceiling Grid	SF- Spackle Flange
GSG- Screw Slot Ceiling Grid	NFN- Flangeless[4]	GS- Screw Slot Ceiling Grid	NF- Flangeless[4]

[1]See below for mounting detail. Consult factory for tegular edged tiles.
[2]Individual units cannot be joined. All end trims are factory installed and cannot be removed in the field. Individual fixtures designed to fall on-grid.
[3]Continuous runs are designed to fall on-grid with acoustical grid ceilings.
[4]NF and NFN to be utilized for metal pan / millwork ceiling.
[5]347 volt and UNV not available with MR16 and battery packs.
[6]Some Edge configurations will not accommodate all electrical options. Consult factory.
[7]Includes 4 ft individual unjoinable units, G1G, FLF mounts, Universal voltage, std white finish, single and dual circuit.
[8]Available for acoustical grid ceilings. Wall rail painted white unless otherwise specified.
[9]1/2" to 5/8" drywall thickness. Available for standard 1/2" flange (FL).
[10]See back page for Layout and Ordering Information.
[11]Add CL to all fixture types involved in the connector layout. See back page for additional information.
[12]Integral battery packs with remote test switch are provided with 1B and 2B options.

Individual Luminaires[1]

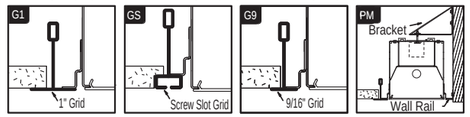


[1]Acoustical Grid Ceiling and Inaccessible Ceilings available as individual units or continuous rows. Individual units and rows are available for on-grid installation with acoustical ceilings.

Mounting Detail

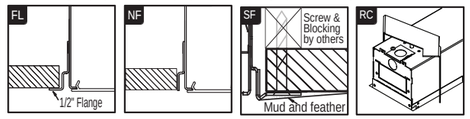
Acoustical Grid Ceiling Options

1" Grid Lay-In (G1), Screw Slot Grid Lay-In (GS), 9/16" Grid Lay-In (G9), Perimeter Mount (PM)



Inaccessible Ceiling Options

Flanged (FL), Flangeless (NF), Spackle Flange (SF), Rotating Crossbar (RC)



PINNACLE ARCHITECTURAL LIGHTING™ 12655 East 42nd Avenue, Suite 50 Denver, Colorado 80239 Ph 303.322.5570 Fax 303.322.5568 www.pinnacle-ltg.com
December 2009

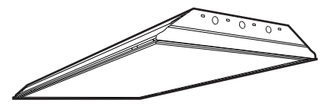
LITHONIA LIGHTING®

Catalog Number	
2SP5-G-2-28T5-A12-347-GEB10PS	
Notes	Type
	A4

Specification Premium T5 Troffer

SP5 2'X4'

T5 and T5HO Lamps
2, 3 or 4 Lamps



Specifications

Length: 48 (1218)
Width: 24 (609)
Depth: 3-11/16 (94)
Weight: 22 lbs (9.9 kg)

All dimensions are inches (millimeters).

FEATURES & SPECIFICATIONS

INTENDED USE

Specification premium, high performance, static T5 luminaires provide general illumination for recessed applications; ideal for restricted plenum spaces.

ATTRIBUTES

Designed specifically for use with high-efficiency T5 lamps, electronic ballasts and rotary sockets.

CONSTRUCTION

Smooth hemmed sides and smooth, inward formed end flanges for easy handling. Lighter weight fixture allows safe, easy installation.

Standard steel door frame has superior structural integrity with premium extruded appearance and precision flush mitered corners. Steel door allows easy lens replacement without frame disassembly (for lenses up to .156" thick). Powder-painted, steel latches provide easy, secure door closure.

Superior mechanical light seal requires no foam gasketing. Integral T-bar clips secure fixture to T-bar system. Housing formed from cold-rolled steel. Acrylic shielding material 100% UV stabilized. No asbestos is used in this product.

US PATENTS: 6,210,025; 6,231,213; 6,213,625; 2,288,471.

FINISH

Five-stage iron-phosphate pretreatment ensures superior paint adhesion and rust resistance. Painted parts finished with highly reflective matte white enamel.

OPTICAL

A12 lens features reverse apex technology for superior lamp obscuration and improved visual comfort.

ELECTRICAL SYSTEM

Standard ballast is electronic programmed rapid start, thermally protected, resetting, Class P, HPF, non-PCB, UL Listed, CSA certified ballast, universal voltage and sound rated A.

Luminaire is suitable for damp locations. AWM, TFN or THHN wire used throughout, rated for required temperatures.

LISTING

Standard: UL. Optional: Canada — CSA or cUL; Mexico — NOM.

WARRANTY

Guaranteed for one year against mechanical defects in manufacture.

Specifications subject to change without notice.

ORDERING INFORMATION

For shortest lead times, configure product using **standard options (shown in bold).**
Example: 2SP5 G 2 28T5 A12 MVOLT GEB95

Series
- **2SP5**

Trim type
- **G Grid**
- F Overlapping flanged
- MT Modular fit in

Number of lamps
- **2**
- **3**
- **4**

Lamp type

28T5	**28W T5 (46")**
54T5HO	**54W T5HO (46")[1]**

Door frame
- (blank) **Flush steel, white**
- FN Flush aluminum, natural
- FM Flush aluminum, matte black
- FW Flush aluminum, white
- RN Regressed aluminum, natural
- RM Regressed aluminum, matte black
- RW Regressed aluminum, white

Diffuser type

A12	**#12 pattern acrylic, reverse apex**
RA125	#12 pattern acrylic, .125" thick, reverse apex
A12125	#12 pattern acrylic .125" thick
A19	#19 pattern acrylic .156" thick

Voltage
- **MVOLT[2]**
- 120
- 277
- 347[3]
- Others available.

Ballast

GEB95	**0.95 ballast factor[4,5]**
GEB10PS	**1.00 ballast factor**
GEB95S	0.95 ballast factor, step dimming[4,5]
GEB115	1.15 ballast factor[4,5]
GEB115S	1.15 ballast factor, step dimming[4,5]
S5	0.95 ballast factor, SIMPLY5 system[5,6]

Options

1/3	One three-lamp ballast (T5HO only)
1/4	One four-lamp ballast (T5HO only)
EL14	**Emergency battery pack[7,9]**
GLR	**Internal fast-blow fuse[7]**
GMF	**Internal slow-blow fuse[7]**
LP835	3500K
LPM835P	Premiere 3500K[5]
LP841	4100K
PWS1836	**6' prewire, 3/8" dia., 18-gauge, 3 wires**
PWS1846	6' prewire, 3/8" dia., 18-gauge, 4 wires[9]
JP	Palletized and stretch-wrapped without individual cartons
CSA	CSA Certified
NOM	NOM Certified

NOTES:
1 For T5HO applications, use GEB10PS.
2 MVOLT (120-277 volts), 50-60HZ.
3 For 347V, use GEB95S or GEB10PS.
4 Available with two- or four-lamp configurations only.
5 28T5 lamps only.
6 SIMPLY5 system includes 13' S5 RELOC wiring system. Specify voltage unless HW (hardwire) or PWS1836 is ordered. For two-lamp 28T5 only.
7 Must specify voltage: 120V or 277V.
8 Use with GEB95S or GEB115S.
9 Not available with three- or four-lamp 28T5 configurations.

Fluorescent **Sheet #: SP5-2x4** STAT-230

Verge™

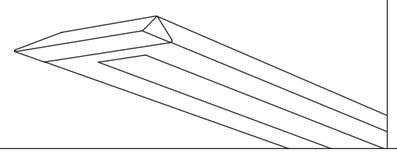
LEDALITE

Suspended

Direct/Indirect

2 T5

RESPONSE® mesoOptics® airwave™



Project Name

Spec Type

Notes

Order Guide

Some combinations of product options may not be available. Consult factory for assistance with your specification.

7606	F02	Q	G	–		–		–		–		–	

Product Series & Type
Verge Direct/Indirect

Lamping
2 T5

Lower Optics
Q MesoOptics® Lens

Upper Optics
N None
G 80% Down Kit
J 100% Down Kit

See details on reverse

Run Length
Enter the total run length in feet (4ft increments)

See details on reverse

Wiring
1 1 cct
2 2 cct
3 1 cct w/ Emergency cct
4 2 cct w/ Emergency cct
5 1 cct w/ Battery Pack
6 2 cct w/ Battery Pack
7 1 cct Dimming

Consult website for complete list of standard wiring options

Voltage
1 120V
2 277V

Ballast
E Standard Ballast

Consult website for ballast manufacturer information

Color & Finish
W Standard White
C Factory Color
X Custom Color

Consult website for color and finish options

Mounting Hardware

Mount Type
Consult separate mounting spec sheet for mount type options

Suspension Length
Enter distance from ceiling to top of fixture in inches

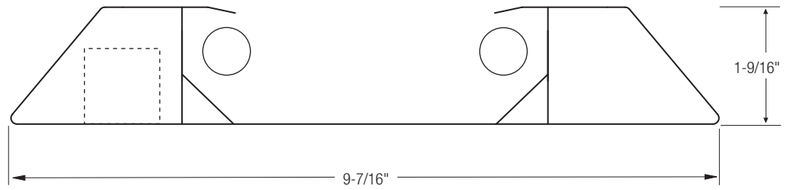
Upgrades & Accessories

Please indicate with check mark.

☐ Lamps Included

☐ Response Daylight (Integrated Controls)
For details visit www.ledalite.com/response

☐ Dust Cover



 Phone: 604.888.6811 Fax: 800.665.5332 Web: www.ledalite.com

Filename 7606F02QG.pdf Rev 1.2

Ledalite is a Philips group brand

PHILIPS

Verge™

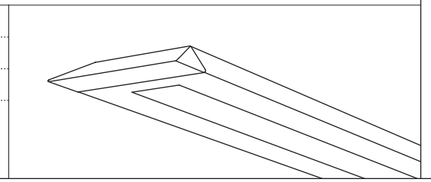
LEDALITE

Suspended

Direct/Indirect

2 T5HO

RESPONSE® mesoOptics® airwave™



Project Name

Spec Type

Notes

Order Guide

Some combinations of product options may not be available. Consult factory for assistance with your specification.

7606	H02	Q	G	–		–		–		–		–	

Product Series & Type
Verge Direct/Indirect

Lamping
2 T5HO

Lower Optics
Q MesoOptics® Lens

Upper Optics
N None
G 80% Down Kit
J 100% Down Kit

See details on reverse

Run Length
Enter the total run length in feet (4ft increments)

See details on reverse

Wiring
1 1 cct
2 2 cct
3 1 cct w/ Emergency cct
4 2 cct w/ Emergency cct
5 1 cct w/ Battery Pack
6 2 cct w/ Battery Pack
7 1 cct Dimming

Consult website for complete list of standard wiring options

Voltage
1 120V
2 277V
3 347V

Ballast
E Standard Ballast

Consult website for ballast manufacturer information

Color & Finish
W Standard White
C Factory Color
X Custom Color

Consult website for color and finish options

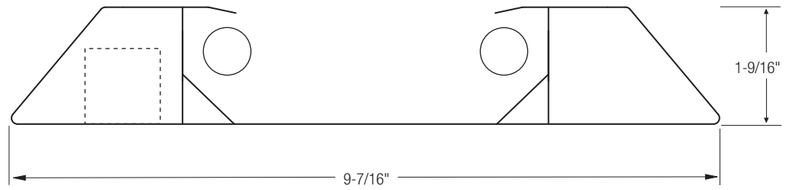
Mounting Hardware

Mount Type	Suspension Length
Consult separate mounting spec sheet for mount type options	*Enter distance from ceiling to top of fixture in inches*

Upgrades & Accessories

Please indicate with check mark.

- ☐ Lamps Included
- ☐ Response Daylight (Integrated Controls)
  For details visit www.ledalite.com/response



 Phone: 604.888.6811 Fax: 800.665.5332 Web: www.ledalite.com Filename 7606H02QG.pdf Rev 1.2

Ledalite is a Philips group brand

PHILIPS

DAY-BRITE®
CLDW

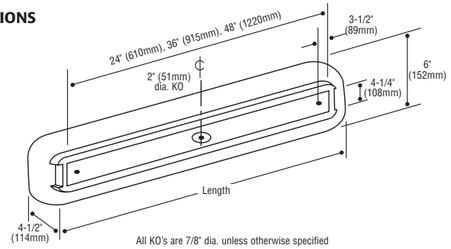
CLOUDLINE BRACKET

A functional and attractive wall luminaire.

DESIGN FEATURES

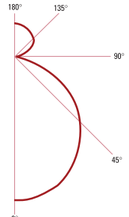
- These fixtures are primarily used for wall mounting; however they may also be surface mounted to ceilings.
- Housing is multi-stage phosphate treated for maximum corrosion resistance and finish coat is high reflectance baked white enamel.
- For individual mounting only.
- Lens is one piece smooth opal acrylic.
- Lens is retained by a thumb screw on each end.
- cUL certified.

DIMENSIONS



All KO's are 7/8" dia. unless otherwise specified

CLDW232A-120-1/2-EB -- IES File: D19743.IES



Coefficients of Utilization

RF	20%		RC	80%	
RW	70	50	30	10	
RCR					
0	77	77	77	77	
1	68	64	61	57	
2	61	55	50	45	
3	56	48	42	37	
4	51	42	36	31	
5	46	37	31	26	
6	43	33	27	22	
7	39	30	24	20	
8	37	27	21	17	
9	34	25	19	15	
10	32	23	17	14	

SAMPLE CATALOGUE NUMBER: CLDW232-120-1/2-EB

FAMILY
CLDW – Cloudline Wall Bracket

NO. OF LAMPS
(not included)
1
2

LAMP TYPE/WATTAGE
14 – 14wT5 (22")
17 – 17wT8 (24")
20 – 20wT12 (24")
24HO – 24wT5HO (22")
21 – 21wT5 (34")
39HO – 39wT5HO (34")
25 – 25wT8 (36")
28 – 28wT5 (46")
32 – 32wT8 (48")
54HO – 54wT5HO (46")

VOLTAGE
120
277
347
UNV – Universal voltage, 120-277 volt (with T8 electronic ballast option only)

OPTIONS
See pages 145 to 149 for options information.

CLOUDLINE BRACKETS —PRODUCT AVAILABILITY

Size	Family	Lamps/ Fixture	Lamp Type
2'	1, 2	14, 17, 20, 24HO	26-3/4"(679)
3'	1, 2	21, 25, 39HO	38-3/4"(984)
4'	1, 2	28, 32, 54HO	50-3/4"(1289)

DAY-BRITE®
CLDW

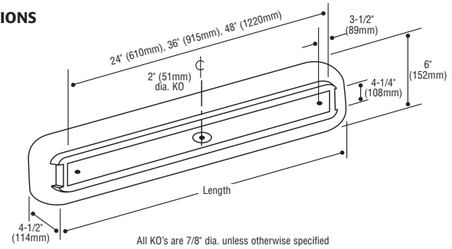
CLOUDLINE BRACKET

A functional and attractive wall luminaire.

DESIGN FEATURES

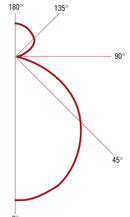
- These fixtures are primarily used for wall mounting; however they may also be surface mounted to ceilings.
- Housing is multi-stage phosphate treated for maximum corrosion resistance and finish coat is high reflectance baked white enamel.
- For individual mounting only.
- Lens is one piece smooth opal acrylic.
- Lens is retained by a thumb screw on each end.
- cUL certified.

DIMENSIONS



All KO's are 7/8" dia. unless otherwise specified

CLDW232A-120-1/2-EB -- IES File: D19743.IES



Coefficients of Utilization

RF	20%		RC	80%	
RW	70	50	30	10	
RCR					
0	77	77	77	77	
1	68	64	61	57	
2	61	55	50	45	
3	56	48	42	37	
4	51	42	36	31	
5	46	37	31	26	
6	43	33	27	22	
7	39	30	24	20	
8	37	27	21	17	
9	34	25	19	15	
10	32	23	17	14	

SAMPLE CATALOGUE NUMBER: CLDW232-120-1/2-EB

FAMILY
CLDW – Cloudline Wall Bracket

NO. OF LAMPS
(not included)
1
2

LAMP TYPE/WATTAGE
14 – 14wT5 (22")
17 – 17wT8 (24")
20 – 20wT12 (24")
24HO – 24wT5HO (22")
21 – 21wT5 (34")
39HO – 39wT5HO (34")
25 – 25wT8 (36")
28 – 28wT5 (46")
32 – 32wT8 (48")
54HO – 54wT5HO (46")

VOLTAGE
120
277
347
UNV – Universal voltage, 120-277 volt (with T8 electronic ballast option only)

OPTIONS
See pages 145 to 149 for options information.

CLOUDLINE BRACKETS —PRODUCT AVAILABILITY

Size	Family	Lamps/ Fixture	Lamp Type
2'	1, 2	14, 17, 20, 24HO	26-3/4"(679)
3'	1, 2	21, 25, 39HO	38-3/4"(984)
4'	1, 2	28, 32, 54HO	50-3/4"(1289)

COOPER LIGHTING - METALUX®

DESCRIPTION

The HB series is an outstanding solution for high mounting height industrial or retail applications. The HB optic has been optimized to provide maximum performance from either the T5 or T8 lamps. Optional uplight component is provided to enable excellent ceiling uniformity. HB's high lumen package allows the benefits of fluorescent to be applied at high mounting heights that were traditionally exclusive to H.I.D. The primary benefits include exceptional color rendering, high system efficacy, 95% lumen maintenance, long lamp life, instant on/instant re-strike, economical dimming, and uniform brightness control. Primary applications include "big box" retail, shopping malls, light industrial, gymnasiums, etc.

		Type
Catalog #		B5
Project		
Comments		Date
Prepared by		

SPECIFICATION FEATURES

A ... Construction
Full bodied steel housing utilizes captive fasteners to protect optical assembly and assure structural integrity. The housing features an integral ballast channel that adds strength and provides numerous KOs for easy installation. Optional Top Access Plate allows service in electrical compartment without removal of lamps. Die formed internal reflectors are available in both high reflectance specular material or in painted after fabrication white enamel.

B ... Electrical
Class "P" ballasts are positively secured by mounting bolts. Roto-lock lampholders. Optional modular power receptacle meets UL2459 and NEC 410.73 and is UL/cUL rated for make and break under load from outside the luminaire to speed maintenance. Thermally optimized for environments up to 149°F (65°C) when used with high temperature ballasts in open uplight configurations. UL/CUL listed. Suitable for damp locations.

C ... Finish
White enamel finish preceded by a multistage cleaning cycle, iron phosphate coating with rust inhibitor to protect against contaminants and oxidation.

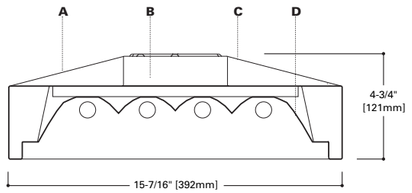
D ... Downlight/Uplight Optics
Die formed reflectors are faceted with two optical distributions: medium and wide. Medium beam optical modules utilize 95% specular aluminum while the wide distribution utilizes a high performance 95% reflective polyester powder coated finish. Gasketed door frame and lens assembly is optional for more demanding environments. Uplight option provided to enable ceiling uniformity.

Mounting
The HB series is suited for surface, suspension mounting with optional wire hook and chain set, stem or cable mounting. Top connector box mounting is also available.

Options
Integral Occupancy Sensor available and provides from 600 sq. ft. (MS) up to 1250 sq. ft. (MSO) of coverage in a maximum mounting height of 40'.

F-BAY
HB SERIES

15" x 4' High-Bay
4 Lamp
HIGH-BAY INDUSTRIAL LUMINAIRE



F-BAY FLUORESCENT HIGH-BAY

ENERGY DATA

Input Watts:
EB Ballast
432 (109)
EB/Plus Ballast
432 (147)
ER Ballast
432 (112)
454 (229)
ER/Plus Ballast
432 (144)
Luminaire Efficacy Rating
LER = 66 (White)
LER = 70 (Specular)
Catalog Number: HB-454T5-UPL
Yearly Cost of 1000 Lumens, 3000 hrs. at .08 KWH = $3.42

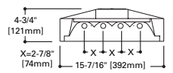
* Reference the lamp/ballast data in the Tecnical Section for specific lamp/ballast requirements

** Consult Pre Sales Technical Support.

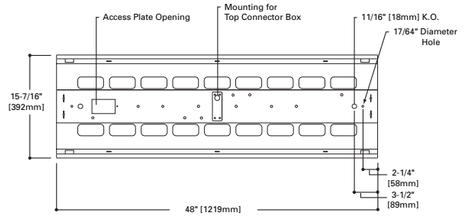
LAMPS CONTAIN MERCURY. DISPOSE ACCORDING TO LOCAL, STATE OR FEDERAL LAWS

LINEAR DISCONNECT
Safe and convenient means of disconnecting power

LAMP CONFIGURATIONS



DIMENSION TOP VIEW



COOPER Lighting
www.cooperlighting.com

Specifications and Dimensions subject to change without notice.
Consult your representative for additional options and finishes.

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COOPER LIGHTING - METALUX®

DESCRIPTION

The HB series is an outstanding solution for high mounting height industrial or retail applications. The HB optic has been optimized to provide maximum performance from either the T5 or T8 lamps. Optional uplight component is provided to enable excellent ceiling uniformity. HB's high lumen package allows the benefits of fluorescent to be applied at high mounting heights that were traditionally exclusive to H.I.D. The primary benefits include exceptional color rendering, high system efficacy, 95% lumen maintenance, long lamp life, instant on/instant re-strike, economical dimming, and uniform brightness control. Primary applications include "big box" retail, shopping malls, light industrial, gymnasiums, etc.

		Type
Catalog #		B6
Project		
Comments		Date
Prepared by		

SPECIFICATION FEATURES

A ... Construction
Full bodied steel housing utilizes captive fasteners to protect optical assembly and assure structural integrity. The housing features an integral ballast channel that adds strength and provides numerous KOs for easy installation. Optional Top Access Plate allows service in electrical compartment without removal of lamps. Die formed internal reflectors are available in both high reflectance specular material or in painted after fabrication white enamel.

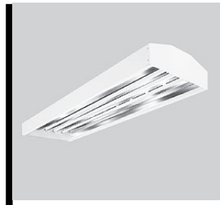
B ... Electrical
Class "P" ballasts are positively secured by mounting bolts. Roto-lock lampholders. Optional modular power receptacle meets UL2459 and NEC 410.73 and is UL/cUL rated for make and break under load from outside the luminaire to speed maintenance. Thermally optimized for environments up to 149°F (65°C) when used with high temperature ballasts in open uplight configurations. UL/CUL listed. Suitable for damp locations.

C ... Finish
White enamel finish preceded by a multistage cleaning cycle, iron phosphate coating with rust inhibitor to protect against contaminants and oxidation.

D ... Downlight/Uplight Optics
Die formed reflectors are faceted with two optical distributions: medium and wide. Medium beam optical modules utilize 95% specular aluminum while the wide distribution utilizes a high performance 95% reflective polyester powder coated finish. Gasketed door frame and lens assembly is optional for more demanding environments. Uplight option provided to enable ceiling uniformity.

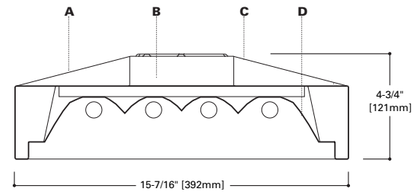
Mounting
The HB series is suited for surface, suspension mounting with optional wire hook and chain set, stem or cable mounting. Top connector box mounting is also available.

Options
Integral Occupancy Sensor available and provides from 600 sq. ft. (MS) up to 1250 sq. ft. (MSO) of coverage in a maximum mounting height of 40'.



F-BAY
HB SERIES

15" x 4' High-Bay
4 Lamp
HIGH-BAY INDUSTRIAL LUMINAIRE



F-BAY FLUORESCENT HIGH-BAY

ENERGY DATA

Input Watts:
EB Ballast
432 (109)
EB/Plus Ballast
432 (147)
ER Ballast
432 (112)
454 (229)
ER/Plus Ballast
432 (144)
Luminaire Efficacy Rating
LER = 66 (White)
LER = 70 (Specular)
Catalog Number: HB-454T5-UPL
Yearly Cost of 1000 Lumens, 3000 hrs. at .08 KWH = $3.42

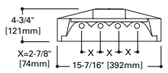
* Reference the lamp/ballast data in the Tecnical Section for specific lamp/ballast requirements

** Consult Pre Sales Technical Support.

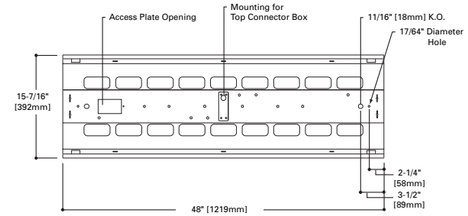
LAMPS CONTAIN MERCURY. DISPOSE ACCORDING TO LOCAL, STATE OR FEDERAL LAWS

LINEAR DISCONNECT
Safe and convenient means of disconnecting power

LAMP CONFIGURATIONS



DIMENSION TOP VIEW



COOPER Lighting
www.cooperlighting.com

Specifications and Dimensions subject to change without notice.
Consult your representative for additional options and finishes.

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METALUX®

DESCRIPTION

The HB series is an outstanding solution for high mounting height industrial or retail applications. The HB optic has been optimized to provide maximum performance from either the T5 or T8 lamps. Optional uplight component is provided to enable excellent ceiling uniformity. HB's high lumen package allows the benefits of fluorescent to be applied at high mounting heights that were traditionally exclusive to H.I.D. The primary benefits include exceptional color rendering, high system efficacy, 95% lumen maintenance, long lamp life, instant on/instant re-strike, economical dimming, and uniform brightness control. Primary applications include "big box" retail, shopping malls, light industrial, gymnasiums, etc.

Catalog #		Type
Project		B7
Comments		Date
Prepared by		

SPECIFICATION FEATURES

A···Construction
Full bodied steel housing utilizes captive fasteners to protect optical assembly and assure structural integrity. The housing features an integral ballast channel that adds strength and provides numerous KO's for easy installation. Center access plate location allows for easy access to ballast leads on all new and retrofit projects regardless of mounting type.

B···Electrical
Class "P" ballasts are positively secured by mounting bolts. Roto-lock lampholders. Optional modular power receptacle meets UL2459 and NEC 410.73 and is UL/cUL rated for make and break under load from outside the luminaire to speed maintenance. UL/CUL listed. Suitable for damp locations. Thermally optimized for environments up to 149°F (65°C) when used with high temperature ballasts in an open uplight configuration.

C···Finish
White enamel finish preceded by a multistage cleaning cycle, iron phosphate coating with rust inhibitor to protect against contaminants and oxidation.

D···Downlight/Uplight Optics
Die formed reflectors are faceted with two optical distributions –medium and wide. Medium beam optical modules utilize 95% specular aluminum while the wide distribution utilizes a high performance 95% reflective polyester powder coated finish. Gasketed door frame & lens assembly is optional for more demanding environments. Uplight option provided to enable ceiling uniformity.

Mounting
The HB series is suited for surface, suspension mounting with optional wire hook and chain set or cable mounting.

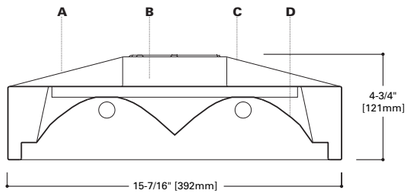
Options
Integral Occupancy Sensor available and provides from 600 sq. ft. (MS) up to 1250 sq. ft. (MSO) of coverage in a maximum mounting height of 40'.

F-BAY HB SERIES

15" x 4' High-Bay 2 Lamp

HIGH-BAY INDUSTRIAL LUMINAIRE

F-BAY FLUORESCENT HIGH-BAY



ENERGY DATA

Input Watts:
EB Ballast
232 (58)

EB/Plus Ballast
232 (73)

ER Ballast
232 (57)
254 (117)

ER/Plus Ballast
232 (74)

Luminaire Efficacy Rating
LER = 72
Catalog Number: HB-254T5-UPL

Yearly Cost of 1000 Lumens, 3000 hrs. at .08 KWH = $3.33

* Reference the lamp/ballast data in the Technical Section for specific lamp/ballast requirements

** Consult Pre Sales Technical Support.

LAMPS CONTAIN MERCURY. DISPOSE ACCORDING TO LOCAL, STATE OR FEDERAL LAWS

LINEAR DISCONNECT
Safe and convenient means of disconnecting power.

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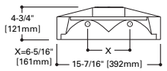
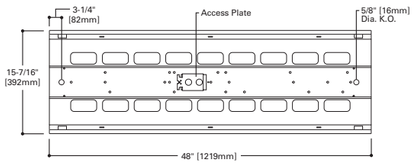
LAMP CONFIGURATIONS



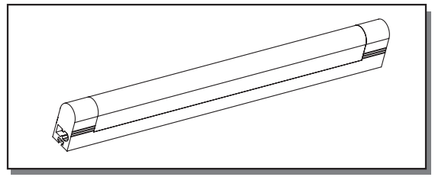
DIMENSION TOP VIEW



COOPER LIGHTING

Day-Brite® Lighting

MICRO UNDERCABINET



T5
14", 23", 36", or 48"
1 Lamp
An extremely small undercabinet luminaire using T5 lamps

CONSTRUCTION/FINISH

- Lens removable without tools for easy maintenance and cleaning.
- Rocker switch standard.
- Low profile (only 7/8" deep) provides neat, trim appearance.
- Mounting brackets included for mounting parallel or perpendicular to the mounting surface.
- Up to three units can be "daisy-chained" together using the supplied connectors.

ELECTRICAL

- UL listed.
- Electronic ballast is standard.
- Lamp included.
- Power cord with standard wall plug included, no wiring necessary.
- Available in 120 volt only.

ENCLOSURE

- High impact lens.
- Lens easily removable without tools.
- Linear prisms in lens for glare control.

CATALOG NUMBER

MUC | 1 | [ ] – 120

FAMILY
MUC - Micro Undercabinet

LAMP WATTS/ LUMINAIRE LENGTH
8 - 8wT5 (13-5/8")
13 - 13wT5 (22-7/8")
21 - 21wT5 (35-3/6")
28 - 28wT5 (47-5/8")

NO. OF LAMPS
1

VOLTAGE
120

JOB INFORMATION

1240-WU

Job Name:□
Type:

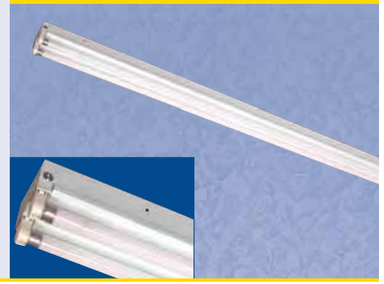
T5 STRIPS

Uses latest technology T5 ballasts and lamps. Ideal for most fluorescent lighting applications including general illumination, cove lighting and display cases.

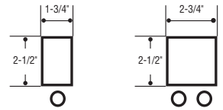
DESIGN FEATURES

- Designed for ceiling mount, wall mount or chain hung.
- Highly reflective baked white enamel.
- Suitable for individual or continuous row mounting.
- Only 2-1/2" deep.
- Uses efficient T5 lamps or H.O. lamps for up to 70% more light output.
- CSA/cUL certified.

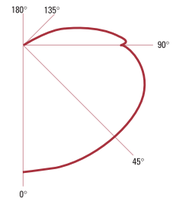
DAY-BRITE®
STRIPL



DIMENSIONS



STRIPL148-120 -- IES File: C8493.JES



Coefficients of Utilization

RF	20%	RC	80%		
RW	70	50	30	10	
RCR					
0	1.081	1.081	1.081	1.081	
1	95	89	84	79	
2	85	76	68	61	
3	77	65	57	50	
4	70	57	48	41	
5	63	50	41	34	
6	58	44	35	29	
7	53	40	31	25	
8	49	35	27	21	
9	45	32	24	18	
10	42	29	21	16	

SAMPLE CATALOGUE NUMBER: STRIPL114-120

FAMILY
STRIPL – T5 Strip
TSTRIPL – Tandem

NO. OF LAMPS PER CROSS SECTION
1 (not included)
2

LAMP TYPE/WATTAGE
14/24HO – 22"
21/39HO – 34"
28/54HO – 46"
35/80HO – 58"

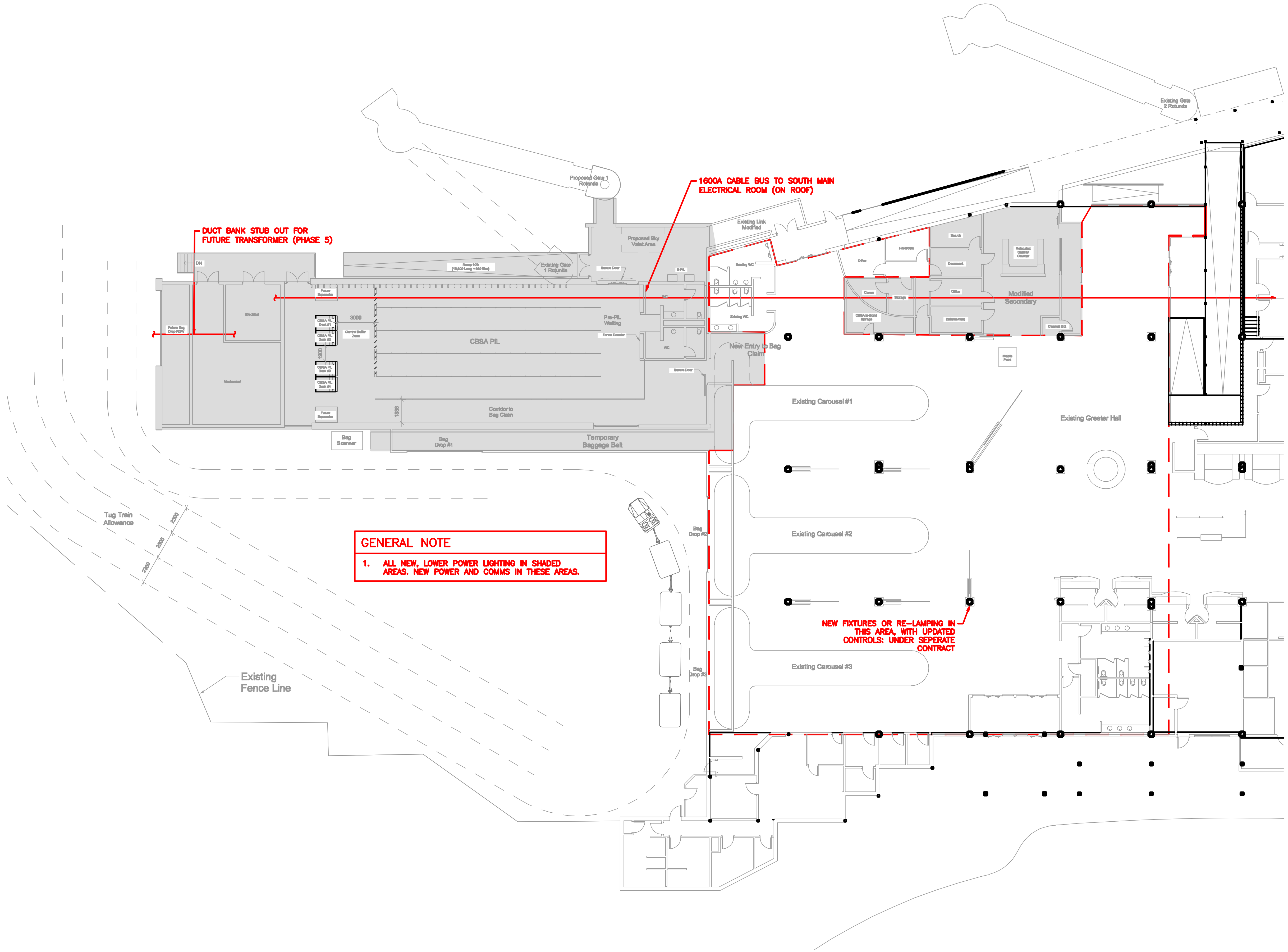
VOLTAGE
120
277
347

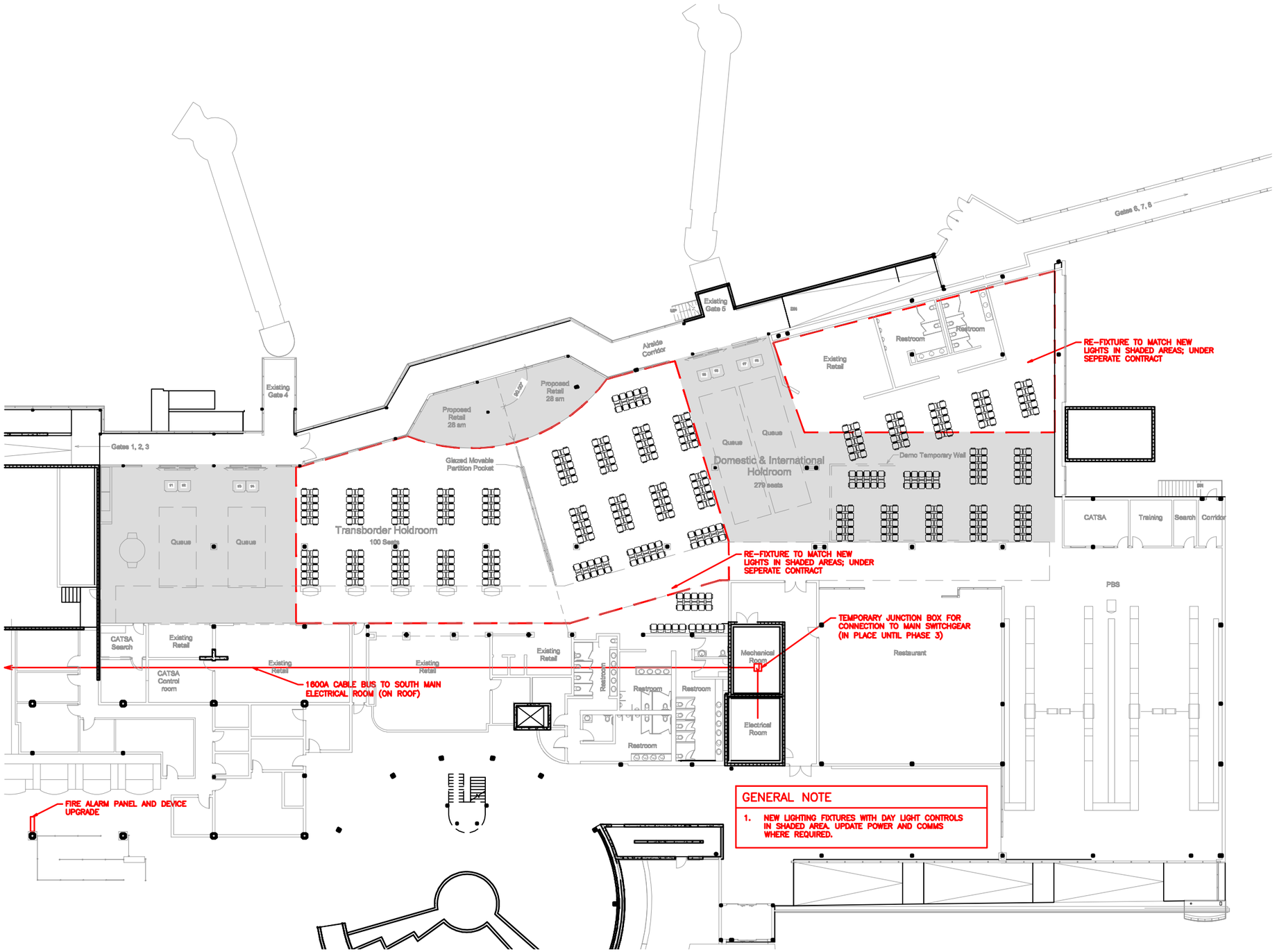
OPTIONS
See pages 145 to 149 for options and accessories information.

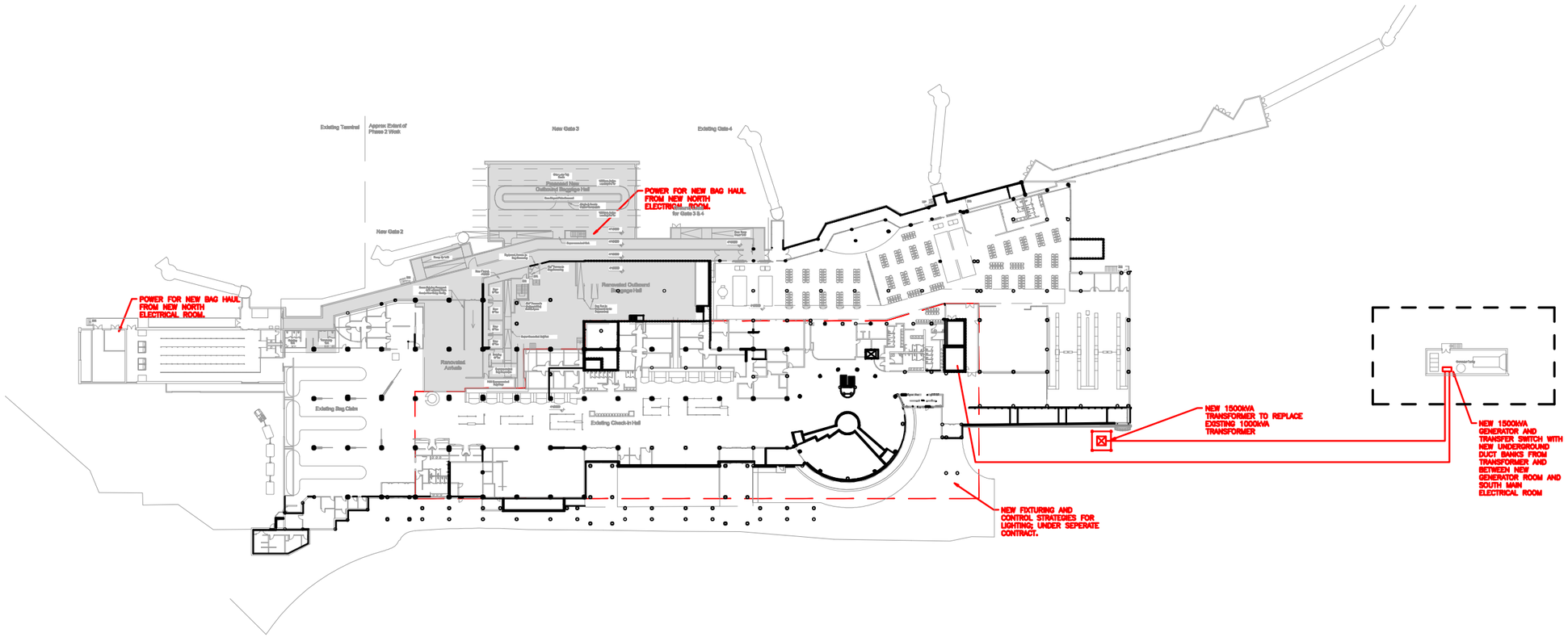
STANDARD STRIPLIGHT—PRODUCT AVAILABILITY

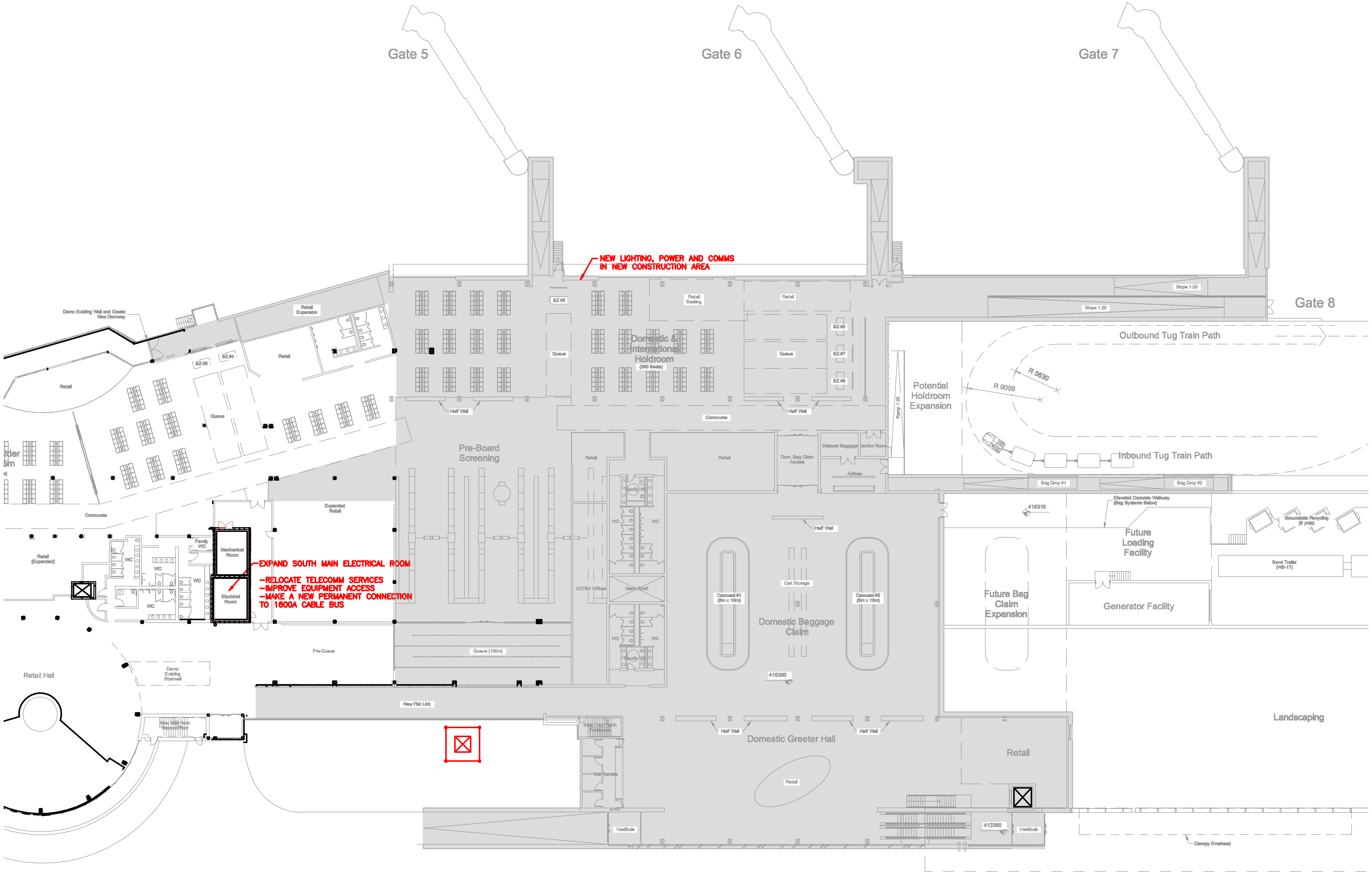
Size	Family	Lamps Cross-Sect	Lamps/ Fixture	Lamp Type	Length in. (mm)
22"	STRIPL	1 or 2	1/2	14/24HO	22 3/8"(570)
34"	STRIPL	1 or 2	1/2	21/39HO	34 1/4"(870)
46"	STRIPL	1 or 2	1/2	28/54HO	46"(1170)
58"	STRIPL	1 or 2	1/2	35/80HO	57 7/8"(1470)
92"	TSTRIPL	1 or 2	2/4	28/54HO	92"(2340)

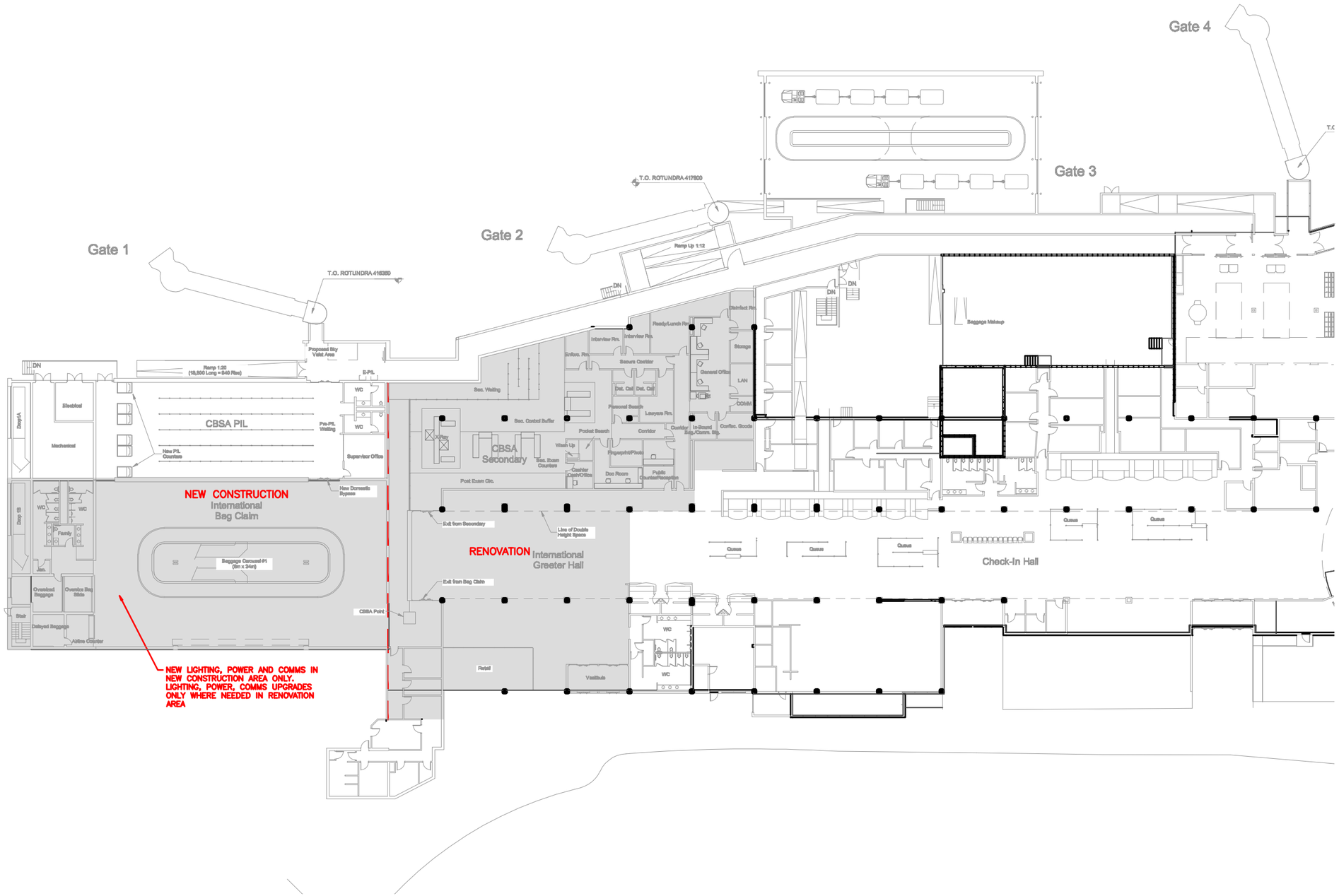
Accessories (ordered separately):
- **WG-T5** – Strip-1LP (must specify length)
- **WG-T5** – Strip-2LP (must specify length)

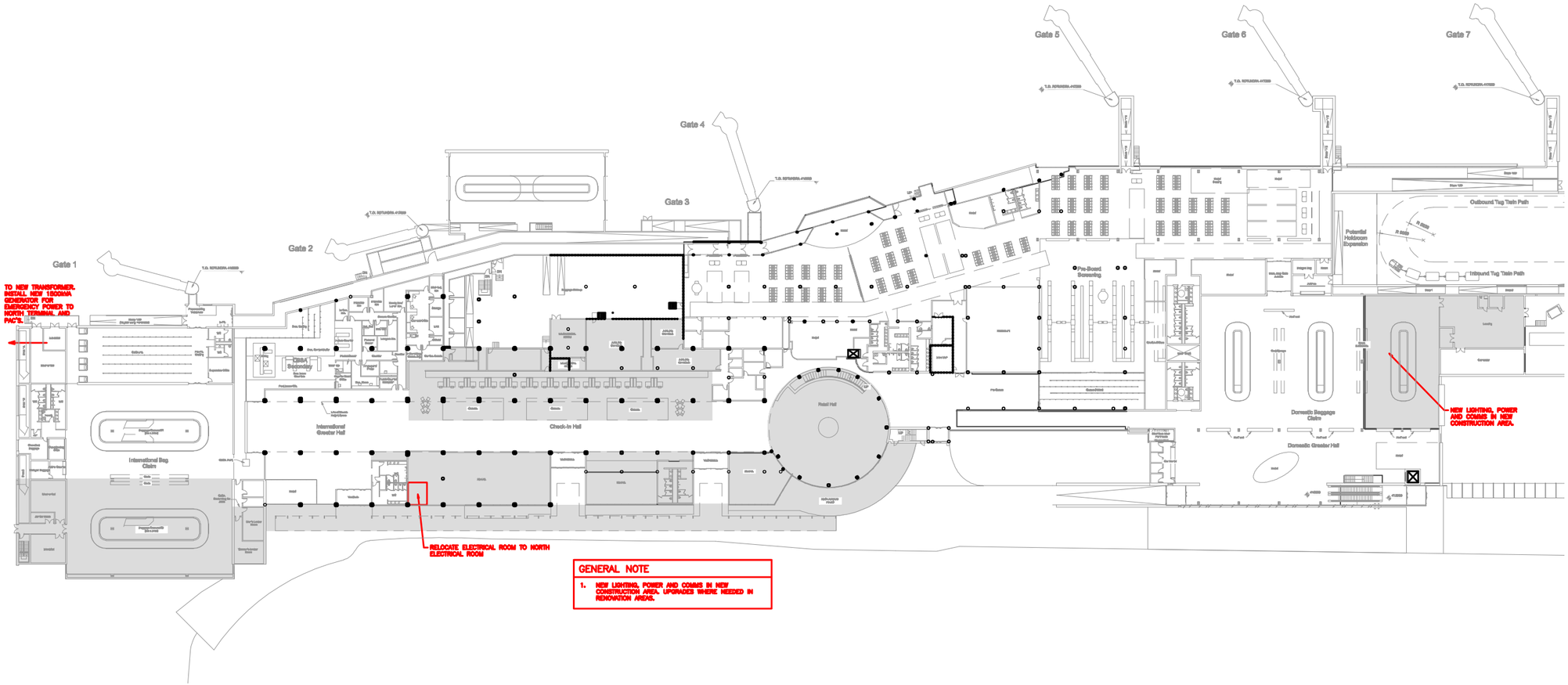

DUCT BANK STUB OUT FOR FUTURE TRANSFORMER (PHASE 5)
1600A CABLE BUS TO SOUTH MAIN ELECTRICAL ROOM (ON ROOF)
Proposed Gate 1 Rotunda
Existing Gate 2 Rotunda
Existing Gate 1 Rotunda
Proposed Sky Valet Area
Existing Link Modified
CBSA PIL
Pre-PIL Waiting
Corridor to Bag Claim
Temporary Baggage Belt
Bag Scanner
Bag Drop #1
Bag Drop #2
Bag Drop #3
New Entry to Bag Claim
Modified Secondary
Existing Carousel #1
Existing Carousel #2
Existing Carousel #3
Existing Greeter Hall
Tug Train Allowance
Existing Fence Line
GENERAL NOTE
1. ALL NEW, LOWER POWER LIGHTING IN SHADED AREAS. NEW POWER AND COMMS IN THESE AREAS.
NEW FIXTURES OR RE-LAMPING IN THIS AREA, WITH UPDATED CONTROLS: UNDER SEPERATE CONTRACT


Gates 6, 7, 8
Existing Gate 6
Airside Corridor
Existing Gate 4
Gates 1, 2, 3
Proposed Retail 28 sm
Proposed Retail 28 sm
Glazed Movable Partition Pocket
Transborder Holdroom
100 Seats
Queue
Queue
Domestic & International Holdroom
279 seats
Queue
Queue
Existing Retail
Restroom
Restroom
Demo Temporary Wall
RE-FIXTURE TO MATCH NEW LIGHTS IN SHADED AREAS; UNDER SEPERATE CONTRACT
CATSA
Training
Search
Corridor
PBS
RE-FIXTURE TO MATCH NEW LIGHTS IN SHADED AREAS; UNDER SEPERATE CONTRACT
TEMPORARY JUNCTION BOX FOR CONNECTION TO MAIN SWITCHGEAR (IN PLACE UNTIL PHASE 3)
Restaurant
CATSA Search
Existing Retail
CATSA Control room
Existing Retail
Existing Retail
Existing Retail
1600A CABLE BUS TO SOUTH MAIN ELECTRICAL ROOM (ON ROOF)
Mechanical Room
Electrical Room
Restroom
Restroom
Restroom
Restroom
FIRE ALARM PANEL AND DEVICE UPGRADE
GENERAL NOTE
1. NEW LIGHTING FIXTURES WITH DAY LIGHT CONTROLS IN SHADED AREA. UPDATE POWER AND COMMS WHERE REQUIRED.


Existing Terminal
Approx. Extent of Phase 2 Work
New Gate 3
Existing Gate 4
New Gate 2
Proposed New Outbound Baggage Hall
POWER FOR NEW BAG HAUL FROM NEW NORTH ELECTRICAL ROOM.
for Gate 3 & 4
Renovated Outbound Baggage Hall
Renovated Airfield
Existing Bag Claim
Existing Check-In Hall
POWER FOR NEW BAG HAUL FROM NEW NORTH ELECTRICAL ROOM.
NEW 1500kVA TRANSFORMER TO REPLACE EXISTING 1000kVA TRANSFORMER
NEW 1500kVA GENERATOR AND TRANSFER SWITCH WITH NEW UNDERGROUND DUCT BANKS FROM TRANSFORMER AND BETWEEN NEW GENERATOR ROOM AND SOUTH MAIN ELECTRICAL ROOM
NEW FIXTURING AND CONTROL STRATEGIES FOR LIGHTING; UNDER SEPERATE CONTRACT.


Gate 5
Gate 6
Gate 7
Gate 8
NEW LIGHTING, POWER AND COMMS IN NEW CONSTRUCTION AREA
Domestic & International Holdroom
Outbound Tug Train Path
Inbound Tug Train Path
Potential Holdroom Expansion
Pre-Board Screening
EXPAND SOUTH MAIN ELECTRICAL ROOM
-RELOCATE TELECOMM SERVICES
-IMPROVE EQUIPMENT ACCESS
-MAKE A NEW PERMANENT CONNECTION TO 1600A CABLE BUS
Mechanical Room
Electrical Room
Domestic Baggage Claim
Future Loading Facility
Future Bag Claim Expansion
Generator Facility
Landscaping
Domestic Greeter Hall
Retail
Retail Hall
Concourse
Queue


Gate 1
Gate 2
Gate 3
Gate 4
T.O. ROTUNDRA 417830
T.O. ROTUNDRA 417800
T.C
Ramp Up 1:12
DN
Proposed Sky Valet Area
Ramp 1:20
(18,000 Long = 840 Rise)
E-PIL
WC
CBSA PIL
Pre-PIL Waiting
New PIL Counters
Supervisor Office
Elevator
Mechanical
Duty/A
Sec. Waiting
Sec. Control Buffer
CBSA Secondary
Sec. Exam Counters
Post Exam Circ.
Pocket Search
Corridor
Wash Up
Fingerprint/Photo
Cashier Cash/Offline
Doc Room
Public Counter/Reception
Key
Interview Rm.
Enforc. Rm.
Secure Corridor
Det. Cell
Personal Search
Lawyers Rm.
Ready/Lunch Rm.
Disinfect Rm.
Storage
General Office
LAN
COMM
Corridor
In-Bound Sec./Comm. Sh.
Confisc. Goods
Baggage Makeup
Queue
Check-In Hall
NEW CONSTRUCTION
International
Bag Claim
New Domestic Bypass
Exit from Secondary
Line of Double Height Space
RENOVATION International
Greater Hall
Exit from Bag Claim
CBBA Point
Retail
Vestibule
Duty/B
Family
Jan.
Oversized Baggage
Oversize Bag Slide
Stair
Delayed Baggage
Airline Counter
Baggage Carousel #1
(9m x 34m)
NEW LIGHTING, POWER AND COMMS IN NEW CONSTRUCTION AREA ONLY. LIGHTING, POWER, COMMS UPGRADES ONLY WHERE NEEDED IN RENOVATION AREA


Gate 1
Gate 2
Gate 3
Gate 4
Gate 5
Gate 6
Gate 7
TO NEW TRANSFORMER. INSTALL NEW 1500KVA GENERATOR FOR EMERGENCY POWER TO NORTH TERMINAL AND PAC'S.
RELOCATE ELECTRICAL ROOM TO NORTH ELECTRICAL ROOM
NEW LIGHTING, POWER AND COMMS IN NEW CONSTRUCTION AREA.
Outbound Tug Train Path
Inbound Tug Train Path
Potential Holdroom Expansion
Pre-Board Screening
Check-in Hall
International Greeter Hall
International Bag Claim
Domestic Baggage Claim
Domestic Greeter Hall
Retail Hall
CBSA Secondary
GENERAL NOTE
1. NEW LIGHTING, POWER AND COMMS IN NEW CONSTRUCTION AREA. UPGRADES WHERE NEEDED IN RENOVATION AREAS.

10.0 ENVIRONMENT AND SUSTAINABLE DESIGN

▸ Executive Summary

The Kelowna Airport has identified energy efficiency as a priority for this project. As part of the City of Kelowna, the Airport needs to comply with the City's climate change commitments and the design team was tasked with evaluating the greenhouse gas impact of the expansion. The design team also created several options to reduce airport green house gas emissions. An energy audit was performed at an early stage of the project to assess potential energy saving in the existing building. Data from this energy audit has been integrated into this document to show energy and green house gas savings associated with the recommended upgrades. The energy audit report can be found in the Appendix.

As part of an integrated design process, energy modeling is also being used to guide the design of the Kelowna Airport Expansion. Different types of analyses were performed: peak heating and cooling load, solar angles, glare, room temperature, and energy consumption. Outputs from those studies help the design team understand how to improve energy efficiency and sustainability. Important factors regarding energy efficiency can be analyzed in detail to provide energy cost savings necessary to support return on investment calculations.

The results from this integrated design process has been summarized in a tabular format presenting six options for the airport expansion ranging from building to Code to the incorporation of best design practices including a hybrid geothermal heating and cooling system. Due to the increased building area after the expansion, just building to current Building Code will increase the airport's carbon footprint by 87%. The various upgrades and energy audit initiatives can reduce the airport carbon footprint substantially as shown in the table to the right. The addition of geothermal has a significant effect on reducing greenhouse gas emissions as it replaces natural gas consumption for heating with electricity consumption to drive the heat pumps. Electricity production in British Columbia is nearly entirely produced with green house gas neutral hydro electric power.

	V0	**V1**	**V2A**	**V2B**	**V3**	**V4**	**V5**	**V6**
	Existing ATB only	New Building Code compliant	Envelope upgrade and energy audit	V2a +triple glazing	Mech&Elec system Upgrade 1	Mech&Elec system Upgrade 2	V3 plus Geothermal	V4 plus Geothermal
Total CO2 (tCo2)*	502	939	794	786	558	464	247	220
% overall carbon change	0%	87%	58%	56%	11%	-8%	-51%	-56%

BACKGROUND

British Columbia Climate Action Charter

Kelowna carbon reduction goals have been formalized trough the British Columbia Climate Action Charter. The City of Kelowna Green Gas Emission Inventory explains the commitment of the city toward reducing carbon emission as follows:

"In 2001, Kelowna joined the Partners for Climate Protection Program. Municipal Council then endorsed the Kyoto Protocol in March of 2002 and adopted the Federation of Canadian Municipalities resolution towards the reduction of greenhouse gas emissions (GHG) in September of 2002. On September 21st, 2007 the City signed on to the Climate Action Charter (Appendix 1). In signing the Charter, the City committed to being carbon neutral in respect to City operations by 2012, as well as to measuring and reporting community greenhouse gas emissions and creating a complete, compact, more energy efficient community. In 2008, the provincial government adopted Bill 27 - Local Government (Green Communitie Statutes Amendment Act. Bill 27 requires municipalities to identify a numeric target for greenhouse gas and to amend their Official Community Plans (OCP) to reflect this target by May 31st, 2010. Eager to show leadership on greenhouse gases, the Province committed to a very ambitious 33% reduction from 2007 levels, by 2020. The target set by the Province (for the Province as a whole) establishes a starting point for communities such as the City of Kelowna in setting municipal community emissions targets. It should be noted that, in addition to targeting a 33% reduction by 2020, the Province is also targeting an 80% reduction by 2050. This report focuses on what would be required to achieve the 2020 reductions. The Provincial targets, although not at this point legally imposed on local jurisdictions, cannot be achieved without the cooperation of communities such as Kelowna.

To achieve a 33% reduction of greenhouse gas emissions by 2020, a significant change will be required of all Kelowna residents and businesses including the corporation of the City of Kelowna. In the simplest terms, by 2020, each Kelowna resident will need to generate less than half the greenhouse gas emissions they generated in 2007. Achieving those reductions

Sustainability Goals and objectives

The design team is using Kelowna's target for reducing carbon emission by 33% as a target for the airport. Several design options were developed to better understand what is required to meet the target. This report provides an estimate of the energy consumption and green house gas emissions for different design options.

ENERGY MODELING METHODOLOGY AND ASSUMPTIONS

Methodology

The IES Virtual Environment Software was used to test energy use, day lighting strategies, mechanical system options and to calculate energy consumption. IES software was selected for its ability to model the advanced systems that are being considered for the airport. IES has been identified as the “most comprehensive, most rigorous, and best integrated suite of tools for building energy design and analysis on the world market today.” (Cadalyst Labs Review)

IES VE calculates energy consumption on an hourly basis, based on a detailed set of inputs that include the following:

- 3D building information
- Type of glazing
- Type of building materials and construction
- Internal and external shading
- Shading from other buildings (or in our case, the surrounding mountains)
- Internal lighting types and schedules
- Heating and cooling loads and schedules
- Zone temperature set point and schedules
- Terminal equipment characteristics and performance
- Central system characteristics and performance
- Energy type (natural gas, electricity, etc.)

It is important to recognize that energy modeling is a tool best used to evaluate different design options as part of a design process. Building operations and occupant behaviour have a significant impact on actual energy consumption that is not effectively considered by the energy model. The existing building was modeled to take into account impact of the existing building on the new expansion, but energy simulation was not performed for the existing building. Real energy consumption was used instead for greater accuracy.

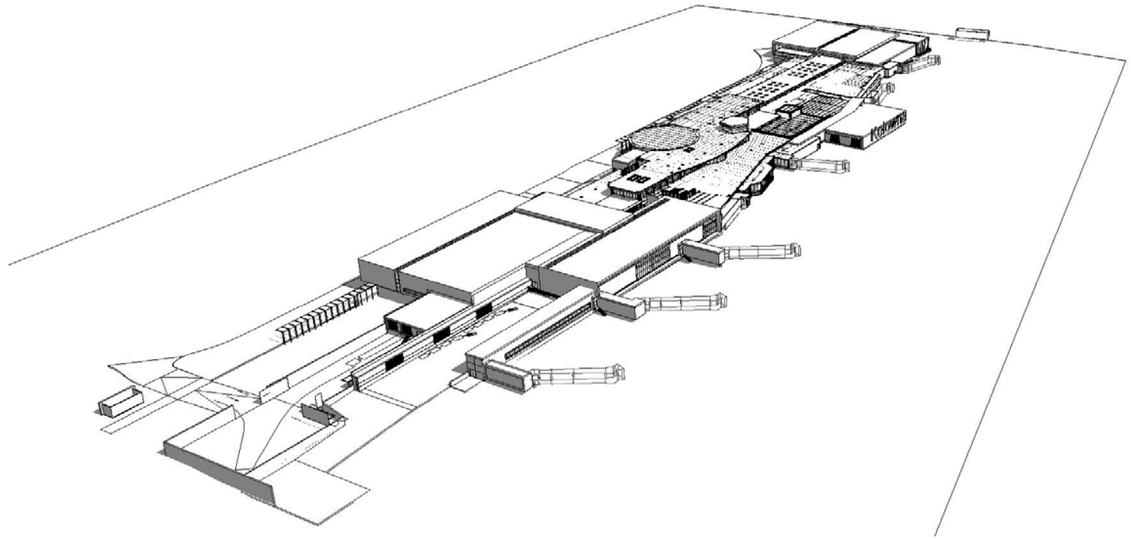


Figure 1 – 3D View of the Revit Model

Climate Data

The Kelowna, BC CWEC climate data used for this analysis describes a typical meteorological year and includes hourly values for many parameters including:

- Dry bulb temperature
- Dew point temperature
- Relative Humidity
- Solar Radiation
- Wind speed and direction
- Cloud cover

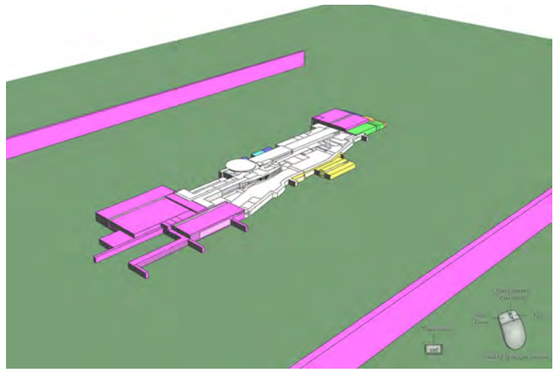


Figure 2 – 3D view of the IES model

Occupancy and Schedules

The following maximum occupancy numbers were used in the model:

CBSA	250
International Baggage Claim 1	202
International Baggage Claim 2	202
Domestic Baggage Claim	874
International/Domestic Hold Room Expansion	416

The maximum occupancy was adjusted according to the following time of day schedule. This schedule is based on the anticipated aircraft arrivals and departures predicted by the J. Suehiro March 2010 YLW Facilities Program Analysis:

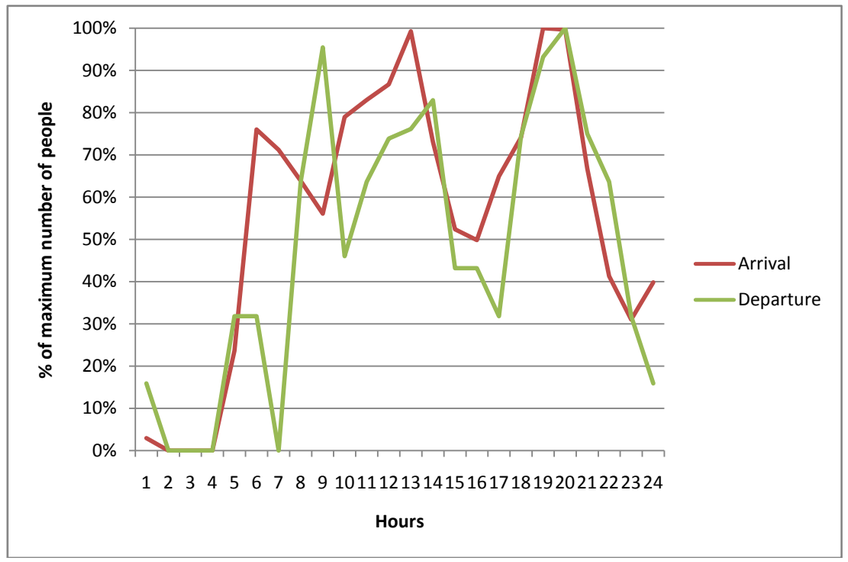


Figure 3 – Occupancy schedule for arrival and departure

Fans are considered to run from 5am to 11pm and light are assumed to operate from 6am to 11pm with a residual lighting power of 15% during the night.

Mechanical and Electrical

New construction mechanical and electrical system energy efficiency is based on the ASHRAE 90.1 2004 standard. Lighting power densities are defined for the different space types. Mechanical system types are defined in the ASHRAE 90.1 2004 Appendix G and equipment performance in section 6. The Design Option section gives details about the mechanical systems modeled.

Radiant floor areas

Radiant floor cooling was considered as a design option. Pipe imbedded in the concrete slab are not practical in certain area of the building where flexibility is required. For this reason, not all the areas were modeled with radiant floor.

Thermal mass elements

Concrete walls and slab where model in some areas to give the building more thermal inertia.

Impact of surrounding mountains on building shading

Mountain range East and West of the Airport have an impact on the solar gain. Mountains shade the building at sun rise and sun set. This has an impact on the energy consumption of the building.

A topographical map was analysed to determine horizon line angle with elevation and distance take-off.

A shading surface with the same height and distance from the airport was modeled in the software. A flat shading surface was used to model the horizon line instead of a mountain surface as it would have the same shading effect without requiring the significant computer processing time required to analyze a complex shape.

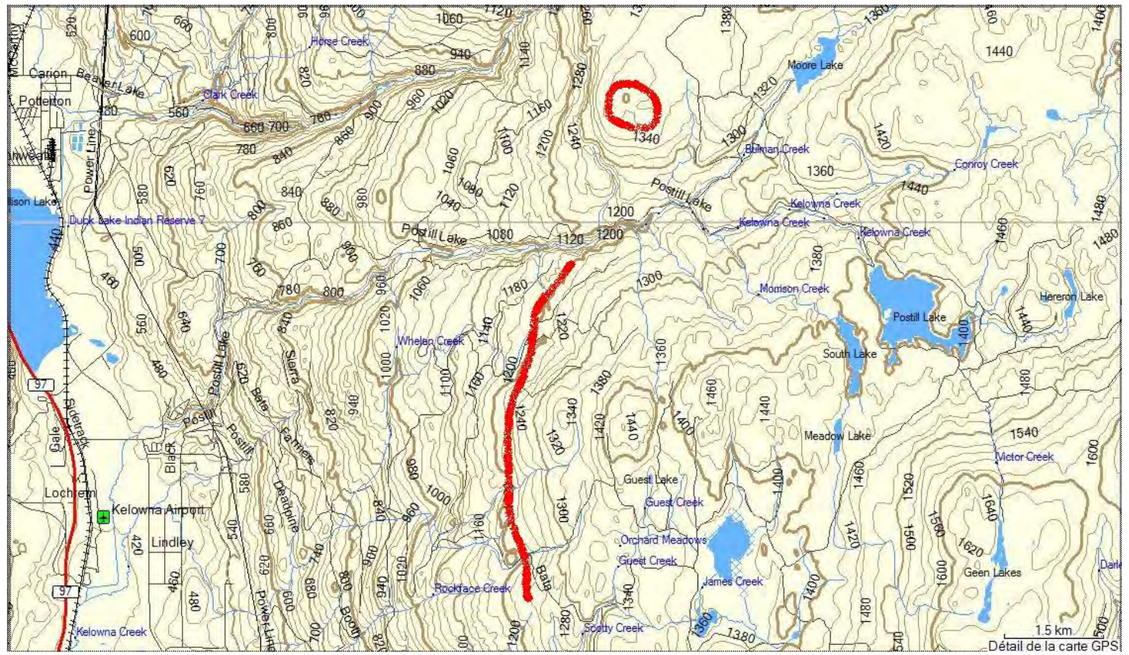


Figure 4 – Topographical map of Kelowna's airport surrounding (East side) identifying the mountain ridge and elevation that shades the airport

The horizon line is at an angle of 10 degrees from the horizontal on the West side and 7 degrees on the East side. This information can be incorporated in a sun path diagram to understand the impact of the mountains. A sun path diagram shows the path of the sun through the sky. This chart shows that the mountains are blocking the sun for the first hour of the day and for the last 40min of the day.

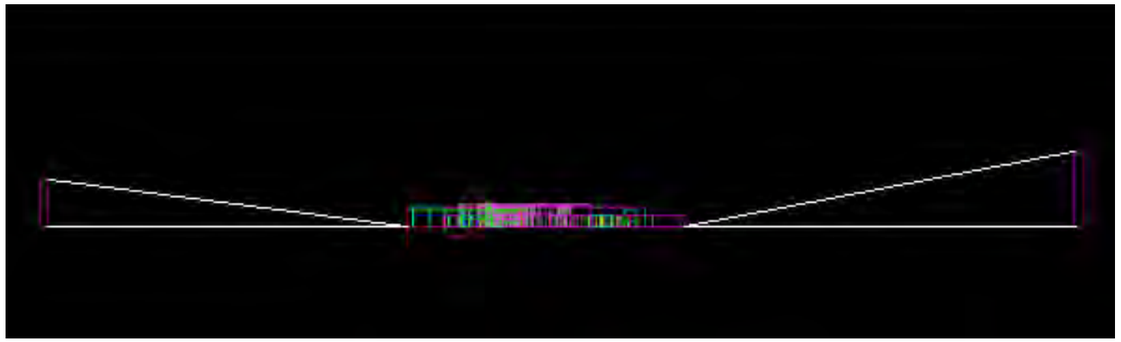


Figure 5 – Horizon line modeled in IES

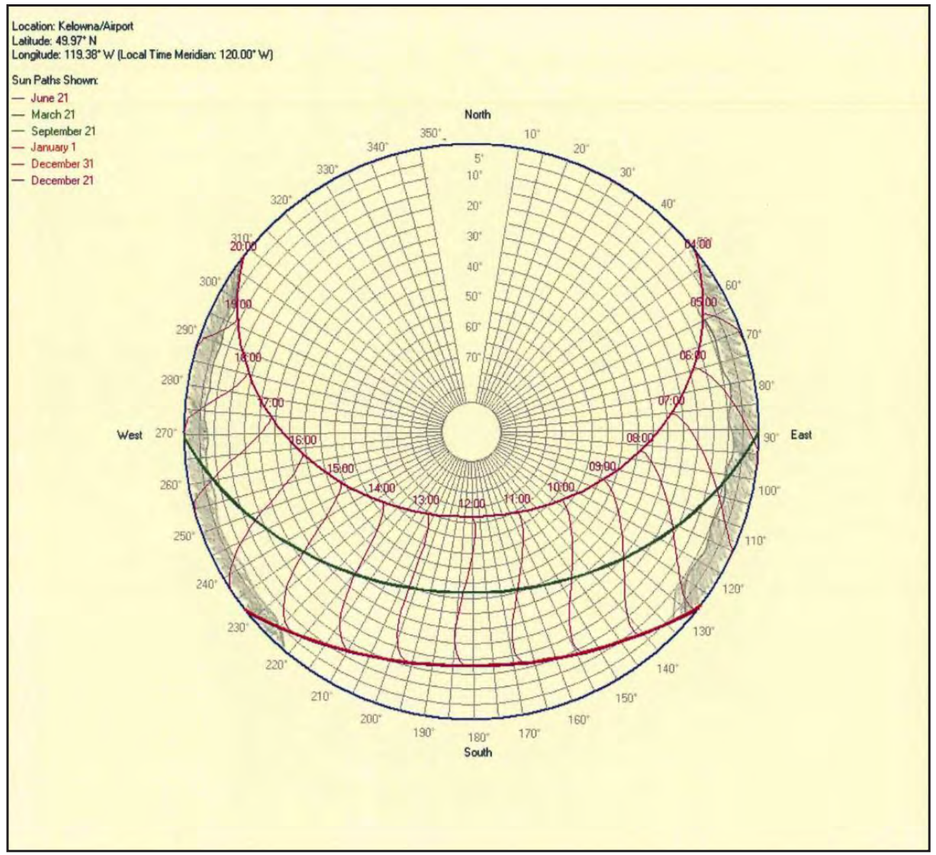


Figure 6 – Sunpath chart for Kelowna showing approximate shading from the mountain in gray

Utility Cost

Base on current utility bills, utility rates are 6.9¢/kWh for electricity and $11.18/GJ for natural gas. These rates include all demand and distribution charges. Designing this building for 2025, future rates need to be used in the analysis. Predicting future energy rates is difficult and subject to great debate. Natural gas is actively traded on the financial markets and can be purchased 5 years in advance. Looking at those future rates, we can identify a trend that can be extrapolated to predict 2025 rates. For this analysis we are being very conservative and are using the following values:

Commodity

Average Commodity price in the last year	Average BC gas supplier rates for fixed 5 year rate	2025 commodity rates used in the analysis
6.83$/GJ	7.9$/GJ	9$/GJ

Distribution Charge

Average distribution charge in the last year	2025 distribution charge used in the analysis
2.27$/GJ	3.7$/GJ

Other Charges

Other charge in the last year	2025 distribution charge used in the analysis
2.08$/GJ	2.08$/GJ

Total Natural gas price used is the sum of the commodity, distribution charge and other charges; 13.7$/GJ.

Future electricity rates are harder to determine due to the fact that the electricity market is regulated in BC. British Columbia government is keeping the rate as stable as possible and price follows the inflation rates. For this reason, electricity rates were kept the same as current rates in the energy simulation.

In our opinion, these rates are quite conservative (low). Higher gas rates were encountered in the last decade and could return particularly if the economy heats up again increasing demand, or if supply is constrained.

Energy Source Carbon Emissions

The following factors were used to convert utility consumption into green house gas emissions:

Electricity: 0.02kg/kWh1F

Gas: 0.181kg/kWh2F

Process Energy

Process energy related to aircraft operation such as the baggage handling systems, bridge powered units and any other aircraft operation were not included in the analysis. The impact of these processes should be done in a separate study to assess the carbon performance of the airport operations. Several opportunities exist to reduce process energy that the airport should consider to help meet their carbon reduction target. Efficient baggage handling systems, a policy to reduce aircraft powered unit use, and efficient apron lighting are a few ideas to be considered.

Integrated design approach

Optimization of facades

The energy model was used in the facade design process to help the design team understand the amount of heat gained from the sun shining through the windows. This is an important design consideration as uncontrolled solar gains can exceed the cooling capacity of efficient HVAC systems such as displacement ventilation and chilled slabs.

Solar and internal gains was analysed for each design option. The significant east and west facades require special attention as the low sun at sunrise and sunset will shine in through the east and west facades causing glare and temperature control challenges. A typical strategy to address these concerns is to reduce the east and west facade glazing ratio. This strategy was in tension with a desire to provide significant views to the apron, runway and mountains. Views are also important at the drop off and pick up areas. The design team balanced these considerations with an approach that varied the glazing ratio and sun shading to respond to the primary considerations for each space.

The IES Energy simulation software was also used to assess daylight performance. This information was used by the design team to adjust the glazing to provide daylight levels that will enhance the occupant experience. The electrical design was able to utilize this day lighting simulation information to inform their design. Lighting controls and systems will allow the electrical lighting to dim or turn off when sufficient day light is available to save on lighting energy.

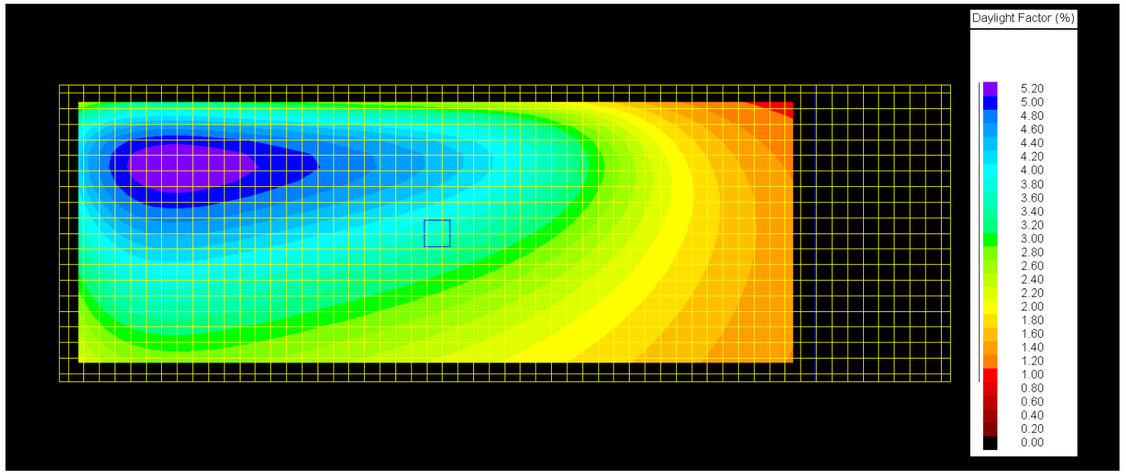


Figure 7 – Daylight analysis in the CBSA area

2 Environment Canada, http://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=EAF0E96A-1
3 US Energy Information Administration, http://www.eia.doe.gov/oiaf/1605/coefficients.html

▸ Design Options

		V0	V1	V2A	V2B	V3	V4	V5	V6	
		Existing ATB only	Base Case	Envelope upgrade	Envelope upgrade plus Triple Glazing	Mec&Elec system Upgrade 1	Mec&Elec system Upgrade 2	V3 plus Geothermal	V4 plus Geothermal	Comment
Architecture	Insulation Values to Code		x							Roof R15, Wall R12, Glass Usi=3.2 w/frame
	Upgrade Insulation Values			x	x	x	x	x	x	Roof R30, Wall R24, Glass Usi=1.8 w/ frame
	High Performance Triple Glazing				x	x	x	x	x	Usi=1.1 with frame
	Additional Thermal Mass			x	x	x	x	x	x	
Mechanical	ASHRAE 90.1 mechanical system		x	x	x					Sys 5 VAV DX cooling, hot water coil, boiler 80%
	VAV Supply Units - Wet Coils					x		x		Sys 7 w/ heat recovery , boiler 87%
	Displacement Ventilation - Wet Coils						x		x	DOAS w/heat recovery, boiler 92%
	Geothermal							x	x	
Electrical	ASHRAE 90.1 compliant		x	x	x					
	Light Power Density reduced by 20%					x	x	x	x	
	Daylight sensor						x	x	x	
Existing Building	Existing building with no change	x	x							
	Implement Energy Audit Items without geothermal			x	x	x	x			Reduction as per audit report
	Implementing Energy audit with geothermal							x	x	

Figure 8 – Design Options

V0 represents the existing building without any expansion. CO2 and energy consumption are obtained from real data.

V1 represents the existing with no change with the addition of the expansion built to code. Insulation values, Lighting power density and mechanical system efficiencies meet ASHRAE90.1-2004 minimum requirements. The mechanical system is a VAV system with hot water coils and DX cooling. This is based on ASHRAE90.1-2004 appendix G assumptions that define baseline system types based on building floor area and the number of floors.

V2a is a first upgrade where the energy audit recommendations are implemented in the existing building with the exception of geothermal. Envelope insulation values are upgraded compared to code values.

V2b adds triple glazing to option V2a.

V3 is an upgrade to the mechanical and electrical systems. The mechanical system is a VAV system with hot and chilled water coils, heat recovery and high efficiency boilers. Lighting is upgraded with more efficient fixtures allowing a 20% Lighting Power Density reduction.

Detailed Results

		V0	V1	V2A	V2B	V3	V4	V5	V6
CO2	C02 Production (existing building) (tco2)	502	502	411	411	411	411	196	96
	C02 Production (new building) (tco2)	0	437	383	374	147	53	51	24
	Total CO2 (tCo2)*	502	939	794	786	558	464	247	220
	% overall carbon change	0%	87%	58%	56%	11%	-8%	-51%	-56%
Energy	Annual electricity consumption (MWh)		1160	1152	1146	1133	805	1251	847
	Annual natural gas consumption (MWh)		2289	1989	1942	688	201	142	39
	equivalent kwh/ft2 (new only)		37.8	34.4	33.8	20.0	11.0	15.3	9.7
	Annual electricity consumption (MWh) existing	4244	4244.0	3115.0	3115.0	3115.0	3115.0	3535.0	3535.0
	Annual natural gas consumption (MWh) existing	2354.0	2354.0	1981.0	1981.0	1981.0	1981.0	371.0	371.0
	equivalent kwh/ft2 (new only) existing	61.4	61.4	47.4	47.4	47.4	47.4	36.4	36.4
Cost	Annual electricity Cost ($) new building		$80,040	$79,513	$79,071	$78,201	$55,577	$86,304	$58,438
	Annual natural gas Cost ($) new building		$112,882	$98,098	$95,777	$33,941	$9,933	$6,994	$1,940
	Annual Energy Cost new building		$192,922	$177,611	$174,848	$112,142	$65,510	$93,298	$60,378
	Annual Energy savings		$0	-$15,310	-$18,074	-$80,780	-$127,412	-$99,624	-$132,543
	Annual electricity Cost ($) (existing)		$292,836	$214,936	$214,936	$214,936	$214,936	$243,916	$243,916
	Annual natural gas Cost ($) (existing)3F		$116,099	$97,703	$97,703	$97,703	$97,703	$18,298	$18,298
	Annual Energy Cost (existing)		$408,935	$312,639	$312,639	$312,639	$312,639	$262,214	$262,214
	Annual Energy savings (existing)		$0	-$96,296	-$96,296	-$96,296	-$96,296	-$146,722	-$146,722

Figure 9 - Design options - Results for 2025 building

4 Annual Energy cost uses future rates (see Utility Cost section)

V4 is a second upgrade to the mechanical and electrical systems. In this option, ventilation is decoupled from the cooling by using displacement ventilation and chilled slabs. Heat recovery is still included in the air systems and condensing boilers are used. Lighting is upgraded with daylight and occupancy sensors.

V5 is the same system as V3 with ground source heat pumps acting as the primary source of heating and cooling. The gas boilers are required to meet heating needs on very cold days. Ground source heat pumps are also providing heat to the existing building.

V6 is the same system has V4 with ground source heat pumps acting as the primary source of heating and cooling. The gas boilers are required to meet heating needs on very cold days. Ground source heat pumps are also providing heat to the existing building.

2016 building

		V0	V1	V2A	V2B	V3	V4	V5	V6
CO2	C02 Production (existing building) (tco2)	502	502	411	411	411	411	196	196
	C02 Production (new building) (tco2)		348	305	298	117	42	40	19
	Total CO2 (tCo2)*		850	716	709	528	453	237	216
	% overall carbon change		69%	43%	41%	5%	-10%	-53%	-57%
Energy	Annual electricity consumption (MWh)		923	917	912	902	641	996	674
	Annual natural gas consumption (MWh)		1822	1583	1546	548	160	113	31
	equivalent kwh/ft2 (new only)		38	34	34	20	11	15	10
	Annual electricity consumption (MWh) existing	4244.0	4244.0	3115.0	3115.0	3115.0	3115.0	3535.0	3535.0
	Annual natural gas consumption (MWh) existing	2354.0	2354.0	1981.0	1981.0	1981.0	1981.0	371.0	371.0
	equivalent kwh/ft2 (new only) existing	61.4	61.4	47.4	47.4	47.4	47.4	36.4	36.4
Cost	Annual electricity Cost ($) new building		$63,712	$63,292	$62,940	$62,248	$44,239	$68,698	$46,517
	Annual natural gas Cost ($) new building		$89,854	$78,086	$76,239	$27,017	$7,906	$5,567	$1,545
	Annual Energy Cost new building		$153,566	$141,379	$139,179	$89,265	$52,146	$74,265	$48,061
	Annual Energy savings		$0	-$12,187	-$14,387	-$64,301	-$101,420	-$79,301	-$105,504
	Annual electricity Cost ($) (existing)		$292,836	$214,936	$214,936	$214,936	$214,936	$243,916	$243,916
	Annual natural gas Cost ($) (existing)4F		$116,099	$97,703	$97,703	$97,703	$97,703	$18,298	$18,298
	Annual Energy Cost (existing)		$408,935	$312,639	$312,639	$312,639	$312,639	$262,214	$262,214
	Annual Energy savings (existing)		$0	-$96,296	-$96,296	-$96,296	-$96,296	-$146,722	-$146,722

Figure 10 – Design options - Results for 2025 building

5 Annual Energy cost uses future rates (see Utility Cost section)

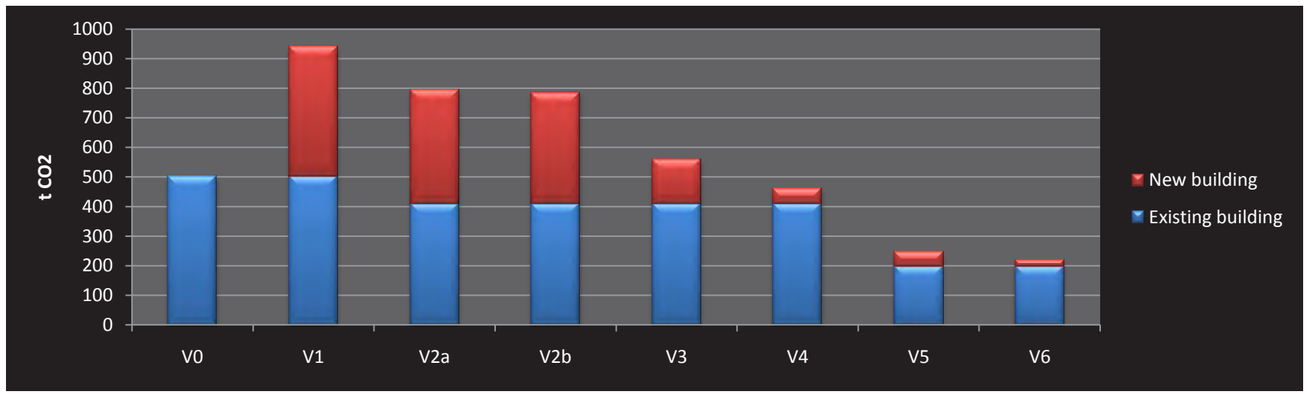


Figure 11 – Design option carbon emissions (2025 building)

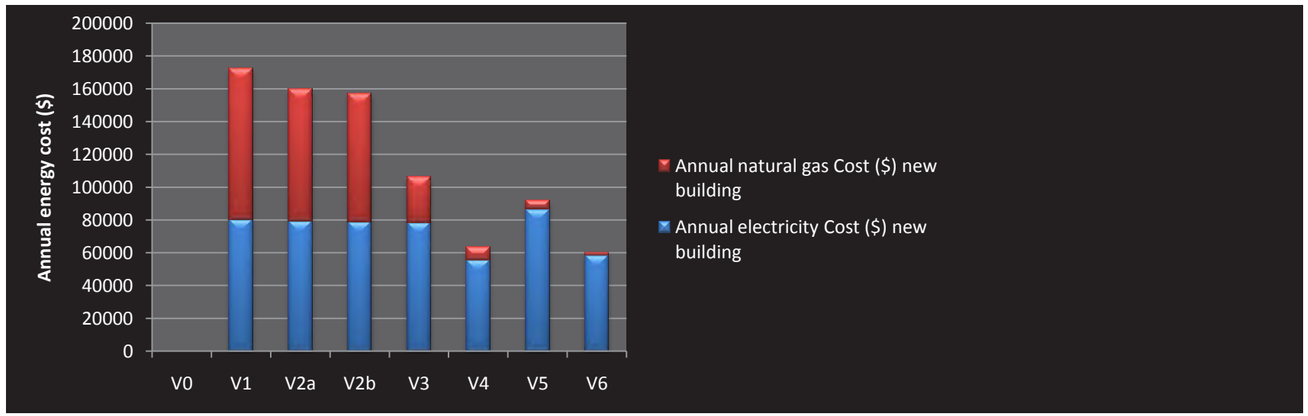


Figure 12 – Design Option annual energy costs (2025 building)

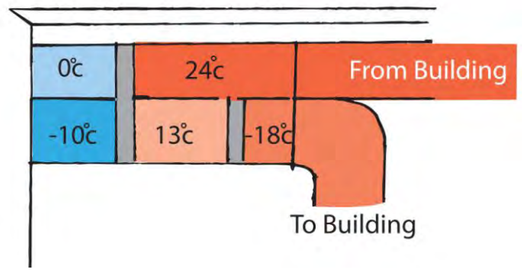
▸ Proposed Energy Conservation Measures

Upgraded Insulation Values

Upgrades to the building envelope are most cost effective at the time of construction. The significant roof area will allow improvements to roof insulation to generate considerable cost effective savings. Wall and glass performance is also important. Further analysis can be performed in the design development phase to find the optimum insulation values for each building component to maximize return on investment. This analysis will confirm the cost effectiveness of the triple glazing option.

Air-to-Air Heat Recovery

Air-to-air heat recovery devices recover heat from the exhaust air to preheat the air intake. In most case return on investment are around 2-3 years.



Decoupling Ventilation and Cooling

Decoupling cooling from the ventilation allows different energy saving opportunities. With a chilled slab system cooling comes from cold surface fed by cold water instead of coming from cold air. Due to the fact that water can carry more energy than air, delivering cooling is more efficient and fan power is reduced. Displacement systems do not require reheat air at terminal boxes, as is often required in VAV systems. Displacement systems are smaller as they only provide air to meet ventilation requirements, instead of both ventilation and cooling needs as required by VAV systems. The cost savings from the reduced displacement air handling systems are often sufficient to pay for the hydronic cooling systems..

Displacement Ventilation

Displacement ventilation supplies air at temperature slightly lower than air temperature at low level to create an air curtain. When this air reaches a source of heat like a person or equipment, it rises as it picks up the heat creating temperature stratification in the room. The higher the ceiling, the more effective displacement systems are at removing heat gain. It has also the advantages of delivering air close to the occupants as opposed to high at the ceiling increasing ventilation effectiveness thereby allowing lower outside air volumes. By coupling this system with a chilled slab, the airport will be able to lower air volumes significantly.

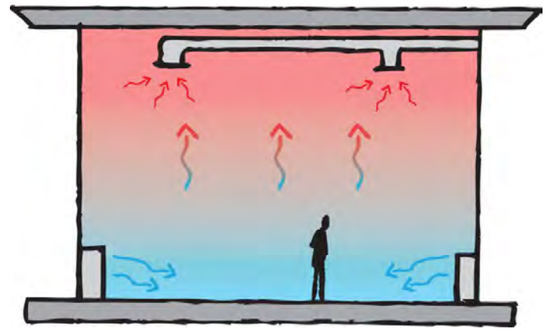


Figure 13 – Displacement ventilation

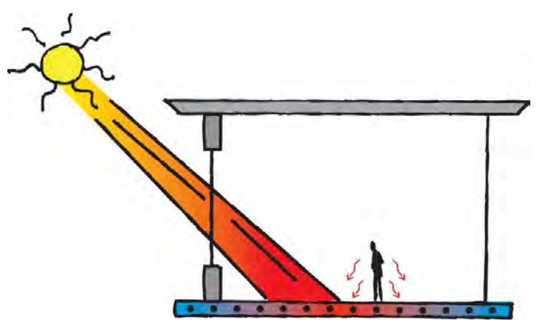
Radiant Floor/Chilled Slab

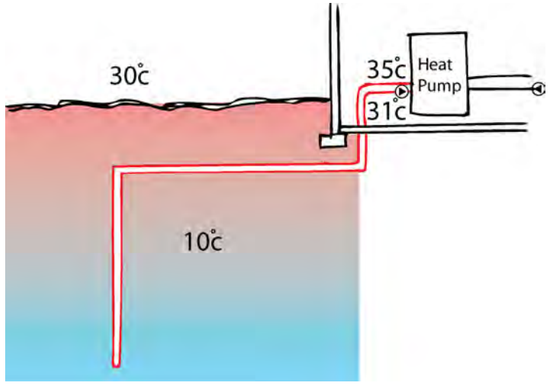
Chilled slab uses the radiant effect of a cold surface to absorb heat gain. Cool water runs inside the slab to maintain the floor surface at 18˚C. At 18˚C, the floor is only a few degrees cooler than room temperature – a difference that will be likely unnoticed by most occupants. This concept offers several advantages. Fan power is reduced by using a water based system for cooling. Space temperature can be a few degrees higher because of the radiant effect of the slab on the occupant. One concern with chilled slab system is that they cannot provide sufficient cooling to offset very high heat loads. For this reason, successful chilled slab design requires careful attention to sources of heat gains such as solar gains from nearby windows.

Ground Source Heat Pump

Ground source heat pumps extract heat from the ground using heat pumps. Heat pumps are similar to chillers, but the cycle is reversible. In winter mode, the ground is cooled and the heat is rejected into the building. In summer operation, the building is cooled and the heat is rejected into the ground. Since the ground temperature remains constant year round, geothermal cooling is more efficient than a typical cooling system. Source of energy is also different, instead of burning natural gas, electricity runs heat pump compressors and the pumps feeding the geothermal system. Switching the heating energy source from natural gas to electricity will reduce carbon emissions.

In order to make the geothermal system cost effective, the system is coupled with a boiler that serves the heating peak. Heating loads for a complete year were analyzed to determine optimal sizing. By sizing the system for 20% of the peak heating load, 80% of the energy can be supplied from the geothermal field. By combining the geothermal system with a boiler system, the return on investment for this system will be in the 10 year range. Once costs are confirmed by a cost consultant, the analysis can be updated to provide more accurate return on investment information.





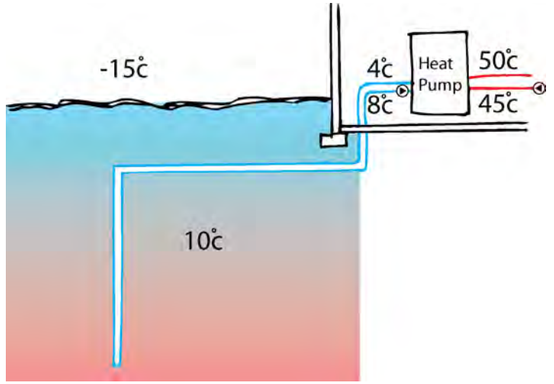


Figure 14 – Chilled slab

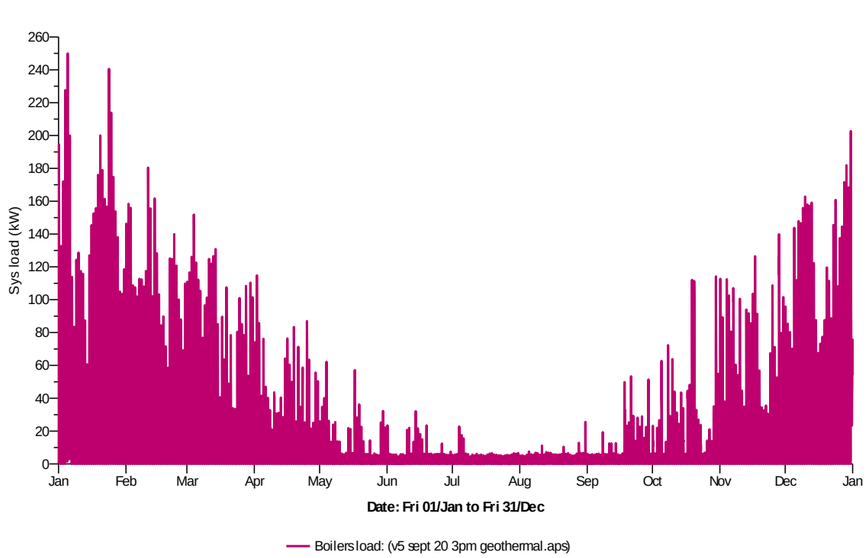


Figure 15 - Cooling load profile for the expansion

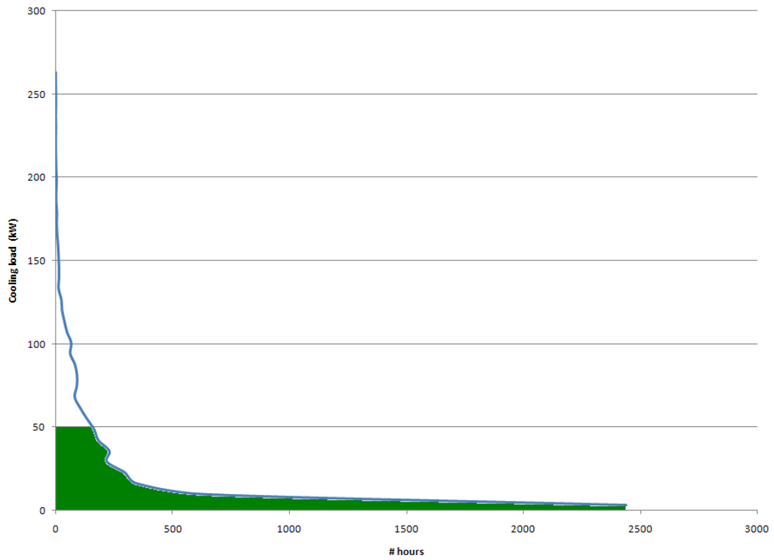


Figure 16 – Cooling load frequency

11.0 STRUCTURAL SYSTEMS

INTRODUCTION

General

The purpose of the Structural Schematic Design Report is to:

- Present the preliminary schemes considered for the structural systems
- Describe the structural systems proposed for the expansion
- Provide the architectural, mechanical, and electrical disciplines with information that will allow the design of the facility to progress, and
- Provide structural information for project costing.

The structural design presented is under development and will be revised and supplemented to meet project expectations, satisfy functional and aesthetic requirements, accommodate the needs of the mechanical and electrical disciplines, and meet cost objectives as the project proceeds.

Project Description

Briefly the Kelowna YLW Expansion comprises several additions to the existing two-storey air terminal building structure, including the trans-border holdroom and international arrivals facilities, domestic arrivals facilities, and outbound bag make-up hall. Phasing of these additions is described earlier in this report. These additions are generally single-storey, with a small two-storey component and a partial basement level beneath the domestic arrivals facility.

Structural Selection Criteria

As the project design develops, we will consider the following:

- **Integration of building systems.** The configuration of the structural roof and floor framing members and lateral load resisting elements will be coordinated closely with the mechanical and electrical systems to provide an efficient and compact integrated building system.
- **Adaptability.** Over time, there may be some desire or need to reconfigure the internal spaces of the air terminal building; the structural systems chosen will allow for future changes to the internal building layout.
- **Safety.** Design loads have been selected that are appropriate for the use and occupancy of the building.
- **Value for money.** Preference will be given to structural systems that provide economy for the project as a whole, taking into account the interdependence of costs between the architectural, structural, mechanical, and electrical systems.
- **Structural serviceability.** The potential for excessive structural deflections or movements will be carefully evaluated
- **Durability and long-term maintenance costs.** Structural materials will be selected that are robust and durable to reduce ongoing maintenance costs, particularly in areas exposed to public view.
- **Appearance.** Exposed structural systems are part of the architectural approach to the design; careful consideration will be given to the appearance of the structure in these areas.

DESIGN CRITERIA

Codes, Standards and Guidelines

Structural systems for the facility will be designed in accordance with the British Columbia Building Code 2006 and the National Building Code 2005 Structural Commentaries (Part 4 of Division B).

Structural components and materials will be proportioned in accordance with the requirements of the following design standards:

- CSA A23.1/A23.2-09 Concrete Materials and Methods of Concrete Construction / Methods of Test and Standard Practices for Concrete
- CAN/CSA A23.3-04 (R2010) Design of Concrete Structures
- CAN/CSA-S16.1-09 Design of Steel Structures
- CAN/CSA-O86-01 Engineering Design in Wood, including CAN/CSA-O86S1-05 Supplement #1
- CSA S304.1-04 Masonry Design for Buildings (Limit States Design).

The engineering design, preparation of related documents and contract administration for the air terminal building will be carried in accordance with the "Guidelines for Structural Engineering Services for Building Projects" published by the Association of Professional Engineers and Geoscientists of British Columbia. An independent concept review of the structural design will be performed by another engineer in accordance with the "Guidelines for Professional Structural Concept Review" published by the Association of Professional Engineers and Geoscientists of British Columbia.

Importance Category

The Building Code requires that an Importance Category be assigned to the facility based on the intended use and occupancy. Kelowna YLW will be designed assuming that the facility is a post-disaster control centre for air transportation.

The following importance factors will be applied to loads:

Load	Ultimate Limit State	Serviceability Limit State
Snow	1.25	0.9
Wind	1.25	0.75
Earthquake	1.5	Not applicable

Design Gravity Loads

Floor and roof areas, unless noted otherwise, will be designed for the following gravity loads:

Main Floor Areas

- Live 4.8 kN/m2
- Concentrated live 9.0 kN
- Super-imposed dead 1.5 kN/m2

Second Floor Areas

- Live 3.0 kN/m2
- Concentrated live 9.0 kN
- Super-imposed dead 1.5 kN/m2

Mechanical Rooms

- Live 3.6 kN/m2
- Equipment Actual weights
- Super-imposed dead 2.0 kN/m2

Roof Areas

- Basic snow and rain (not including drifting or ponding) 3.0 kN/m2
- Live 1.0 kN/m2
- Concentrated live 1.3 kN
- Super-imposed dead 1.0 kN/m2

Lateral Loads from Wind and Earthquake on Primary Structural Members

The lateral load resisting elements will be designed using the following parameters:

Wind

- Reference velocity pressure, 1 in 50 probability of being exceeded in any one year 0.47 kN/m2

Earthquake

- 5% damped spectral response acceleration, expressed as a ratio to gravitational acceleration
- Acceleration and velocity site coefficients
  - » Refer to Geotechnical and Foundation section of the report below
- Structural configuration Irregular
- Seismic Force Resisting System
  Structural steel, moderately ductile concentrically braced frames
  - » Ductility-related force modification factor 3.0
  - » Overstrength-related force modification factor 1.3

Period, T (s)	Spectral Acceleration Sa(T)
0.2	0.28
0.5	0.17
1.0	0.094
2.0	0.056

The seismic restraints for mechanical equipment and services, electrical equipment and services, and architectural components of the air terminal building will be designed by specialist engineers engaged directly by the sub-contractors.

Cladding support elements and attachments to the building structure will be designed for earthquake loads to satisfy the requirements of Article 4.1.8.17 of the British Columbia Building Code 2006

Vertical and Horizontal Deflections

Horizontal components of the structure, floors and roofs, generally deflect downward as a result of gravity loads. Excessive vertical deflections can create concerns, including cracking or crushing of non-structural components, lack of fit for doors and windows, out-of-plumb walls, and water ponding.

Structural members for YLW will be sized to limit deflections that occur after the attachment of non-structural components, including elastic and creep deflections due to sustained load, and immediate deflections due to live or snow load. Deflection limits used in the design are tabulated below, expressed as either an absolute value or as a ratio of span length:

Live Load Deflections	
Roof Members	
Perimeter, smaller of	25 mm L/360
Interior	L/360
Floor members	
Perimeter, smaller of	20 mm L/480
Interior	L/360

Open web steel floor and roof joists will be cambered by an amount equal to the anticipated dead load deflection of the joist. The intent is for the floors to be relatively flat and level, and roofs to have the required slopes for drainage in the long-term under dead loads.

As a result of normal construction procedures and material behavior, it is not possible to achieve perfectly flat and level floors. The project specifications will provide tolerances for floor flatness.

Structural members spanning horizontally, such as girts supporting a curtain wall, will be designed to limit horizontal movements to L/360.

Fire Rating

As discussed in the architectural section of the report, the suspended floors, the supporting columns, and all stair and elevator walls will be designed for a 1 hour fire resistance rating to conform to the required building classification. The roof construction is not required to have a fire resistance rating.

The fire resistance rating for structural steel members is achieved by providing fire retardant spray or other fireproofing on the open web steel joists and structural steel beams, girders, and columns.

CONSTRUCTION MATERIALS

Material Strengths

The following materials are proposed for the YLW expansion:

- Concrete, conforming to CSA-A23.1, made with Type GU Portland cement, as follows:

Application	28 day strength (MPa)	Exposure Class
Foundations	30	N
Interior slab-on-grade	25	N
Exterior slabs	32	C2
Concrete topping on metal deck	25	N

- Grade 400 deformed bar reinforcing steel conforming to CAN/CSA-G30.18
- Structural steel conforming to CAN/CSA-G40.20/G40.21, grade 350W for W shapes and hollow structural sections, grade 300W for other structural shapes and plate
- Open web steel joists conforming to CAN/CSA-S16.1
- Metal decking conforming to the requirements of CAN/CSA-S136
- Timber construction will conform to materials standards referenced in CAN/CSA O86, glulam bending grades 24f-E or 24f-EX and compression grade 16c-E.

Sustainable Design

The sustainable design attributes of the structural systems include:

- **Recycled steel.** Structural steel and reinforcing steel used in expansion of the air terminal building will have a recycled materials content greater than 90%.
- **Re-use of waste materials.** The specifications will require that a portion of the cementitious material used for reinforced concrete members be fly-ash, a waste by product of the coal fired power generation industry. For cast-in-place concrete foundation elements, up to 40% of the total cementitious materials content can be fly ash. For flatwork, fly-ash content is limited to 10% as fly-ash impedes the setting of the concrete and makes slab finishing more difficult.
- **Control of dust and water during construction.** The specifications for the project will be prepared so that the contractor is required to control dust and the erosion of soil from wind and water during construction.
- **Timber framing.** Where practical, portions of the expansion framing will utilize timber harvested from British Columbia forests.

GEOTECHNICAL ISSUES AND FOUNDATIONS

A report titled *"Preliminary Geotechnical Engineering Report, Air Terminal Building (ATB) Expansion, Kelowna International Airport"*, dated February 25, 2010, was prepared by Levelton Consultants Ltd. A second report titled *"Preliminary Geotechnical Engineering Report, Baggage Make-Up Facility Expansion, Kelowna International Airport"*, dated February 23, 2010, was also prepared by Levelton.

The Levelton reports indicate that the soil stratigraphy generally consists of a surface layer of asphalt pavement 100-150 mm thick, underlain by approximately 0.6-1.3 m of compact to dense granular fill, underlain by a layer of firm to stiff clayey silt / silty clay / silt, underlain by interlayered, generally loose to compact sand / silty sand and stiff silt /clay / silty clay.

Groundwater elevations were reported to be between 1.3 and 3.0m below grade.

Recommended site preparation includes removal of the existing asphalt pavement and excavation to the required foundation grade. The anticipated foundation subgrade is existing granular fill, which is recommended to be compacted with vibratory equipment to re-densify any disturbed soils prior to commencing foundation construction. Where excavation exposes fine grained sols, a geotextile will be required as a separator over the subgrade prior to placement of engineered fill.

Levelton recommend that foundations bearing on the existing granular fill or on compacted engineered fill can be designed based on a serviceability limit state (SLS) soil bearing resistance of 125 kPa ,and a factored ultimate limit state (ULS) soil bearing resistance of 190 kPa. Spread and strip footings designed in accordance with these recommendations will be utilized for the facility expansion.

Sulfate concentrations in the collected soil samples range from less than 0.05 and 0.15%, indicating a moderate degree of sulfate attack, and necessitating the use of sulphate-resistant concrete.

Analysis by Levelton of the information gained from cone penetration testing and seismic cone penetration in the area of the expansion indicates that layers of loose sand / silty sand deposits located below the water table are liquefiable during a design-magnitude earthquake. Accordingly, Levelton recommend that design of the structure be based on Site Class 'F' conditions. The results of site-specific analysis undertaken by Levelton indicate that acceleration and velocity site coefficients of 1.78 and 3.64 respectively should be used for earthquake design of the air terminal building.

Levelton also recommends the installation of a perimeter foundation drainage system comprised of rigid, perforated PVC pipe placed within a drain rock surround, wrapped with a non-woven geotexile.

A slab-on-grade floor is considered feasible for this site; this is consistent with the existing construction.

Retaining walls with heights of up to 2.4 m may be required to accommodate the existing grades. These walls will be designed to resist the applied lateral soil pressures.

SUPERSTRUCTURE

Construction Materials

The primary construction materials considered for the superstructure of the expansion are structural steel, concrete and timber.

Cast-in-place concrete was used for a previous portion of the air terminal building superstructure; the exposed structure is prominent in the existing public areas. Concrete construction is site labour intensive, requiring several skilled trades including formwork crews, rebar installers, and concrete placing and finishing crews. The higher labor and material cost, the increased mass of concrete construction (resulting in increased foundation and lateral load resisting systems for sites like Kelowna) do not favor concrete superstructure construction. Consequently, we do not recommend cast-in-place concrete construction for the air terminal building expansion.

The use of structural steel reduces the vertical and lateral loads to be resisted by the structure (as compared to concrete), and also reduces reliance on site labour. Structural steel is anticipated to be the most economical system for the spans and building volumes of the type proposed.

Timber construction has been used on a number of similar projects, allowing the structure to be expressed as part of the architectural design, highlighting the timber that is harvested in British Columbia. Fire rating requirements will suggest timber be limited to roof construction only, although other uses may be possible.

In arriving at the recommended structural systems for the Chilliwack Secondary School we have given close consideration to both structural steel and timber alternatives.

Suspended Floor Construction

Suspended floors for the expansion will comprise concrete topping over composite metal deck, supported on open web steel joists and structural steel beams, consistent with the existing second floor areas.

Roof Framing

The functional needs of the various portions of the expansion, whether the arrival / departure lounges or the bag make-up hall, dictate the structural bay sizes; the structural design must economically accommodate these requirements. The structure may be exposed to view as part of the architectural design in portions of the facility.

After carefully balancing project costs and function with architectural appearance, we recommend that structural steel framing be used for expansion, with possibly some use of timber framing. Preliminary framing plans for the various roof areas are shown in the drawings on this page and the following page.

Roof framing will be sloped to drains.

Lateral Load Resisting System

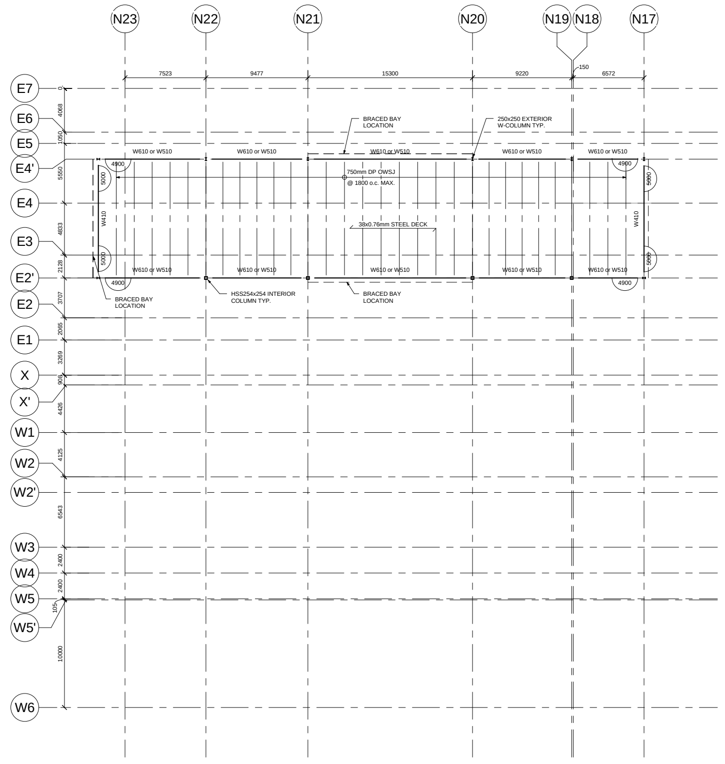
Lateral load resisting elements will be required to stabilize the facility under wind loads and seismic inertial forces. Lateral loads and forces acting on the building will be transferred horizontally through the floor and roof diaphragms to the vertical lateral load resisting elements. The vertical elements that transfer these loads and forces to the foundation will consist of structural steel cross, chevron and V bracing.

In the final design, we will analyze the structure for lateral loads and forces using the ETABS computer program.

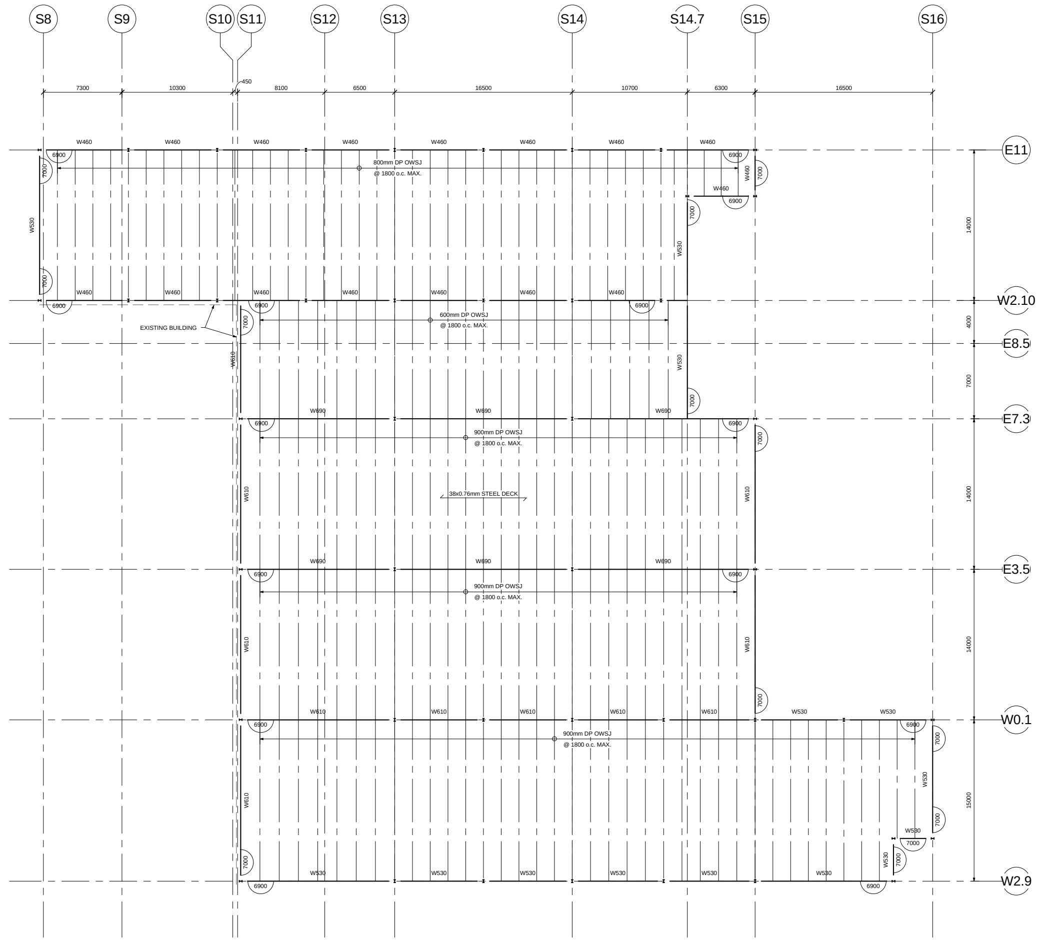
Building Control Joints

To reduce stresses that develop due to concrete shrinkage and thermal movements, structures are typically subdivided by building control joints spaced at approximately 70 m centres. As well, large structures are often separated by expansion joints at structural discontinuities or irregularities to reduce thermal, shrinkage and diaphragm stresses. Further, seismic separation of additions from the existing structure may reduce the extent of required seismic upgrading.

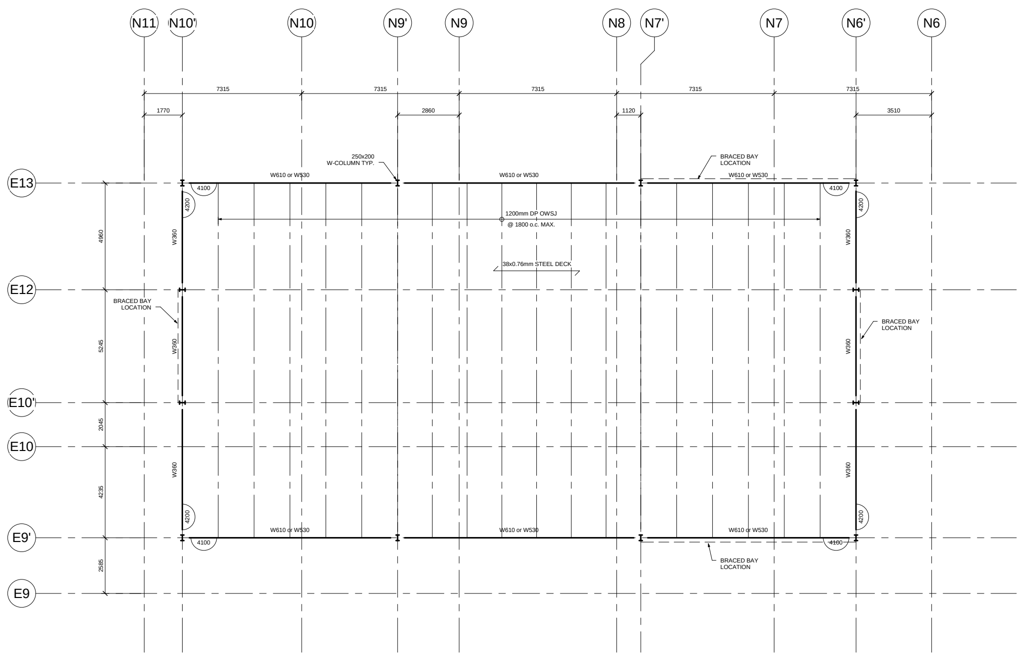
The expanded YLW air terminal building is very long in the north-south direction and somewhat irregular in plan. The international arrivals facilities, the domestic arrivals facilities, and the bag make-up hall each will be separated from the existing structure. The expansion joints are not required within the slab on grade.



1 PHASE 1 EXPANSION PLAN
1 : 200



5 PHASE 3 PARTIAL EXPANSION PLAN
1 : 200



2 PHASE 2 EXPANSION PLAN
1 : 100

NOTE:

1. TOP OF STEEL ELEVATION BASED ON TOP OF FINSHED FLOOR VARIANCE SHOWN THUS: 5000

BEAM ELEVATIONS BASED ON 100mm JOIST SEAT, CONTRACTOR TO ADJUST ELEVATIONS AS REQUIRED FOR JOIST SEAT VARIANCE.

COSTING

In determining overall building costs from the information presented in this report, appropriate allowances must be made for atypical geometry, heavily loaded areas, and special framing required to suit the functional requirements of the other disciplines.

Project costs must include allowances for the following:

- The geotechnical requirements for site preparation, granular fill beneath slabs-on-grade and the like, including potential increased structural fill depths due to unanticipated soil conditions.
- Excavation shoring and dewatering requirements
- Structural framing for mechanical and electrical rooms, including pads, curbs, equipment supports, special framing around mechanical and electrical service penetrations, and the like.
- Structural steel framing for stairs, guards, railings and handrails.
- Roof ladders and cages.
- Steel framing for elevator support beams, rail and ladders.
- Framing for overhead doors.
- Structural steel for perimeter metal deck support, diaphragm chords, drag struts and the like.
- Cast-in plates for connections.
- Additional steel or timber framing to provide support for significant suspended loads.
- Miscellaneous structural framing for the support of exterior cladding, glazing, louvers, and screens not accommodated by the steel stud framing.
- Exterior structures such as retaining walls, planters, walks, curbs, and so forth.
- Exterior structural slabs adjacent to entries.
- Fire protection for structural steel and timber members.
- Window washing requirements.

12.0 SIGNAGE AND WAYFINDING

13.0 CIVIL

Information to be provided at a later date.

14.0 CODE

General Project Description

The proposed Kelowna International Airport (KIA) is located in Kelowna BC.

Applicable Building Code

This report identifies building code requirements based upon compliance with the current British Columbia Building Code 2006 (BCBC 2006). References stated herein are to the BC Building Code 2006 unless otherwise indicated

Fire separation assemblies will be based upon Underwriters' Laboratories of Canada List of Equipment and Materials, Fire Resistance (ULC), unless otherwise noted.

AUTHORITY HAVING JURISDICTION

The authority having jurisdiction for the project is the City of Kelowna.

BUILDING HEIGHT AND AREA (APPROXIMATE)

The building area as defined by the BCBC for purposes of determining the classification of the building will be approximately 16,975 m^2.

BUILDING CLASSIFICATION

Occupancy classifications are determined in accordance with the requirements of Subsection 3.1.2.

The majority of the airport expansion will be used for pedestrian circulation, queuing, and waiting areas associated with processing aircraft passengers, and for service areas associated with baggage handling. Therefore, the applicable major occupancy classifications for the main floor are Group A, Division 2, Assembly, Group F, Division 3, Medium Hazard Industrial (baggage areas) and Group D (second floor). To be discussed and confirmed with City of Kelowna.

The KIA will also include ancillary office and retail areas, intended for the use of occupants of the building and interspersed throughout the floor areas on each level. In accordance with Sentence 3.2.2.8.(1), occupancies that constitute more than 10% of the floor area of the storey in which they are located are considered major occupancies. There are no office or retail occupancies that are over 10% of the total floor area located on the main floor.

CONSTRUCTION AND SPRINKLERING REQUIREMENTS

Subsection 3.2.2 describes applicable construction requirements to prevent fire spread and collapse based on building size and occupancy and the provision of automatic sprinklering. For a building containing multiple major occupancies

- Article 3.2.2.6., requirements for the most restrictive major occupancy shall apply to the whole building, and
- Article 3.2.2.7., where one major occupancy is located entirely above another, it is permissible to apply the requirements of Subsection 3.2.2. to each portion of the building separately (while considering the height and area of the whole building), except that the fire-resistance rating of the floor assembly between the major occupancies shall be determined based on the lower occupancy.

Applicable requirements of Subsection 3.2.2., based on the major occupancies within the KIA are as follows.

- Article 3.2.2.24. Group A, Division 2, Assembly, up to 6 Storeys, Any Area, Sprinklered for the Arrivals and Departures level.
- Article 3.2.2.67. Group F, Division 3, Any Height, Any Area, Sprinklered for the areas used for baggage handling
- Article 3.2.2.49. Group D, Any Height, Any Area, Sprinklered for the second floor office area. As the entire second floor is used for office use, it will be considered a major occupancy.

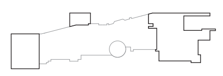
The requirements of 3.2.2.24 and 3.2.2.67 are the most restrictive and will be applied throughout. In summary, construction requirements for the Kelowna Airport expansion are as follows.

- The building will be of non-combustible construction.
- The building will be sprinklered throughout
- For the Arrivals and Departures Levels, floor assemblies will be fire separations with a fire-resistance rating not less than 1 hour. Interconnections will be provided as per requirements listed in 3.2.8.2.(6).
- For the F3 occupancies, floor and wall assemblies between that area and the remainder of the building will be fire separations with a fire-resistance rating not less than 2 hours.
- Loadbearing walls, columns and arches will have a fire-resistance rating not less than that required for the supported assembly.
- Article 3.1.3.1.(3), In a building conforming to the requirements of Articles 3.2.8.2. to 3.2.8.9., the requirements of Sentence (1) for fire separations between major occupancies do not apply at the vertical plane around the perimeter of an opening through the horizontal fire separation. Therefore, no fire separation will be required between the main and second floor (as long as the requirements of Articles 3.2.8.2. to 3.2.8.9. are maintained).

YLW
Kelowna International Airport

SCHEMATIC DESIGN

KEYPLAN

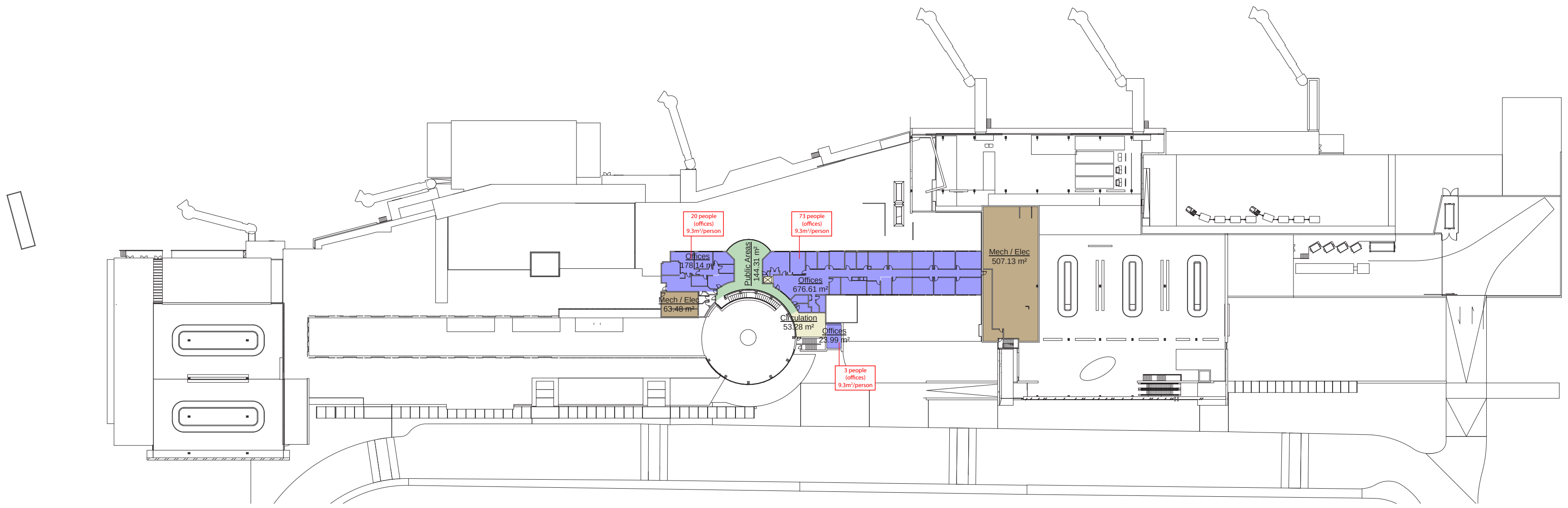


LEGEND

- Bag Claim 2015
- Bag Claim 2025
- Bag System
- Circulation
- Customs CBSA PIL
- Customs Secondary
- Holdroom
- HR Seating
- Mech / Elec
- Meeter Greeter Hall
- Offices
- Public Areas
- RestRooms
- Retail
- Security

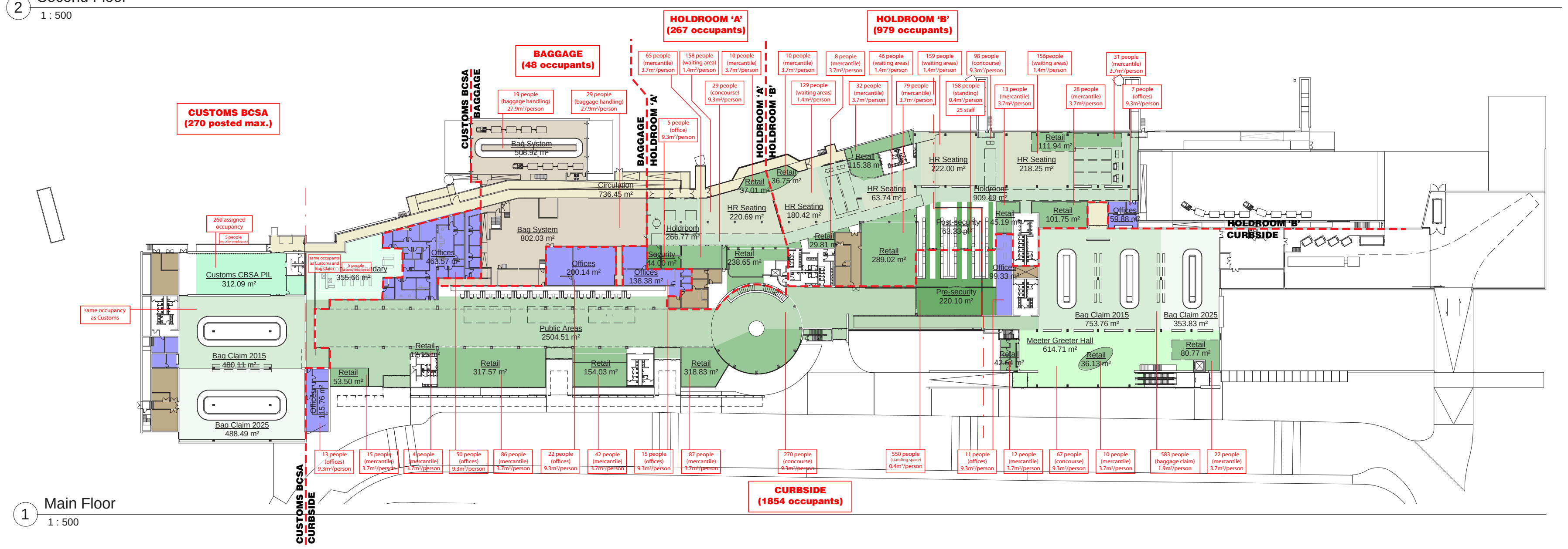
3 Basement
1 : 500

Basement floor - Code Compliance - Area Schedule	
Name	Area
Bag System	1,579 m²
Circulation	151 m²
Mech / Elec	51 m²



2 Second Floor
1 : 500

Second floor - Code Compliance - Area Schedule	
Name	Area
Circulation	59 m²
Mech / Elec	571 m²
Offices	879 m²
Public Areas	144 m²
RestRooms	23 m²



1 Main Floor
1 : 500

Main floor - Code Compliance - Area Schedule	
Name	Area
Bag Claim 2015	1,234 m²
Bag Claim 2025	842 m²
Bag System	1,311 m²
Circulation	773 m²
Customs CBSA PIL	312 m²
Customs Secondary	356 m²
Holdroom	1,176 m²
HR Seating	905 m²
Mech / Elec	422 m²
Meeter Greeter Hall	615 m²
Offices	1,139 m²
Public Areas	2,505 m²
RestRooms	618 m²
Retail	2,021 m²
Security	704 m²

CODE PLANS

INTERCONNECTED FLOOR AREAS

There will be a central Atrium in the building. This interconnected floor space need not conform to the requirements of articles 3.2.8.3. to 3.2.8.9. because:

- The interconnected floor space is open only to the ground and second floors.
- The building is fully sprinklered.
- The building consists of only Group A, Division 1 and 2 occupancies.
- The allowable building area is unlimited.

ADDITIONAL CONSTRUCTION REQUIREMENTS

- Janitor rooms will be separated from the remainder of the building by fire separations having no required fire-resistance rating (3.3.1.21.).
- Exit stairs will be separated from the remainder of the building by fire separations having a 1 hour fire-resistance rating (3.4.4.1.(1)).
- Elevator hoistways will be separated from the remainder of the building by fire separations having a 1 hour fire-resistance rating (Table 3.5.3.1.). Elevator machine rooms will be separated from the remainder of the building (except from the elevator hoistways) by fire separation having a fire-resistance rating of 1 hours (3.5.3.3.).
- Service rooms containing fuel-fired appliances will be separated from the remainder of the building by fire separations having a 1 hour fire-resistance rating (3.6.2.1.(1)).
- A room for the storage of combustible refuse will be separated from the remainder of the building by a fire separation having a fire-resistance rating of 1 hour (3.6.2.5.).
- Vertical service spaces will be separated from the remainder of the building by fire separations having a 45 minute fire-resistance rating (Table 3.6.3.1.), or will be dampered at each floor level.

HIGH BUILDING CONSIDERATIONS

The height of the building from grade to the floor level of the highest storey is approximately 6.9 m. Therefore, the building will not incorporate requirements for high buildings (3.2.6.1.(1)(a)).

SITE ACCESS FOR FIRE FIGHTING

- Because the building area is greater than 600 m2, access for fire department vehicles is required to be provided between 3 m and 15 m of a principle entrance of the building (3.2.5.4. & 5.). The City of Calgary Fire Department, in a meeting dated June 26, 2008, granted approval to provide fire truck access to within 30 m of the main entrance, provided hard surfaces capable of supporting a fire truck were constructed between the roadway and the main entrance.
- The site roadway access route will:
  - » Have a clear width not less than 6m.
  - » Have a centerline radius not less than 12 m.
  - » Have an overhead clearance not less than 5 m.
  - » Have a change of gradient no greater than 1 in 12.5.
  - » Be designed to support fire-fighting equipment in all climatic conditions.
  - » Have no dead-end portions longer than 90 m.
  - » Be connected to a public thoroughfare.

OCCUPANT LOADS

The occupant load of a building is used to determine the number and width of exit facilities that must be provided and the width of access routes leading to exits from within floor areas. BCBC 2006 acceptable solutions require occupant load to be determined based on the occupant density factors prescribed in Table 3.1.17.1., and, if not based on those values, a sign indicating an alternative occupant load is required to be posted in a conspicuous location. The occupant load should represent a realistic approximation of the largest number of people who can reasonably be expected to occupy a given floor area.

Additionally, Annex material to NFPA 101 Life Safety Code provides suggested occupant load factors specific to airport floor areas as follows:

NFPA 101 TABLE A.7.3.1.2 AIRPORT TERMINAL OCCUPANT LOAD FACTORS

AIRPORT TERMINAL AREA	M2 / PERSON (GROSS)
Concourse	9.3
Waiting Areas	1.4
Baggage Claim	1.9
Baggage Handling	27.9

Occupant loads in non-public areas of the KIA will be calculated based on application of Table 3.1.17.1., except where NFPA 101 provides factors that are specific to airports.

For the purposes of occupant loads, the Airport has been divided into multiple areas:

The occupant load has been calculated as follows:

MAIN FLOOR

Curbside:

• Office:	1017.17 sq.m. @ 9.3 sq.m.:	110 persons
• Mercantile:	1015.62 sq.m. @ 3.7 sq.m.:	275 persons
• Concourse:	3119.22 sq.m. @ 9.3 sq.m.:	336 persons
• Standing (pre-security)	220.10 sq.m. @ 0.4 sq.m.:	550 persons
• Baggage Claim	1107.59 sq.m. @ 1.9 sq.m.:	583 persons

Total: 1854 persons

Customs:

• Posted Occupancy	270 persons

Total: 270 persons

Holdroom 'A':

• Office:	4.00 sq.m. @ 9.3 sq.m.:	5 persons
• Mercantile:	275.66 sq.m. @ 3.7 sq.m.:	75 persons
• Concourse:	266.77 sq.m. @ 9.3 sq.m.:	29 persons
• Waiting Areas	220.69 sq.m. @ 1.4 sq.m.:	158 persons

Total: 267 persons

Holdroom 'B':

• Office:	59.88 sq.m. @ 9.3 sq.m.:	7 persons
• Mercantile:	729.84 sq.m. @ 3.7 sq.m.:	198 persons
• Concourse:	909.49 sq.m. @ 9.3 sq.m.:	98 persons
• Waiting Areas	684.41 sq.m. @ 1.4 sq.m.:	489 persons
• Standing (pre-security)	63.33 sq.m. @ 0.4 sq.m.: + 25 staff	184 persons

Total: 976 persons

Baggage:

• Baggage Handling:	508.92 sq.m. @ 27.9 sq.m.:	19 persons
• Baggage Handling:	802.03 sq.m. @ 27.9 sq.m.:	29 persons

Total: 48 persons

SECOND FLOOR		
• Office:	178.14 sq.m. @ 9.3 sq.m.:	20 persons
• Office:	676.61 sq.m. @ 9.3 sq.m.:	73 persons
• Office:	23.99 sq.m. @ 9.3 sq.m.:	3 persons
		Total: 96 persons
BASEMENT FLOOR		
Baggage Handling:	866.02 sq.m. @ 27.9 sq.m.:	31 persons
		Total: 31 persons

EGRESS AND EXIT CAPACITIES

As prescribed by BCBC 2006 Article 3.3.1.17. and Sentence 3.4.3.2.(1), the minimum aggregate width of exits serving floor areas intended for occupancy is to be determined by multiplying the occupant load of the area served by 6.1 mm per person for horizontal routes such as ramps, doorways and corridors, and 8 mm per person for most stairs.

Additionally, for interconnected floor spaces in the KIA, in accordance with Sentence 3.4.3.2.(6), widths are required to be cumulative for the areas served unless the cumulative occupant load can be accommodated within exit stairs or protected floor spaces.

- Every room or suite having an occupant load greater than 60 persons, a travel distance greater than 25 m to a door, or an area greater than 200 m2 will have two egress doors leading from the room or suite (3.3.1.5.).
- The minimum width of corridors used by the public will be 1100 mm (3.3.1.9.(2)).
- Dead end corridors will not exceed 3 m in length (3.3.1.9.(7)).
- Travel distance to at least one exit will not exceed:
  - » 45 m in a floor area that contains an occupancy other than a high-hazard industrial occupancy, provided it is sprinklered throughout,
  - » 105 m in any floor area served by a public corridor, in which rooms and suites are not separated from the remainder of the floor area by a fire separation, provided the public corridor is not less than 9 m wide, the ceiling height is not less than 4 m, the building is sprinklered throughout, and not more than one half of the required doorways from a room or suite open into the public corridor if the room or suite is required to have more than one egress doorway, and
  - » 30 m in any floor area other than those referred to above.
- Guards on stairs will be 920 high at flights, and 1070 high at landings. They shall not have openings greater than 100 mm, nor shall they facilitate climbing (3.4.6.5.).
- Stair Configuration - No flights of stairs will have a vertical rise of more than 3.7 m between floors or landings (3.4.6.3.(1)). Treads for stairs will have a run of not less than 280 mm between successive steps, and risers will be not more than 180 mm (3.4.6.7.(1&2)). The leading edge of each stair tread will have a radius or bevel between 6 and 10 mm in horizontal dimension (3.4.6.7.(4)).
- One exit stair may exit through a lobby in conformance with 3.4.4.2.:
  - » The lobby will not be more than 4.5 m above grade.
  - » The path through the lobby to the exterior will not exceed 15 m.
  - » Service rooms and storage rooms will not open directly into the lobby.
  - » The lobby will be separated from adjacent spaces by a fire separation having no required fire-resistance rating.

The required exit widths are as follows:

MAIN FLOOR

Curbside: 1854 persons x 6.1mm/person = **11,310 mm of exit width**

Customs: 270 persons x 6.1mm/person = **1,647 mm of exit width**

Holdrooms: 267+976 = 1243 persons x 6.1mm/person = **7,582 mm of exit width**

Baggage Handling: 48 persons x 6.1mm/person = **293 mm of exit width**
*(2 exits required at minimum widths required by code)

SECOND FLOOR

Office: 96 persons x 8.0mm/person = **768 mm of exit width**
*(2 exits required at minimum widths required by code)

BASEMENT FLOOR

Baggage Handling: 31 persons x 6.1mm/person = **293 mm of exit width**
*(2 exits required at minimum widths required by code)

BARRIER-FREE CONSTRUCTION

- A barrier-free path of travel will be provided to not less than 50% of the pedestrian entrances to the building and throughout all normally occupied spaces (3.8.1.2.(1) & 3.8.2.1.(1)). At least one door at each barrier free entrance will be provided with a power door operator (3.8.3.3.(5)(c)).
- Controls intended for operation by occupants will be mounted between 400 mm and 1200 mm above the floor (3.8.1.5.).
- Barrier-free parking spaces will be provided in accordance with Table 3.8.2.2.
- The exterior passenger loading zone will have an access aisle and curb ramp (3.8.2.2.(3)).
- Appropriate signs will be provided indicating locations of barrier free facilities (3.8.3.).
- Exterior walks that form part of a barrier-free path of travel will be at least 1100 wide and designed as a ramp if the slope exceeds 1 in 20 (3.8.3.2.).
- Every door in a barrier-free path of travel will have a clear width of not less than 800 mm in the open position (3.8.3.3.(1)). Door hardware in a barrier-free path of travel will be of a design that does not require tight grasping and twisting of the wrist as the only means of operation (3.8.3.3.(3)). Closers on interior doors in a barrier free path of travel will include a delayed (3 second) closing time (3.8.3.3.(9)). Except within suites or where power door operators are used, doors in a barrier free path of travel will have a clear space beyond the latch side of 600 mm where the door swings toward the approach side, and 300 mm where the door swings away (3.8.3.3.(10)). Vestibules in a barrier-free path of travel will be at least 1200 mm long in addition to the door swing of any door swinging into the vestibule (3.8.3.3.(11)).
- Ramps in a barrier-free path of travel will be minimum 870 wide between handrails, and will have a maximum slope of 1 in 12 (3.8.3.4.).
- Elevators will comply with Appendix E of CAN/CSA-B44, Safety Code for Elevators (3.8.3.5.). At least one elevator serving each storey will have clear inside cab dimensions of 2032 mm x 1295 mm, and a door width of 1067 mm (Appendix A-3.5.4.1.(1)).
- All assembly areas with an area greater than 100 m2 will be provided with assistive listening devices in accordance with 3.8.3.7.
- Public washrooms will include at least one barrier free water closet stall with an open space having a diameter of not less than 1500 mm. The water closet seat heights, urinal opening heights, lavatory heights and clearances, grab bars, counter heights and mirrors will comply with 3.8.3.8. to 3.8.3.11.
- Counters more than 2 m long that serve the public will have at least one barrier free section not less than 760 mm wide (3.8.3.14.).

PLUMBING SERVICES

PLUMBING SERVICES – Utilizing the occupant loads noted in Section 11, the KIA requires the following washroom fixtures.

LEVEL	DESCRIPTION	OCCUPANT LOAD	NUMBER OF WATER CLOSETS		NUMBER OF URINALS	NUMBER OF LAVATORIES	
			M	F		M	F
1	Curbside	1854	8	19	5	7	10
1	Customs	270	1	6	2	2	3
1	Holdroom 'A'	267	1	6	2	2	3
1	Holdroom 'B'	976	3	14	5	4	7
1	Bag System	48	1	2	1	1	1
2	Office	96	1	2	1	1	1
B	Bag System	19	1	1	0	1	1

15.0 COST ESTIMATE

APPENDICES

KELOWNA INTERNATIONAL AIRPORT

Energy Audit Study

City of Kelowna

October 2010

Project Number: 03048C0400

Prepared by:

Grant Kidd, P.Eng., **LEED® AP**
Mechanical Associate

COHOS EVAMY
integratedesign™

Table of Contents

1 EXISTING AIRPORT MECHANICAL AND ELECTRICAL SYSTEMS

1.1 General

1.1.1 The Kelowna airport was constructed in many phases from the original 1967 building to the airport today. The mechanical systems have varied over the course of these expansions as technologies and design philosophies have changed. There has been a mix between indoor and outdoor mounted equipment, with several expansion areas served by rooftop units instead of providing internal mechanical rooms. The original internal mechanical systems installed in 1967 and 1971 did not provide for a full central plant concept with room for expandability.

1.1.2 The mechanical systems include multi-zone constant volume, single-zone constant volume rooftop units, fan coils with dedicated outdoor air units, and packaged split system cooling units. The cooling systems include direct expansion (DX) in the majority of the units, a single chiller/tower system to supply fan coils and air handling units.

1.1.3 The existing record drawings were reviewed to determine current mechanical and electrical system configuration, existing equipment installation dates, and potential replacement requirements.

1.1.4 The scope of work for electrical systems was limited to a Lighting Survey to determine potential to reduce lighting energy use and heat gains to the space.

1.2 Existing Ventilation Systems

1.2.1 The East mechanical room 090 was part of the original 1967 construction and originally contained a multi-zone air handling unit, a single boiler, and a centrifugal Trane Torrivent condenser unit. This was revised in 1994 when the single boiler was replaced with two Fulton pulse combustion boilers and the Torrivent unit was replaced with a roof mounted condenser unit. The East mechanical room was renovated again in 2001 when the multi-zone was converted to an outdoor air makeup unit and two additional Buderus Boilers were added. The new outdoor air unit 090 has a hot water heating coil and chilled water cooling coil.

1.2.2 The existing Control Tower room 226 constructed in 1971 contains a dedicated single zone air handling unit with a hot water coil and split DX cooling coil, a single boiler serving the air handling unit and a unit heater, and two outdoor condensing units. The condensing units were replaced in 2001 as part of the major expansion.

1.2.3 The West mechanical room 030 constructed in 1982 contains a multi-zone air handling unit with DX cooling and a dedicated boiler serving the multi-zone heating coil only. This system is constant volume and primarily serves the central original main concourse areas. The DX cooling is served by a roof mounted condensing unit. This mechanical room has not been renovated and the mechanical air handling unit, boiler, and condenser all are beyond their service life.

1.2.4 Mechanical room 223 (unit 045) contains a constant volume mixed air handling unit dedicated to the feature departure lounge area. This unit has a

hot water heating coil and chilled water cooling coil. This unit provides outdoor air directly to the departure lounge area.

1.3 Existing Heating Systems

1.3.1 West mechanical room 030 has one 1350 MBH A.O. Smith 80% efficient atmospheric boiler that only serves the multizone unit. The multizone hot deck provides building heat for these zones.

1.3.2 East mechanical room 090 has two 1438 MBH 84% efficient conventional Buderus G515 forced draft boilers that provide primary building heating for the portion of the airport served by fan coils and terminal heating systems. Two 875 MBH Fulton pulse combustion heating boilers are only used for backup. The primary hot water heating loop is constant volume with two-way valves on fan coils and air handling units. Fan coils provide heating or cooling to each zone. Unit heaters, radiation, and force flow units are also served by this heating loops with unit heaters and force flow units on wild loops and radiation served by two-way control valves.

1.3.3 The Control Tower is served by a single 350 MBH Bryan forced draft 80% efficient conventional boiler serving the air handling unit and a single unit heater.

1.3.4 There are various gas fired rooftop single-zone units located throughout the airport facility that can provide heating and cooling for the zones served.

1.3.5 Electric heat is utilized where hydronic heating is not practical or warranted. Gas fired infra-red heaters are used in the baggage drop-off areas.

1.4 Existing Cooling Systems

1.4.1 West mechanical room 030 is served by a DX refrigeration unit.

1.4.2 The East mechanical room 090, Mechanical room 223 (unit 045), and fan coils located throughout the airport are served by chilled water from the central chiller system.

1.4.3 The Control Tower is served by a DX refrigeration unit.

1.4.4 There are substantial numbers of packaged DX cooled rooftop constant volume units serving various expansion areas.

1.4.5 The chiller located in room 121A consists of a 155 ton McQuay R-22 centrifugal chiller and associated external fluid cooler. The chilled water loop has two 100% redundant pumps serving a constant volume chilled water loop with three way valves. The condenser loop has two 100% redundant pumps serving the fluid cooler coil. Free-cooling switchover valves provide winter operation without the chiller.

1.5 Control Sequences

1.5.1 The only control sequences available from Kimco controls were related to the PBS expansion phase of the airport.

1.5.2 The PBS expansion rooftop units RTU 1 to 7 did incorporate some energy conservation measures such as CO2 control of outdoor air, full recirculation during unoccupied periods, temperature turndown to 15 C during unoccupied periods, and economizer modes. However, it was noted that a very low CO2

setpoint of 500 ppm was utilized for the CO2 control which would be ineffective to reduce outdoor air quantities, since a low setpoint will increase outdoor air flow.

1.5.3 Screenshots of all controlled systems are included in Appendix A to provide an overview of the DDC system capabilities. Most mechanical equipment in the airport has some form of central DDC control.

1.5.4 Several trend logs from the control system included in Appendix B were utilized to determine system operating parameters.

2 LIGHTING SURVEY

2.1 Lighting Survey

2.1.1 A lighting survey was conducted between May 26 and May 27, 2010. This survey included a survey of fixture types, hours of use, potential for daylighting, lamp wattage, and illumination levels.

2.1.2 The lighting survey was conducted under daylight and nightime conditions to determine actual artificial lighting levels.

2.1.3 Several existing areas did have occupancy controls to control lighting operation.

2.1.4 Refer to Appendix C for lighting survey data and luminaire schedules.

2.2 Lighting Energy Conservation Strategies

2.2.1 The existing lighting in the Airport has been installed over the past 40 years with some upgrades occurring during expansion phases. Most of the existing T12 fixtures have been replaced with T8 fixtures, but some areas of T12 fixtures remain.

2.2.2 Lighting efficiency has increased substantially with current technologies and Lighting Power Densities lower than 1.0 W/sq.ft. are readily achievable.

2.2.3 The general illuminance levels can be reduced to the minimum necessary to perform the tasks required.

2.2.4 Occupancy sensors can be extended to more areas of the airport.

2.2.5 Daylight harvesting can be implemented in day lit areas, preferably in conjunction with daylight sensors.

3 EXISTING AIRPORT HEATING AND COOLING LOADS

3.1 Design Assumptions

3.1.1 The winter design temperature is -18.1°C.

3.1.2 The summer design temperature is 35.1°C DB, 19.1°C WB.

3.1.3 Occupancy loads based on ASHRAE 62.

3.1.4 Natural gas was approximately $11.18/GJ.

3.1.5 Electricity blended rate was approximately $0.069/kWhr.

3.2 Load Model

3.2.1 IES Virtual Environment was used to model the existing building and the proposed concept design of the new expansion areas.

3.2.2 Refer to Appendix D for a summary of heating and cooling loads based on the block model.

3.3 Heating and Cooling Loads

3.3.1 The calculated cooling load for the existing building based on the block load is approximately 196 tons. The block load is based on the entire building on a system level without individual room by room calculations. This calculation accounts for variation of cooling loads throughout the day as the solar load moves around the building.

3.3.2 Refer to Appendix E. The installed cooling capacity is approximately 378 tons, which is almost double the block load. This is typical of packaged rooftop unit installations, since the cooling units are rated in nominal sizes and provide a fixed amount of cooling. It was also found the existing chiller was not operating at 100% load.

3.3.3 The calculated cooling load for the expansion based on the Concept drawings is 203 tons. However, this cooling load will be reduced based on sustainable design concepts and reduction of proposed window areas.

3.3.4 The calculated heating load for the existing building based on the block load is approximately 3150 MBH.

3.3.5 Refer to Appendix E. The installed heating capacity is approximately 6,100 MBH which is oversized for the application. However, the packaged rooftop units have more heating capacity than is required for the application, which artificially makes the heating system appear oversized.

3.3.6 The heating and cooling systems are slightly oversized, but at the rooftop unit locations.

4 MECHANICAL ENERGY REDUCTION STRATEGIES

4.1 Right-Sizing Heating and Cooling Loads

4.1.1 The existing mechanical systems are oversized particularly in areas with rooftop units. Packaged rooftop units can be replaced with correctly sized hydronic units when life cycle replacement is due.

4.1.2 The new areas will be correctly sized with mechanical units suitable for the application.

4.2 Demand Based Ventilation

4.2.1 The use of CO2 and occupancy based sensors is highly recommended. The current dedicated outdoor air unit serving the fan coils has variable inlet vanes but should be responding to changes in building occupany.

4.2.2 The CO2 setpoints should be set at 1000 ppm.

4.3 Heat Recovery

4.3.1 Heat from exhaust should be recovered back to the inlet of the dedicated outdoor air system. Heat recovery systems include energy recovery wheels, runaround coils, and heat pipe systems that recover heat from the exhaust air stream for use in the intake air stream. This reduces energy consumption for pre-heating of outdoor air to the air handling units.

4.3.2 The exhaust systems in the existing airport area are widely distributed and smaller in scale. Therefore, significant recovery of exhaust heat would be difficult and will not payback. The new exhaust systems will be designed to provide central heat recovery.

4.4 Peak Capacity Reductions

4.4.1 The reduction of cooling load by reducing the source heat gain can be a very effective strategy to reduce energy use. The use of external shading devices, operable external dampers, and overhangs help to provide this reduction.

4.4.2 The Rotunda area has a very high cooling load due to the large glass areas facing Southwest. The glazing is quite dark, but substantial quantities of cooling air are still required. Therefore, solar control of this area should be evaluated.

4.4.3 The existing East facing passenger corridors also have substantial glass to allow passengers to view airside areas. However, large numbers of split system air conditioning units are required to cool these corridors. It is recommended that glazing be minimized or external shading incorporated.

5 SERVICE LIFE UPGRADES

5.1 West Mechanical Room - Boiler Replacement

5.1.1 The existing boiler serving the multi-zone unit 030 requires life-cycle replacement. This boiler's only purpose is to serve the multi-zone unit and provide heating to each zone.

5.1.2 ECO: The new West Mechanical room air handling unit should be connected to a new heat pump located in the mechanical room. The temperatures required to serve an air handling unit pre-heat function are compatible with temperatures from a heat pump unit. The heat pump unit would be water to water to allow a centralized installation to serve the multi-zone unit.

5.2 West Mechanical Room – Air Handling Unit Replacement

5.2.1 The existing constant volume multi-zone air handling unit requires life cycle replacement due to age of the unit. It was also noted by operational staff that the existing outdoor air intake for this unit is in a very poor location and is subject to vehicle fume entrainment.

5.2.2 ECO: The new air handling unit should be variable volume with variable volume control of each zone. Occupancy or demand based control (CO2) can be used to control volume delivered to each zone as well as outdoor air requirements from the unit. It is also proposed that the air handling unit intake and exhaust be reversed so that outdoor air is drawn from the roof area and exhaust is directed towards the taxi stand areas.

5.3 R-22 Screw Chiller

5.3.1 The existing McQuay dual rotary screw chiller is 10 years old and is using R-22 refrigerant which is slated for phase-out in 2020. This chiller utilizes two single-rotor screw compressors operating in parallel on a single evaporator and condenser. The efficiency of this existing chiller is approximately 0.70 kW/ton, new chillers are more efficient and can achieve better than 0.5 kW/ton, particularly when using variable speed control. Variable speed chillers are more efficient at part load since the variable inlet vanes found on constant speed chillers are eliminated. The variable speed operation of the compressor provides much more efficient operation at part-load as the chiller motor operates at a slower speed.

5.3.2 ECO: Replace the existing chiller when the 2016 mechanical room build out occurs by installing a new more efficient and HCFC free chiller in the new mechanical room.

5.4 Packaged Rooftop Units

5.4.1 There are several packaged rooftop units that will require replacement over the course of the expansion project. These units are not as efficient as a central cooling system with typical performance of 1.25 kW/ton on cooling. Packaged rooftop units are also typically single zone and don't provide consistent temperature control in the space. However, some rooftop units have been recently installed and the Owner should continue to obtain the value from these units until replacement is necessary.

5.4.2 ECO: Allow provision to connect replacement rooftop units into the central heating and cooling system when replacement becomes necessary.

5.5 East Mechanical Room – Boilers

5.5.1 The existing Buderus boilers were only installed in 2001 and these boilers are cast iron style with a long potential service life. The hydronic system is also designed for the higher temperatures provided by these boilers. Therefore, these boilers should continue to provide peak loading and backup to a potential geothermal system. The existing Fulton boilers should be removed to provide space for future heat pumps.

5.5.2 ECO: The investment and embodied energy in the Buderus boilers would be wasted if these boilers were replaced. These boilers should be operated to the end of their life cycle.

5.6 Control Room – Boilers and Air Handling Units

5.6.1 The existing control room is no longer being utilized as a control tower. Therefore the small boiler and air handling unit should be demolished and the system connected to the main loop.

5.6.2 ECO: Provide a new hydronic air handling unit with heating coils and chilled water coils served by a heat pump.

6 FUTURE EXPANSION CONSIDERATIONS

6.1 External Geothermal Field

6.1.1 It is proposed to take advantage of the landscape of the airport by utilizing the infield areas for a closed loop geothermal field. The proximity of Mill Creek and Okanagan Lake to the airport suggests that good ground conditions or an aquifer may be available in the area to provide good borehole performance.

6.1.2 Provide primary heating and cooling base loads by utilizing an economically sized geothermal field (to be determined during the expansion project). Provide central heat pumps located in central mechanical rooms to provide heating and cooling to serve loads. Provide geothermal loop distribution throughout the airport to allow heat pumps to draw or reject heat to the loop. Peak load and backup heating and cooling to be provided by central boilers and chillers.

6.2 Distributed Chiller System

6.2.1 Provision of distributed chiller systems will provide more efficient cooling operation since the chillers would be water cooled. The chillers would be located in each main mechanical room: a new north mechanical room, the existing chiller mechanical room, and the new expansion mechanical room.

6.2.2 Provide efficient variable speed chiller systems to provide chilled water to the building and reduce electrical load. Chillers shall be operated whenever required to provide peak capacity and backup.

6.3 Distributed Boiler System

6.3.1 Provision of distributed boiler systems to provide backup and peak heating for the geothermal system. The boilers would be located in each main mechanical room: a new north mechanical room, the West mechanical room, the existing East mechanical room (existing boilers), and the new expansion mechanical room.

6.3.2 Provide condensing boilers to take advantage of new low temperature heating systems and allow interconnection with the geothermal system.

6.4 Utility Transformer

6.4.1 In order to expand the existing Air Terminal Building more power will be needed from the existing utility transformer. By reducing the lighting power density of the existing Air Terminal Building capacity can be freed up from the transformer for use in the expansions to come. As a result, by reducing the lighting power, not only significant energy can be saved but the cost of revising the utility transformer and electrical distribution equipment can be mitigated.

6.4.2 Reduce lighting and cooling power in the existing building to reduce electrical load and accommodate expansion.

7 ENERGY CONSERVATIONS MEASURES – LOW OR NO COST

7.1 Mechanical Equipment Schedules

7.1.1 Mechanical Equipment should be shut down when the building is unoccupied. It was noticed during review of the control system that the majority of equipment does not shut down.

7.1.2 ECO: Utilize equipment scheduling feature to shut down equipment when not required, typically during unoccupied periods.

7.1.3 Energy Savings: as much as $14,000/year, some units may not be shut down or require a longer rebound period.

7.1.4 Capital Cost Estimate: $0

7.1.5 Simple Payback = immediate.

7.2 Chilled Water Pumps

7.2.1 The existing chilled water pumps are running continuously even when the chillers and cooling towers have shut down.

7.2.2 ECO: Shut down the chilled water pumps when not in use.

7.2.3 Energy Savings: $2,000/year

7.2.4 Capital Cost Estimate: $0

7.2.5 Simple Payback = immediate.

7.3 CO2 Control

7.3.1 The existing CO2 control setpoints are set too low. Exterior ambient CO2 levels are typically 400 ppm, ASHRAE 62 recommends that CO2 sensors be set a maximum of 700 ppm over the ambient which corresponds to a comfortable level of ventilation and odour control.

7.3.2 ECO: Revise CO2 setpoints to 400 + 700 ppm = 1100 ppm maximum. We would recommend 1000 ppm as the setpoint with an alarm at 1100 ppm.

7.3.3 Energy savings are hard to quantify but outdoor air volumes should be reduced.

7.3.4 Capital Cost Estimate: $1300. This capital cost estimate is based on programming time for the DDC system vendor.

7.3.5 Simple Payback = immediate.

7.4 Bypass Water Filtration

7.4.1 Domestic water is current being filtered at each entry location by substantial filtration units. These units consume power and are costly to maintain. The current status of domestic water supply quality should be re-evaluated to confirm these filters are necessary. If they are found to be necessary, a separate unfiltered supply should be connected to fixtures such as toilets, urinals, and hose bibs. The cost consultant identified an extra cost of $103,200 to provide these additional plumbing lines, this cost would make this bypass uneconomical.

8 ENERGY CONSERVATIONS MEASURES – MECHANICAL

8.1 Condensing Boilers

8.1.1 Replacement boilers in the West Mechanical room and possibly the Control Tower mechanical room should be condensing style to provide up to 95% seasonal efficiency. The heating system can be modified in both of these

areas to a low temperature design relatively easily since air is used for heating. Condensing boilers will complement a future geothermal loop as well.

8.1.2 The East Mechanical room could also have one condensing boiler installed to operate in the summer and partial load seasons. The existing hot water loop to the fan coils, radiation, and unit heaters is difficult to revise to low temperature operation since this equipment was all sized at high temperatures. However, the reset schedule can be lowered as much as possible to encourage condensing operation.

8.1.3 ECO: Install condensing boilers for all replacement boilers. Condensing boilers are cost effective and have a short payback period.

8.1.4 Capital Cost Estimate: The opportunity to install condensing boilers is at life-cycle replacement of existing conventional boilers. There will be an up-charge for condensing boilers and the associated stainless steel flues, but this charge will be minimal. Estimated up-charge from a conventional boiler for the West mechanical room would be $30,000 for a condensing boiler system. Note: This cost estimate is the delta for condensing boilers over conventional only, this estimate does not include the entire project cost for boiler replacement.

8.1.5 Energy Savings = $15,019/year. Simple Payback = 2.0 years

8.1.6 Greenhouse Gas savings = 67.5 tCO2.

8.2 Centralized Chilled Water Systems

8.2.1 The existing systems are a mix of direct expansion (DX) condensers, packaged DX units, and a chilled water loop for internal fan coils. The existing direct expansion equipment should be replaced whenever possible with water cooled chillers or as part of a geothermal heat pump loop.

8.2.2 ECO: Provide water cooled chillers for peak loading and as backup for the geothermal system.

8.2.3 Capital Cost Estimate: The capital cost for central chilled water systems can be budgeted in the capital upgrades of each expansion. The intent is to provide geothermal piping mains from the north end of the airport to the south end of the airport to allow connection of heat pump units. The central chillers will be located at the North and South end to support the heat pumps. There will be a capital cost premium between provision of packaged rooftop DX units and central chillers with wet coil units and hydronic piping. The cost premium based on a 200 ton chiller and associated equipment was estimated at $108,700. Note: this cost premium is a the delta between packaged rooftop DX units and central chillers only, not the cost estimate for the entire chilled water system.

8.2.4 Energy Savings = $9500/year. Simple Payback = 11.4 years.

8.2.5 Greenhouse Gas savings = 2.8 tCO2.

8.3 Variable Speed Pumping Systems

8.3.1 The existing heating and cooling pumps serving the hot water and chilled water loops are constant volume. All fan coils and air handling units have 3-way valves and systems are primary only.

8.3.2 ECO: Provide variable speed drives on distribution pumps, add constant volume primary pumps on boilers and chillers complete with a decoupling bridge.

8.3.3 Capital Cost Estimate: There are large numbers of fan coils, approximately 60, that will require replacement of the 3-way valves with 2-way valves to provide variable flow in the system. It is possible to retrofit the 3-way valves to 2-way valves by blocking off one port, which would be significantly less expensive than trying to convert all the existing valves. The capital cost assuming retrofit or maintenance replacement of the 3-way valves is approximately $122,000. Note: this cost estimate assume that the fan coil valves will be replaced as part of the renovation work in each area, therefore ceilings will be accessible for replacement.

8.3.4 Energy Savings = $6,200/year. Simple Payback = 19.7 years.

8.3.5 Greenhouse Gas savings = 1.8 tCO2.

8.4 Geothermal Ground Source Systems

8.4.1 The potential for geothermal ground source systems is being evaluated as part of the Concept design for the airport expansions. There is sufficient land area on the airport infield to accommodate a closed loop system. There is also potential of utilizing standing column geothermal wells, this should be evaluated in the design phase. The geothermal field will not provide the entire heating and cooling load for the airport, with peak loads accommodate by boilers for heating and chillers for cooling.

8.4.2 ECO: Provide a geothermal energy loop throughout the airport connecting the North and South ends to an open or closed ground source heat pump system. This system will allow movement of heat from year round internal load areas to perimeter areas and will provide substantially better performance than the air side condensers typically used. Split systems are available to allow connection of the heat pump loop to existing refrigerant coils or provide cooling to service rooms.

8.4.3 Capital Cost Estimate: The capital cost estimate for the geothermal field will be highly variable based upon open versus closed loop, disturbance to the runway, and overnight premiums for well drilling. However, it is estimated that the geothermal field to support the existing airport block cooling load of approximately 200 tons would be $532,500. Note: this cost estimate is based on 2 tons/well, approximately 100 - 76 m deep vertical bore wells, and 150 mm supply and return piping c/w with manifolds and branch piping connecting to each well.

8.4.4 Energy Savings are approximately $30,000/year over an equivalent condensing boiler system. Simple payback = 17.7 years.

8.4.5 Greenhouse Gas Savings = 283 tCO2.

9 ENERGY CONSERVATION MEASURES – ELECTRICAL

9.1 ASHRAE 90.1 Energy Compliance

9.1.1 The existing lighting system in the building is consuming 1.31 W/ft2. ASHRAE 90.1 specifies lighting power densities for specific spaces within airports and

further states that a transportation building should have Lighting Power Densities (LPD) lower than 1.0 W/ft2. With LEED Certification in mind ASHRAE 90.1 would have to be further reduced by 10%. Therefore the Lighting Power Density target for the airport would be 0.9W/ft2. While the airport may not file for LEED certification this Lighting Power Density reduction represents a LEED pre-requisite minimum and should be considered a best practice whenever Energy Conservation is being pursued. A combination of techniques would be used to achieve the LPD of 0.9W/ft2. Examples are replacing light fixtures, de-lamping the existing fixtures, revising branch circuits, and revising the Lighting Control system program.

9.1.2 ECO: Re-lamp and re-fixture as necessary to surpass ASHRAE 90.1 by 10%.

9.1.3 Energy Savings: 31% of total lighting power, 292615 kW*h/year based on 18hour/day operation, or $20200 at $0.069/kW*h.

9.1.4 Capital Cost Estimate: $27390.

9.1.5 Simple Payback = 1.4 year.

9.2 Administration Open Office Area General Illuminance Levels

9.2.1 The existing lighting system in the open office area is to provide 550 lux on average to the working surface. Providing 550 lux on the desktop in an environment with 4 foot partitions is ineffective due to shadowing. Reducing the area lighting illuminance level to 350 lux will provide a comfortable work environment as well as introduce cost savings through reduced energy consumption, fixture maintenance and re-lamping. Using supplemental task lighting at each workstation will ensure that the occupants receive a comfortable amount of light where they require it.

9.2.2 ECO: Redesign open office area lighting to 350 lux with supplemental task lighting.

9.2.3 Energy Savings: Energy savings and costs for this option are grouped in with the Ashrae 90.1 Energy Compliance Option.

9.2.4 Capital Cost Estimate: Included above.

9.3 Occupancy Sensing in Private Offices

9.3.1 Each private office space uses one or two local switches to control the lights in the space. By installing wall mount occupancy sensors to replace the local switches the lights will always be turned off when the spaces are not occupied. Semi-Automatic Occupancy Sensing is recommended. If there are special requirements of a particular office that require a manual “lights on” override, that feature can be provided with the wall mounted occupancy sensor.

9.3.2 ECO: Install wall mounted occupancy sensors in private office to reduce lighting energy consumption in unoccupied spaces.

9.3.3 Energy Savings: 50% of office lighting energy, 87000 kW*h per year, or $6000 at $0.069/kW*h per year.

9.3.4 Capital Cost Estimate: $14775

9.3.5 Simple Payback = 2.5 years

9.4 Occupancy Sensing in Baggage Claim

9.4.1 Due to the nature of arrival times, the baggage claim area remains inactive for large periods of time during the airports daily operation. Using occupancy sensors in the airside corridor and CBSA area with manual override switches in the Baggage Claim area, the lights could be automatically turned off for a significant period of time each day. A reduced lighting level would be provided during the inactive mode to allow occupants to safely move about the space.

9.4.2 ECO: Install ceiling mounted occupancy sensors in airside corridor and CBSA processing area to reduce amount of time Baggage Claim light fixtures are turned on.

9.4.3 Energy Savings: 50% of Baggage Claim lighting energy, 40000 kW*h per year, or $2750 at $0.069/kW*h per year.

9.4.4 Capital Cost Estimate: $8100

9.4.5 Simple Payback = 2.9 years.

9.5 Washrooms, Locker, Janitor and Storage Rooms Occupancy Sensing

9.5.1 Many Janitor Rooms and Storage rooms often have the lights left on. Wall and ceiling mount occupancy sensors in semi automatic operation would ensure these lights are turned off when the rooms are not in use. The public and staff washrooms are currently turned on all day. Ceiling mounted occupancy sensors in fully automatic mode could effectively turn these lights.

9.5.2 ECO: Install ceiling mounted occupancy sensors in common all washrooms, Janitor Rooms, and Storage Rooms to turn lights off when not in use.

9.5.3 Energy Savings: 50% of room lighting energy or 29500 kW*h at $0.067/kW*h per year, or $2000 at $0.069/kW*h per year.

9.5.4 Capital Cost Estimate: $2175

9.5.5 Simple Payback = 1.1 years.

9.6 Concourse Daylight Harvesting

9.6.1 The Central Concourse has both skylights and clerestories. These features introduce large amounts of daylight into the space and during daytime hours the daylight dominates the lighting in the space. The electric lighting in the concourse could be turned off in the morning when the sun rises and turned on in the evening when the sun sets based on an outdoor photocell.

9.6.2 ECO: Commission existing photocell sensor to turn off concourse lighting during daylight hours.

9.6.3 Energy Savings: 12 hours of daylight harvesting per day for 206000 kW*h, or $14250 at $0.069/kW*h per year.

9.6.4 Capital Cost Estimate: $15,000.

9.6.5 Simple Payback = 1.1 years.

9.7 Rotunda Lounge Daylight Harvesting

9.7.1 The Rotunda Lunge has tall glazing on the West side. These windows introduce large amounts of daylight into the space and during daytime hours the daylight dominates the lounge area lighting in the space. The electric lighting in the upper Rotunda Lounge could be turned off during daylight hours, although the lower Rotunda area where passengers pass through en route to pre-board screening should remain on. The lighting system in the Rotunda Lounge area should be re-evaluated for energy efficiency. The Metal halide indirect lighting system shining upwards on the painted grey perforated curved mesh panel is extremely inefficient. A different ceiling type, or down lighting fixture could allow for a decrease the Lighting Power Density in the area.

9.7.2 ECO: Commission existing photocell sensor to turn off Rotunda Lounge lighting during daylight hours and re-evaluate indirect lighting system to further reduce the lighting power density.

9.7.3 Energy Savings: 12 hours of daylight harvesting per day. Calculated with Concourse lighting above.

9.7.4 Capital Cost Estimate: Included above.

9.8 Daylight Sensing to Control Air Side Corridor Lighting

9.8.1 The Air Side Corridor has large windows approximately every 8 feet. These windows provide ample daylight in the corridor during daytime hours. The electric lighting in the Air Side Corridor could be turned off where ever there are windows during daylight hours.

9.8.2 ECO: Install East facing photocell and commission turn off Air Side Corridor lighting during daylight hours.

9.8.3 Energy Savings: 12 hours of daylight harvesting per day. Calculated with Concourse lighting above.

9.8.4 Capital Cost Estimate: $1300.

9.9 Building Lighting Control System

9.9.1 The Douglas Relay System controls the lighting circuits throughout the building and allows for great lighting flexibility. By revising the time clock and photocell schedules, a more stringent control scheme could be implemented. In general the light fixtures are connected to a large number of small zones. This affords great flexibility although some wiring may need to be revised to allow for maximum implementation of the above strategies. Reducing the hours that exterior light fixtures are turned on by turning them off during the late night period would add further savings.

9.9.2 ECO: Re-commission Time clock and Photocell Schedules for interior and exterior light fixtures. Revise wiring of light circuits as necessary to allow for implementation of daylight harvesting.

9.9.3 Energy Savings: Difficult to quantify.

9.9.4 Capital Cost Estimate: $2000

9.10 Building Luminaire Retrofit

9.10.1 The building has had almost all Fluorescent T12 lamps replaced with Energy Saving T8 lamps however there are a number of T12 lamps still in operation,

most notably in the exterior canopy. These fixtures have high mercury content, are inefficient, and should be replaced or re-lamped to T8.

9.10.2 ECO: Retrofit the remaining T12 lamps to be T8 lamps.

9.10.3 Energy Savings: 20% of fixture lighting energy or 1260 kW*h per year, or $90 at $0.067/kW*h per year.

9.10.4 Capital Cost Estimate: $6900

9.10.5 Simple Payback = 76 years.

9.11 Branch Wiring Revisions

9.11.1 In order to facilitate the above options, minor revisions to the electrical branch wiring may be necessary. These changes may be required in order to create the daylight harvesting schemes and revise fixtures to meet ASHRAE 90.1 depending on the existing conditions.

9.11.2 ECO: Facilitate technical completion of above ECO's

9.11.3 Capital Cost Estimate: $16398

10 SUMMARY

10.1 Mechanical ECO Summary Table

#	Description	ECO	Energy Savings	Capital Cost	Simple Payback	tCO2
.1	Revise Mechanical Schedules	Shut Down Air Handling Units Overnight	$ 14,000	None	Immediate	4.1
.2	Chilled Water Pumps	Shut Down Chilled Water Pumps Overnight	$ 2,000	None	Immediate	0.6
.3	C02 Control	Revise setpoints to 1000 ppm	Difficult to quantify	$1,300	Immediate	-
.4	Bypass Water Filtration	Remove or bypass water filtration, check water quality, provide dedicated piping to water closets	Difficult to quantify	$0 - if water quality is bad, $103,200	Immediate	-
.5	Condensing Boilers	Install condensing boilers when upgrading	$15,000	$30,000	2.0 years	67.5
.6	Central Chillers	Install central water cooled chillers instead of DX units	$9,500	$108,700	11.4 years	2.8
.7	Variable Speed Pumping	Install variable speed drives and 2-way valves on fan coils	$6,200	$122,000	19.7 years	1.8
.8	Geothermal Heat Pump System	Install a ground source geothermal system in conjunction with future expansions	$30,000	$532,500	17.7 years	283

10.2 Electrical ECO Summary Table

#	Description	ECO	Energy Savings	Capital Cost	Simple Payback	tCO2
.1	ASHRAE 90.1 Compliance	Revise lighting from 1.31 W/sq.ft. to 0.9 W/sq.ft.	$20,200	$27,390	1.4 years	5.9
.2	Administration Office Illumination	Reduce illumination to 350 lux	Included item .1	Included item .1	Included item .1	
.3	Occupancy sensors in Private Offices	Add Occupancy Sensors in all private offices	$6,000	$14,775	2.5 years	1.7
.4	Occupancy sensors in Baggage Claim	Add Occupancy Sensors to Baggage Claim	$2,750	$8,100	2.9 years	0.8
.5	WR, LR, JR, and Storage Room Occupancy Sensors	Add Occupancy Sensors to Misc Rooms	$2,000	$2,175	1.1 years	0.6
.6	Concourse Daylight Harvesting	Commission existing photocell to turn off concourse lighting during the day	$14,250	$15,000	1.1 years	4.1
.7	Rotunda Lounge Daylight Harvesting	Commission existing photocell to turn off concourse lighting during the day	Included item .6	Included item .6	Included item .6	
.8	Daylight Sensing for Control Air Side Corridor	Daylight sensing to Air Side Corridor	$1,300	Included item .6	Included item .6	0.3
.9	Building Lighting Control System	Recommisson time clock and photo-cells to exterior light fixtures	Difficult to quantify	$2,000	Immediate	
.10	Building Luminaire Retrofit	Retrofit remaining T12 lamps to T8 lamps	$ 90	$6,900	76 years	
.11	Branch Wiring Revisions	Allowance to complete ECO's 1-10		$16,398		

11 PHASING

11.1 PHASE 1- CBSA PIL and Transborder Holdroom Modification

#	Description	Phase 1 ECO Description	Phase 1 Capital Cost
.1	Revise Mechanical Schedules	Shut Down Air Handling Units Overnight	None
.2	Chilled Water Pumps	Shut Down Chilled Water Pumps Overnight	None
.3	C02 Control	Revise setpoints to 1000 ppm	$1,300
.4	Bypass Water Filtration	Remove or bypass water filtration, check water quality	$0
.5	Condensing Boilers	Install condensing boiler in PIL mechanical room for backup. Install condensing boiler in West mechanical room for life cycle replacement.	$15,000
.6	Central Chillers	Install backup water cooled chiller and tower in PIL mechanical room	$40,000
.7	Variable Speed Pumping	Install variable speed drives and 2-way valves on fan coils in Transborder renovation area.	$61,000
.8	Geothermal Heat Pump System	Install two heat pumps in PIL mechanical room, main underground piping and partial geothermal field	$175,000
#	**Description**	**Phase 1 ECO Description**	**Phase 1 Capital Cost**
.1	ASHRAE 90.1 Compliance	Mockup areas created for areas that will require new fixturing, De-Lamping in areas where this option can be achieved.	$6,825
.2	Administration Office	Reduce illumination to 350 lux	Included

	Illumination		item .1
.3	Occupancy sensors in Private Offices	Add Occupancy Sensors in all private offices	$14,775
.5	WR, LR, JR, and Storage Room Occupancy Sensors	Add Occupancy Sensors to Misc Rooms	$2,175
.6	Concourse Daylight Harvesting	Testing only	$15,000
.7	Rotunda Lounge Daylight Harvesting	Commission photocell sensors	Included item .6
.8	Daylight Sensing for Control Air Side Corridor	Daylight sensing to Air Side Corridor	$1,300
.9	Building Lighting Control System	Recommisson time clock and photo-cells to exterior light fixtures	$1,000
.10	Building Luminaire Retrofit	Retrofit remaining T12 lamps to T8 lamps	$6,900
.11	Branch Wiring Revisions	Allowance to complete ECO's 1-10, as required in Phases 1, 2, 3, 4	$4,373

Total: $ 344,648

11.2 Phase 2 - Outbound Baggage Hall and Modifications to Air Side Corridor / Generator Facility

#	Description	Phase 2 ECO Description	Phase 2 Capital Cost
.8	Geothermal Heat Pump System	Install geothermal pipes through new airside corridors	$107,500
#	**Description**	**Phase 2 ECO Description**	**Phase 2 Capital Cost**
.1	ASHRAE 90.1 Compliance	Revise lighting from 1.31 W/sq.ft. to 0.9 W/sq.ft by re-lamping in existing terminal	$10,328

		building concourse air and ground-side where it is required (up to and not including the Rotunda)	
.6	Concourse Daylight Harvesting	Commission and implement after fixture up-grades	None
.11	Branch Wiring Revisions	Allowance to complete ECO's 1-10	$4,373

Total: $ 122,201

11.3 Phase 3 – Domestic Bag Claim / Meeter Greeter / Holdroom Expansion / Loading Area

#	Description	Phase 3 ECO Description	Phase 3 Capital Cost
.5	Condensing Boilers	Install condensing boilers when upgrading	$15,000
.6	Central Chillers	Install new central chiller and cooling tower in new mechanical room	$68,700
.7	Variable Speed Pumping	Install variable speed drives and 2-way valves on fan coils in renovated areas	$61,000
.8	Geothermal Heat Pump System	Install ground source heat pumps in new penthouse and extend source piping to penthouse	$250,000
#	**Description**	**Phase 3 ECO Description**	**Phase 3 Capital Cost**
.7	Rotunda Lounge Daylight Harvesting	Lighting Fixture Improvements	Included item .6
.11	Branch Wiring Revisions	Allowance to complete ECO's 1-10	$4,373

Total: $399,073

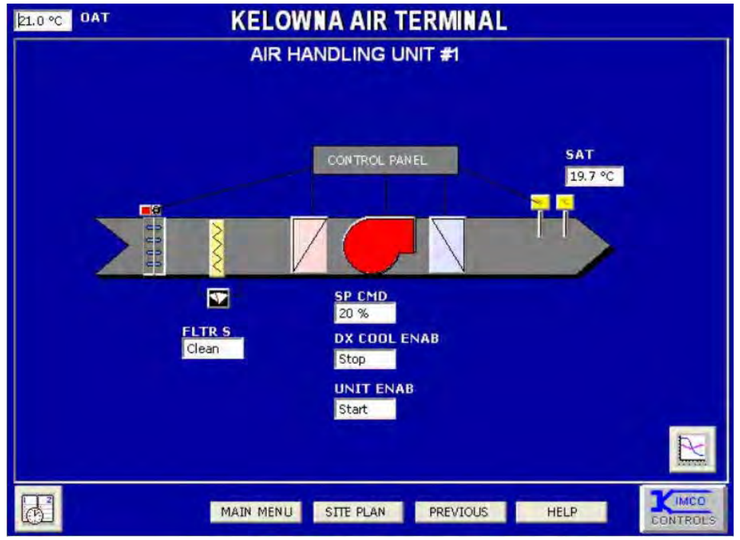
11.4 Phase 4 - International Bag Claim / Meeter Greeter Modifications / CBSA Secondary Expansion

#	Description	Phase 4 ECO Description	Phase 4 Capital Cost
.7	Variable Speed Pumping	Install variable speed drives and 2-way valves on fan coils	$30,000
#	**Description**	**Phase 4 ECO Description**	**Phase 4 Capital Cost**
.1	ASHRAE 90.1 Compliance	Revise lighting from 1.31 W/sq.ft. to 0.9 W/sq.ft. Complete re-lamping in areas that were affected by renovation or new construction during Phase 3.	$10,237
.4	Occupancy sensors in Baggage Claim	Add Occupancy Sensors to Baggage Claim	$8,100
.9	Building Lighting Control System	Re-commission time clock and photo-cells to exterior light fixtures	$1,000
.11	Branch Wiring Revisions	Allowance to complete ECO's 1-10	$3,279

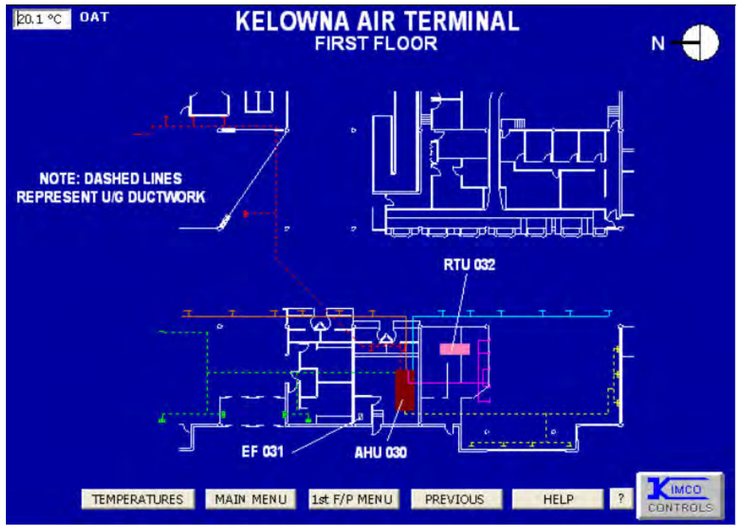
Total: $ 52,616

APPENDIX A

EXISTING MECHANICAL SYSTEMS



AHU-1



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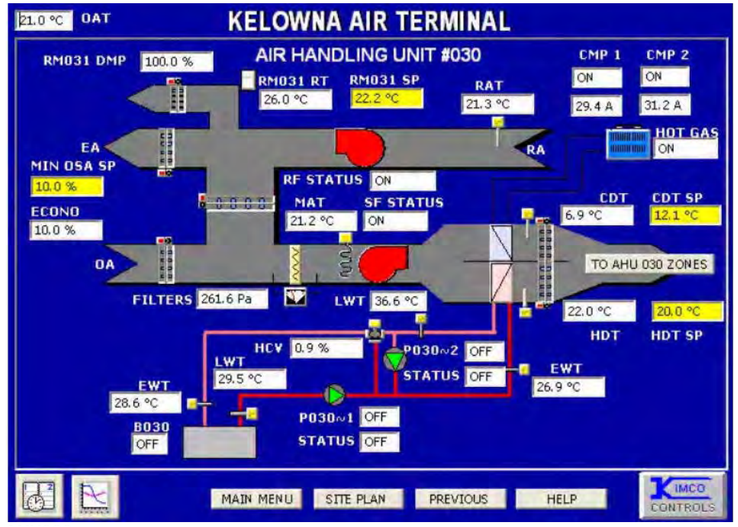
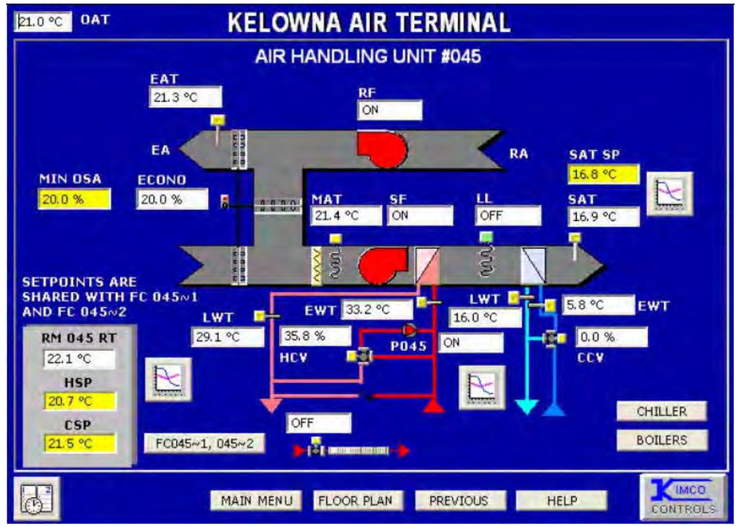


AHU030



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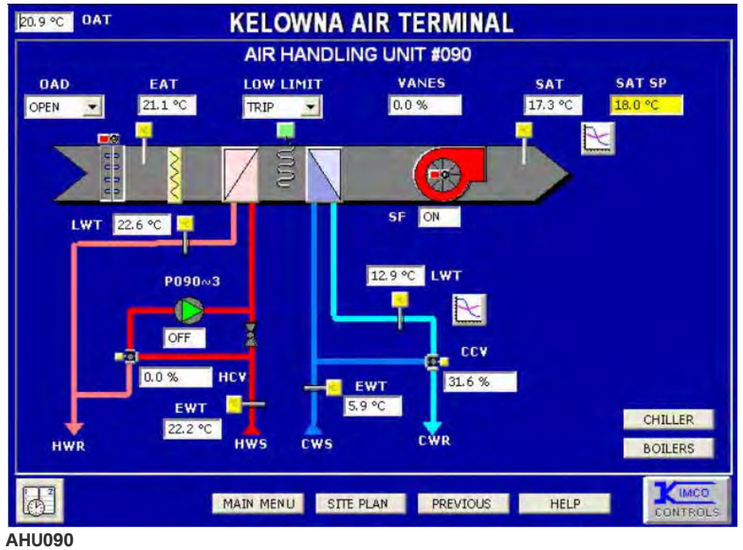

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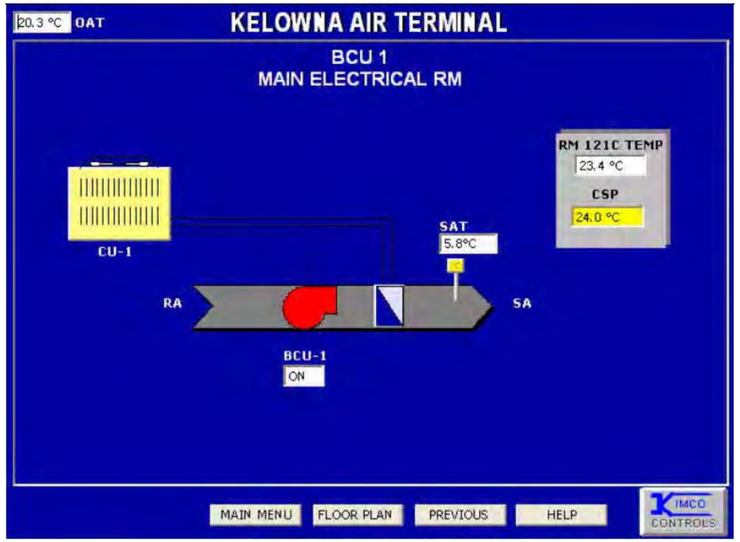
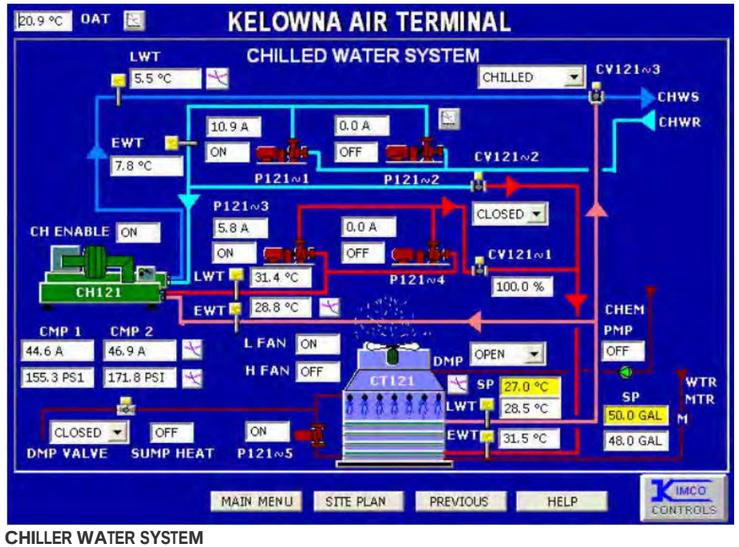
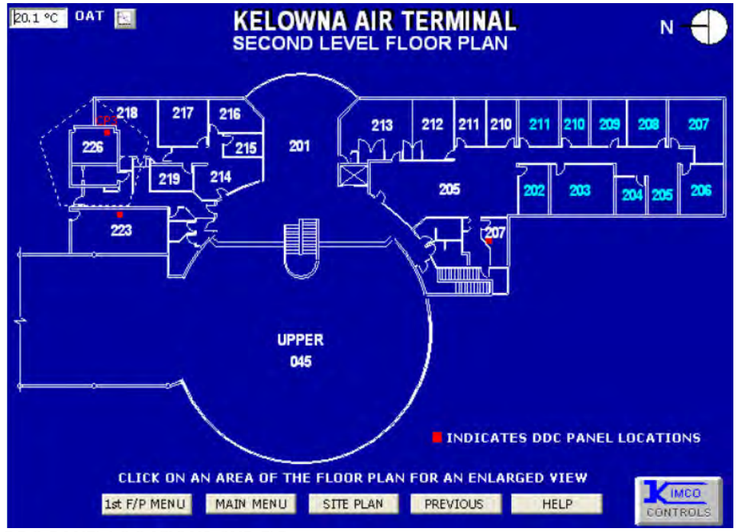


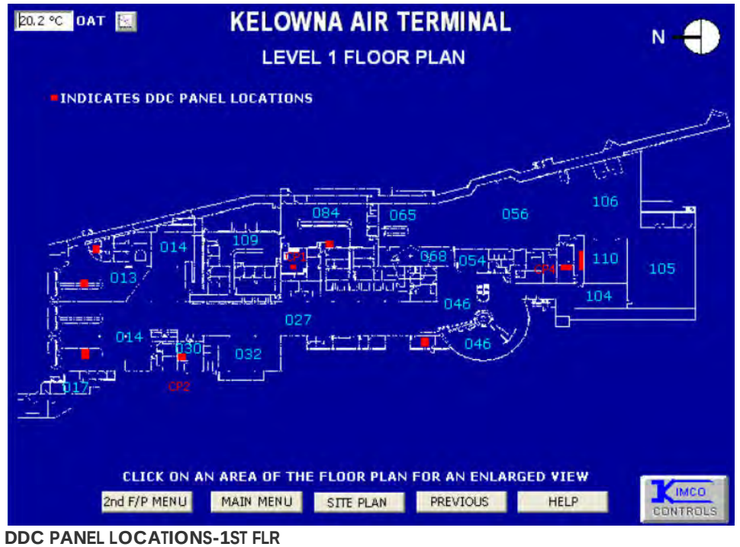
BCU1



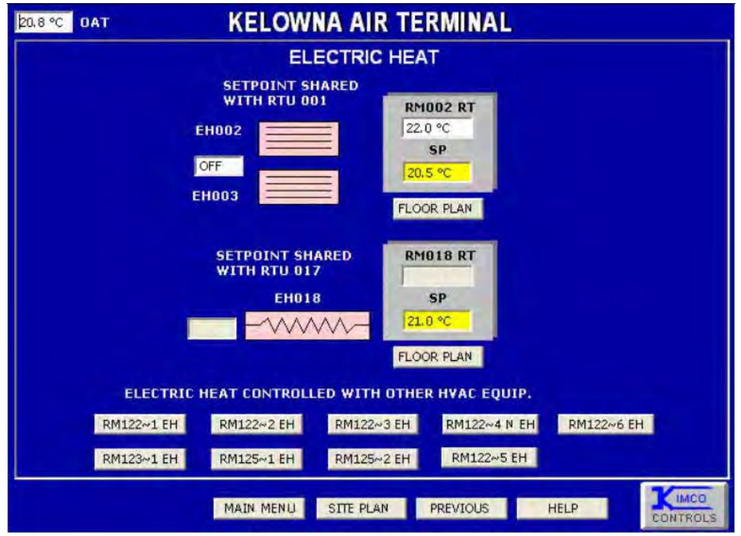
CHILLER WATER SYSTEM



DDC PANEL LOCATIONS-2ND FLR



DDC PANEL LOCATIONS-1ST FLR



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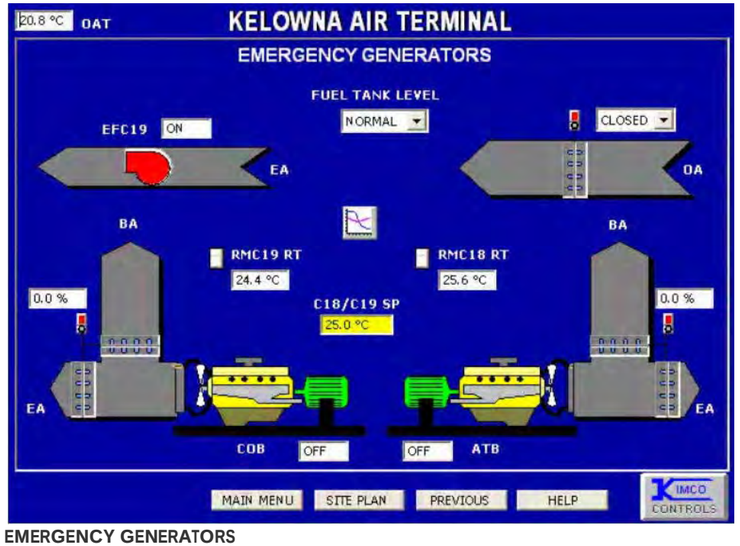
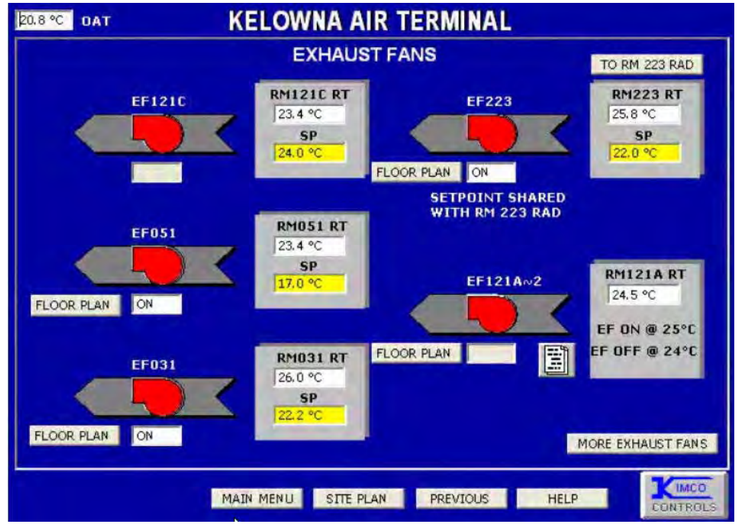
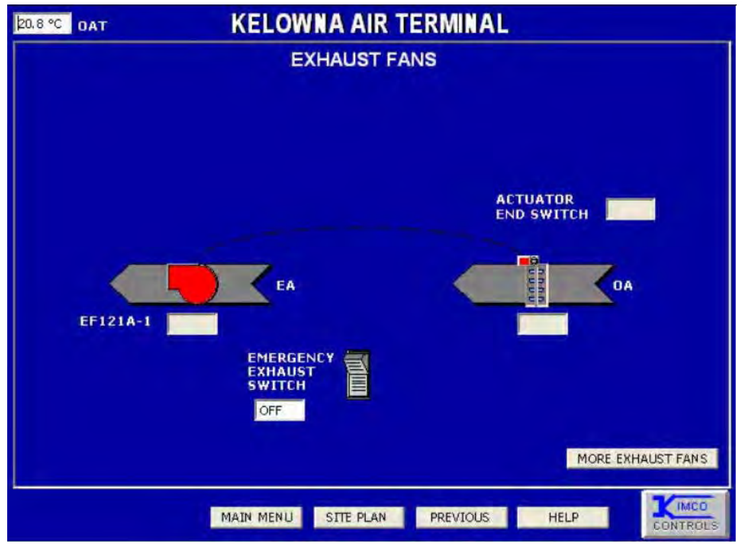


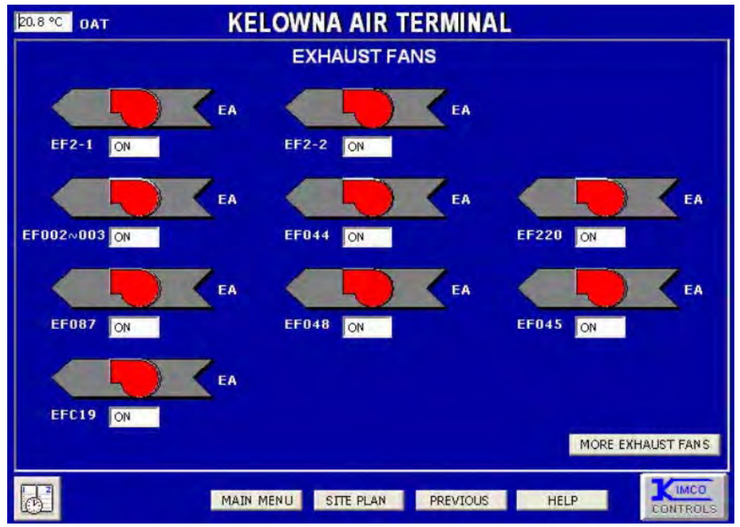
EMERGENCY GENERATORS



EXHAUST FANS 1



EXHAUST FANS 2



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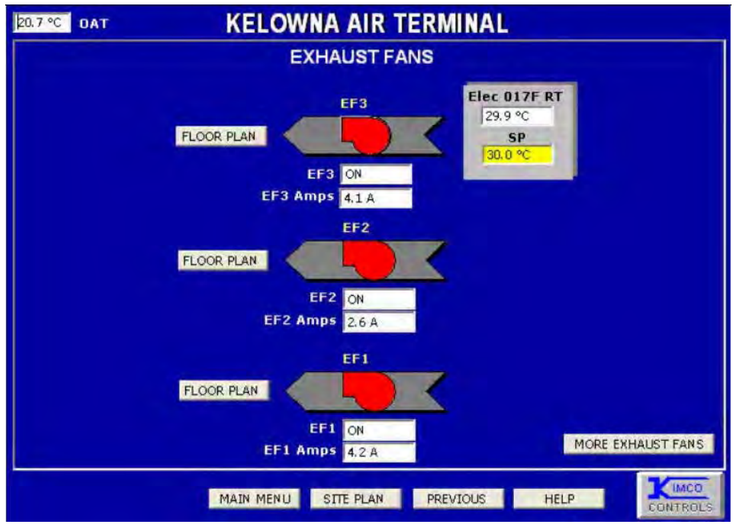

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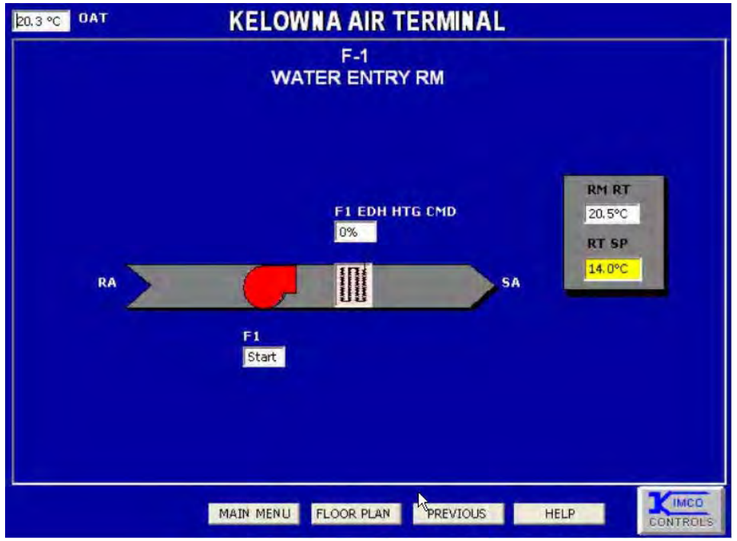
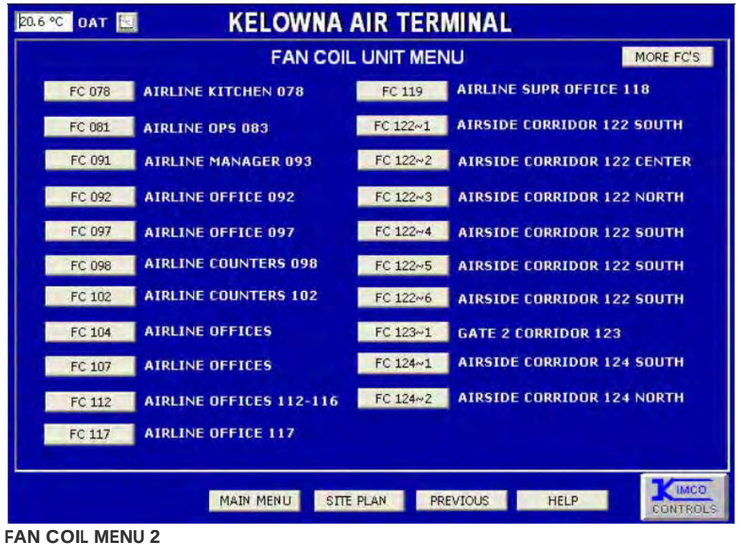


F1 WATER ENTRY

FAN COIL PBS EXPANSION

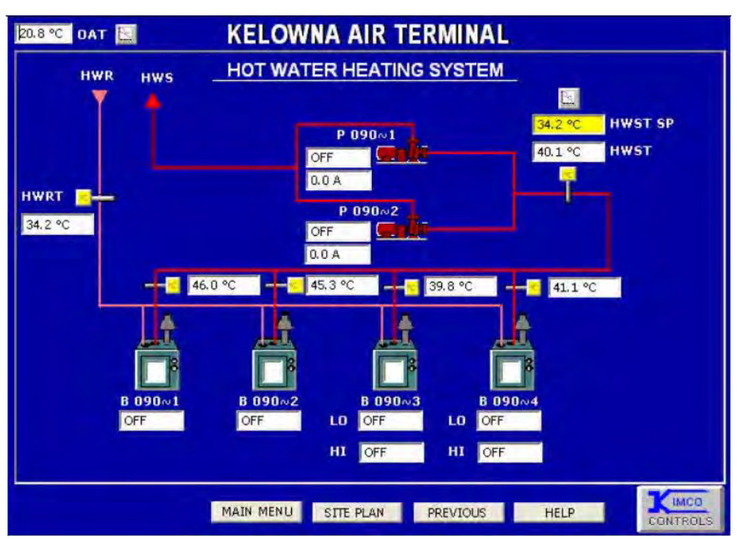
FAN COIL MENU 1



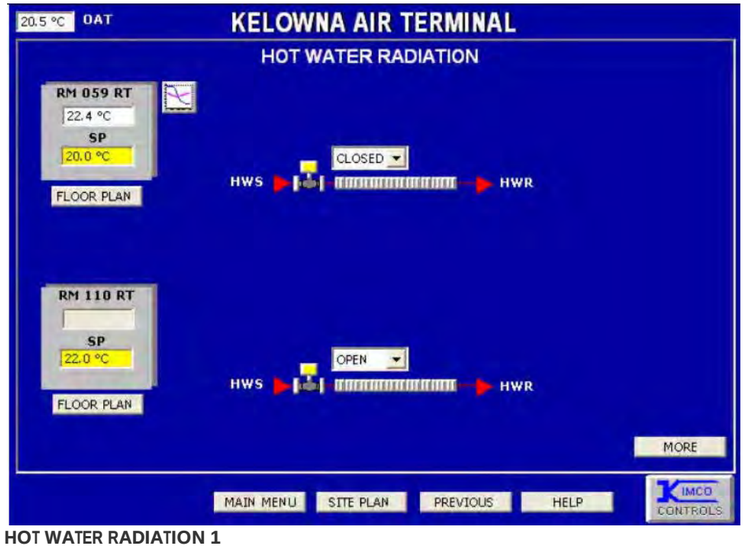
FAN COIL MENU 2

FAN COIL MENU 3

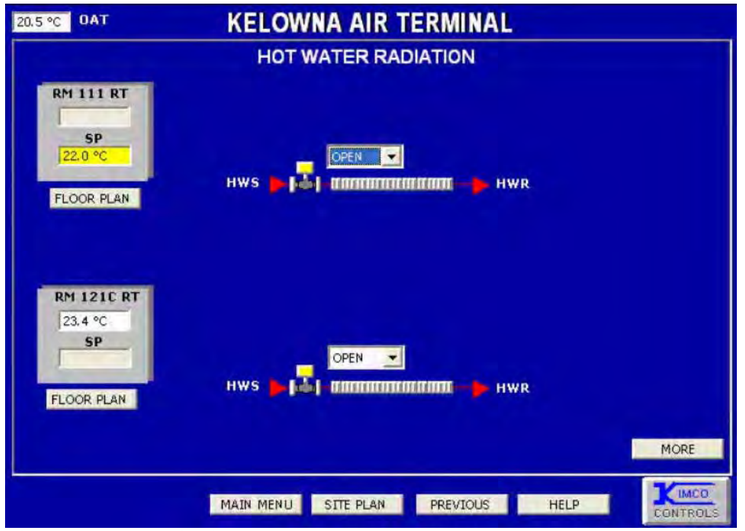
FORCE FLOW MENU



HOT WATER HEATING SYSTEM

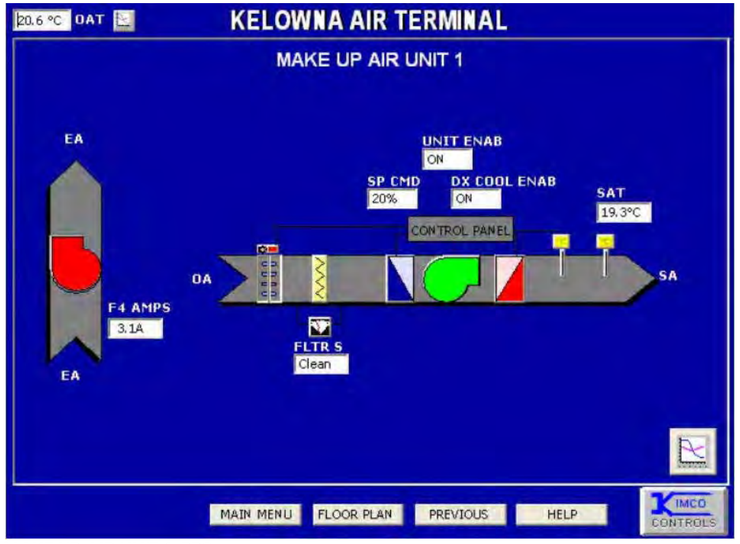


HOT WATER RADIATION 1

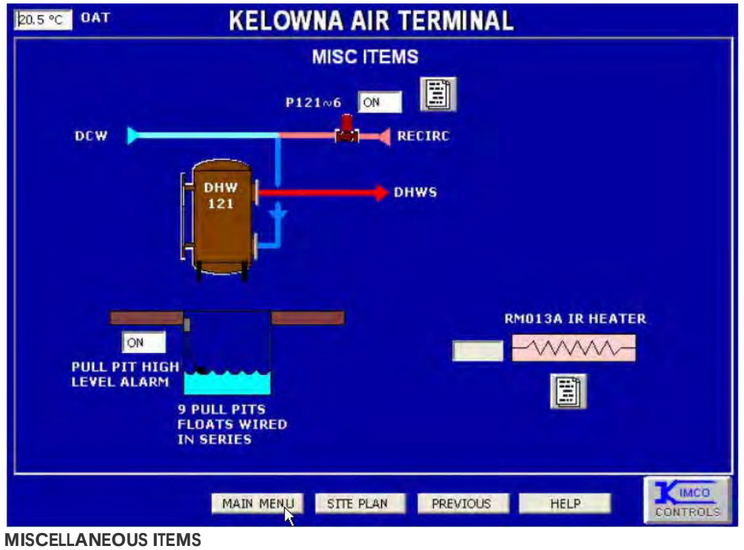


HOT WATER RADIATION 2

HOT WATER RADIATION 3

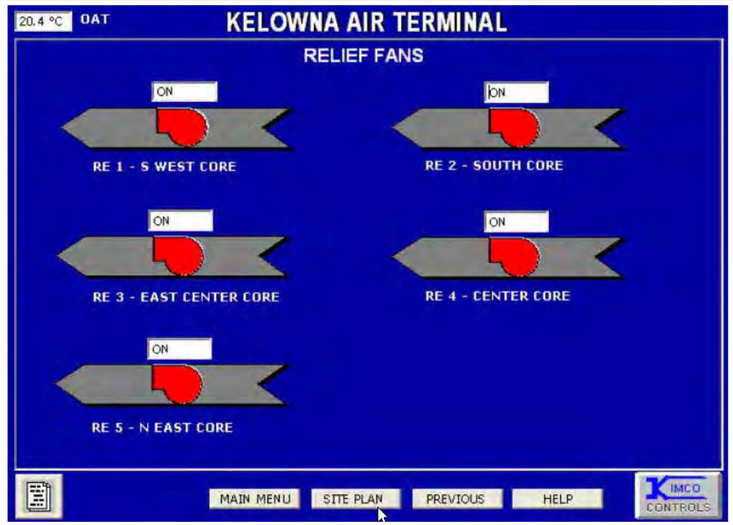


MAKE UP AIR UNIT 1-PBS

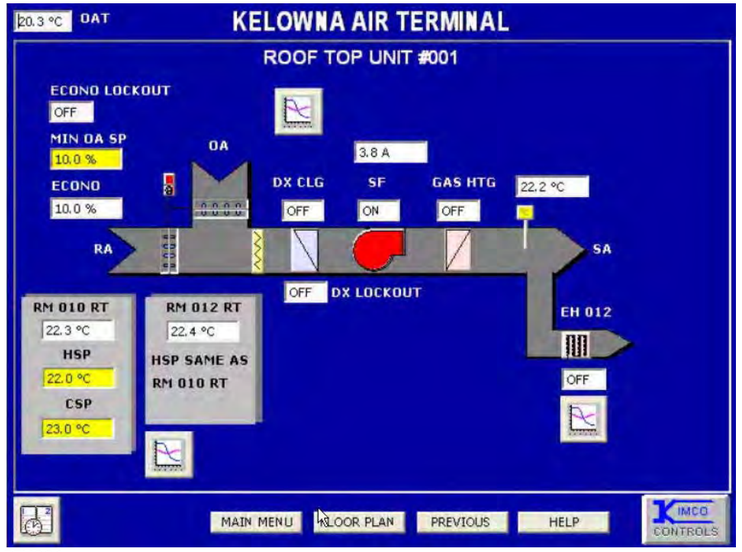


MISCELLANEOUS ITEMS

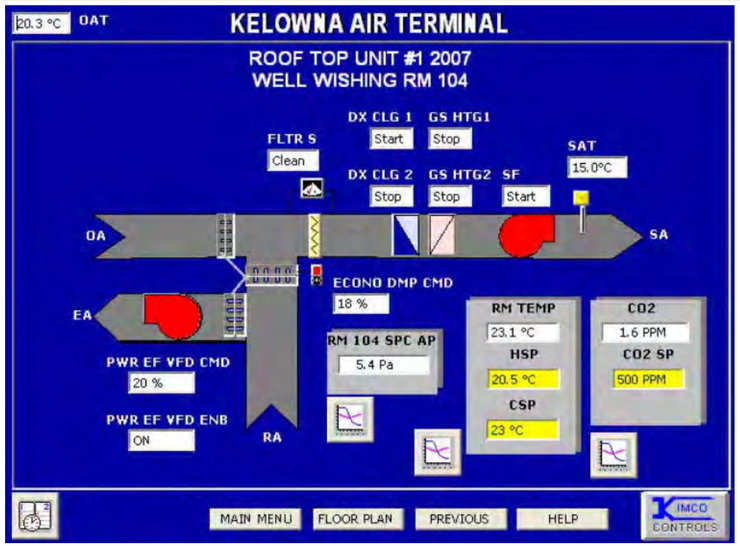
MISCELLANEOUS PBS EXPANSION



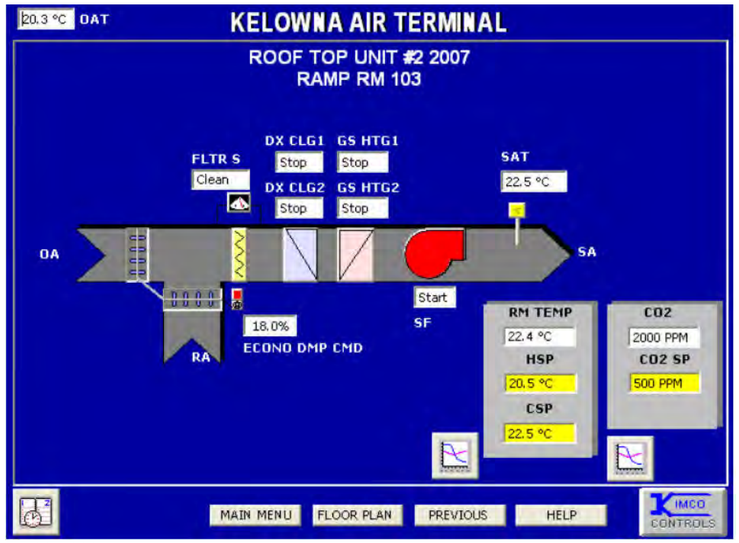
RELIEF FANS



RTU001



RTU001 2007



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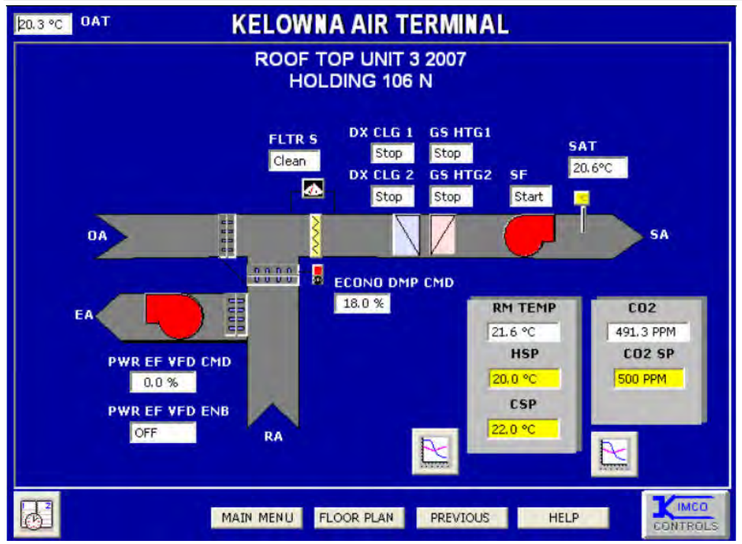

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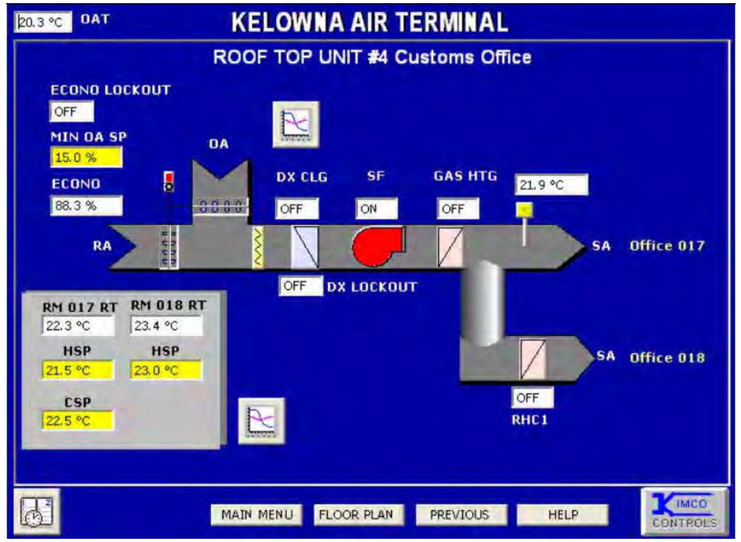

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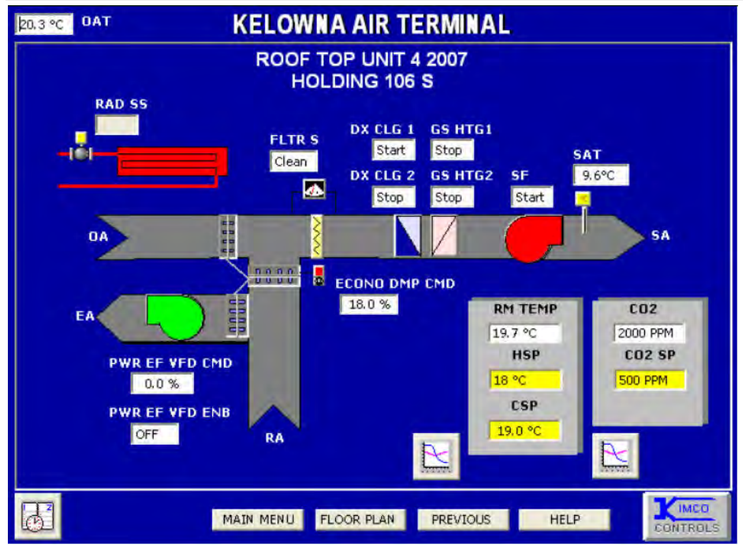
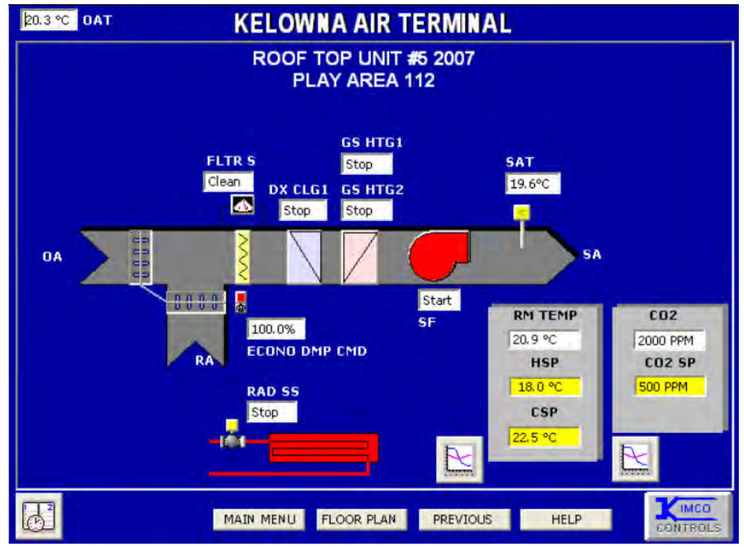


RTU004 2007



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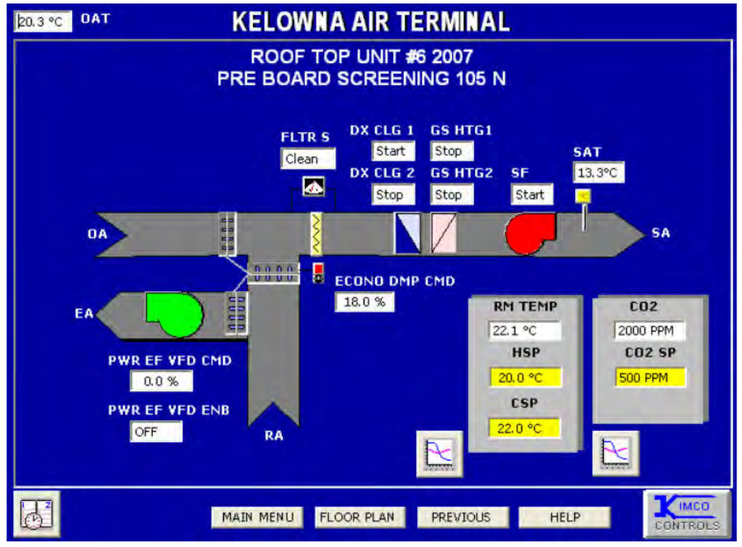
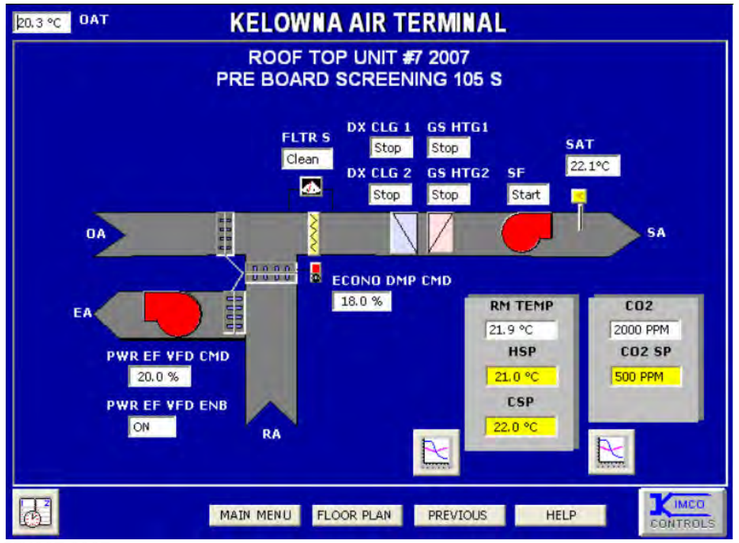
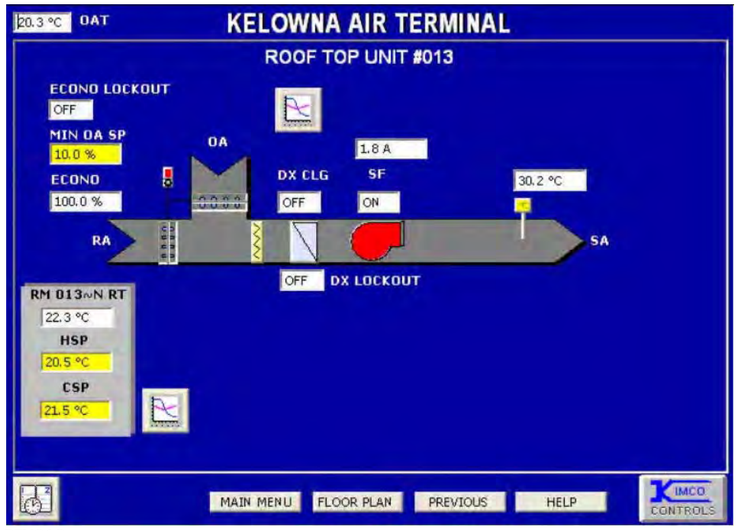


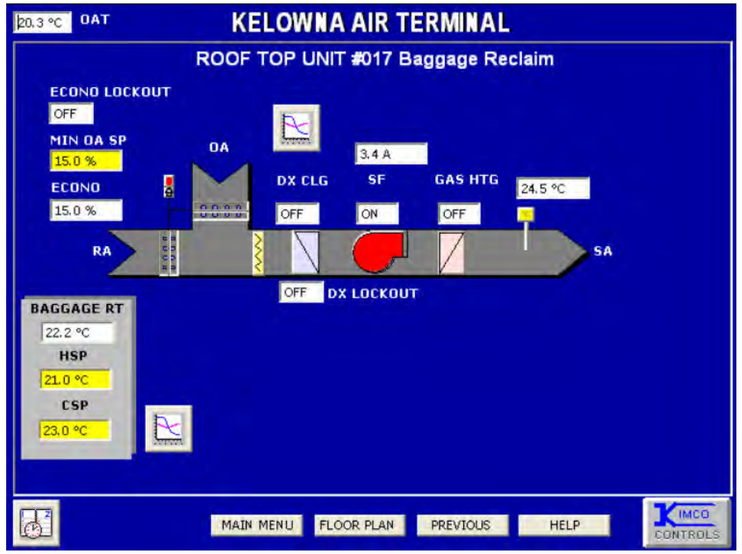
RTU006 2007



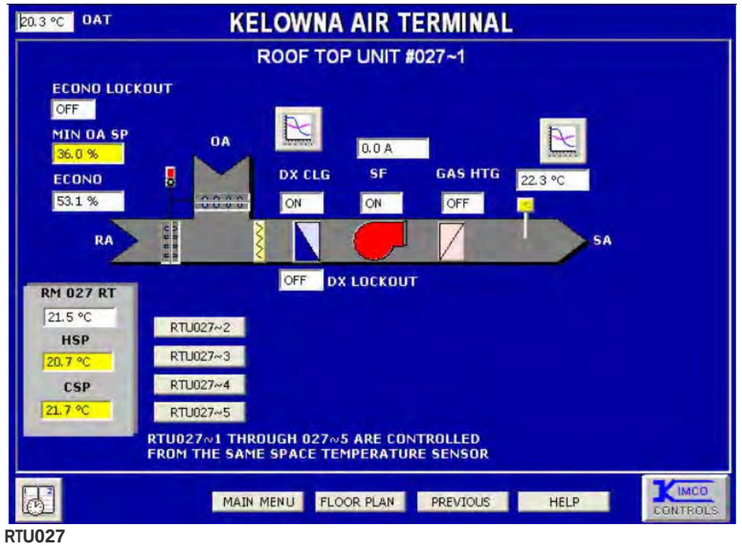
RTU007 2007



RTU013



RTU017



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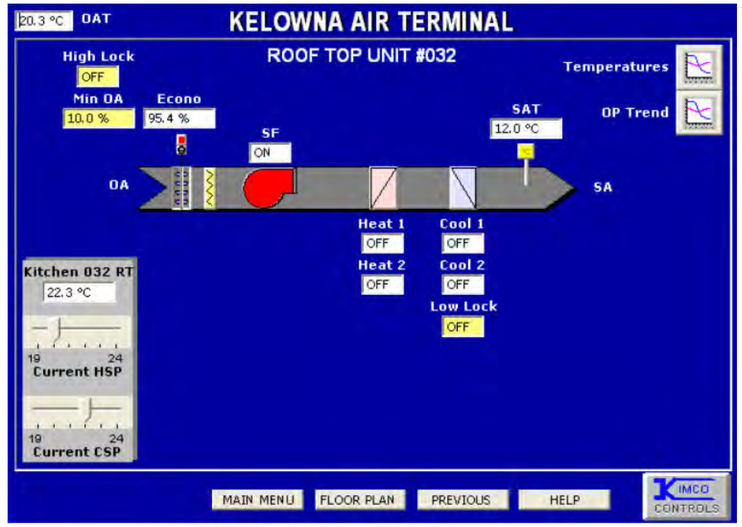

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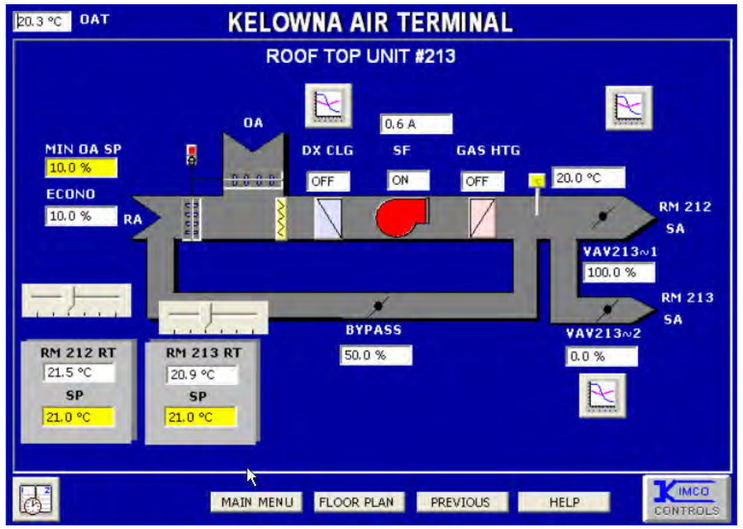
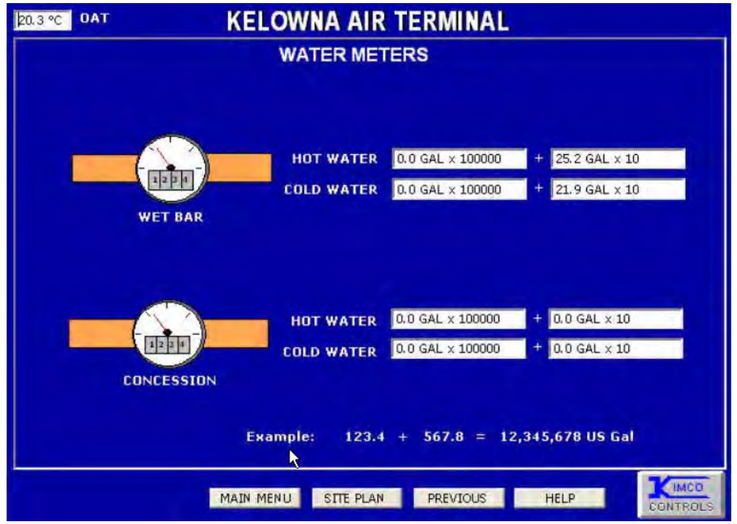


RTU213

RTU MENU

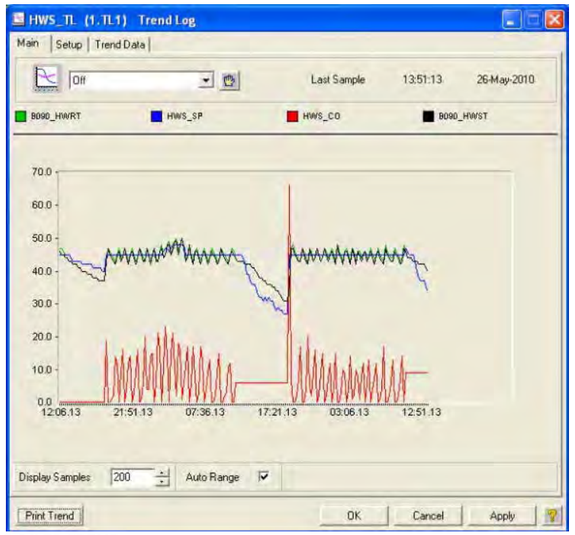
UH MENU



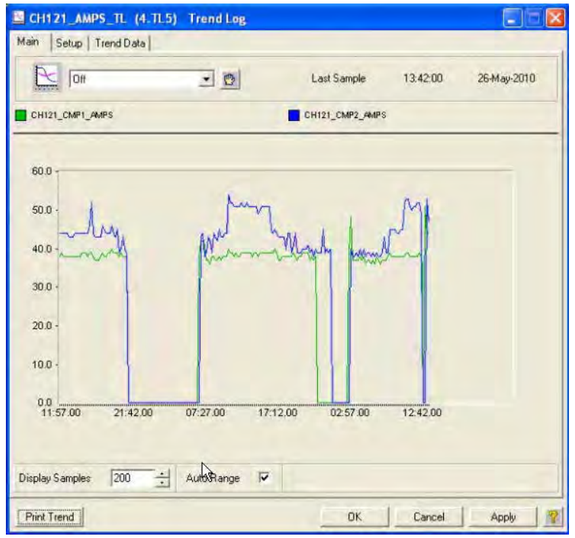
WATER METERS 1

APPENDIX B

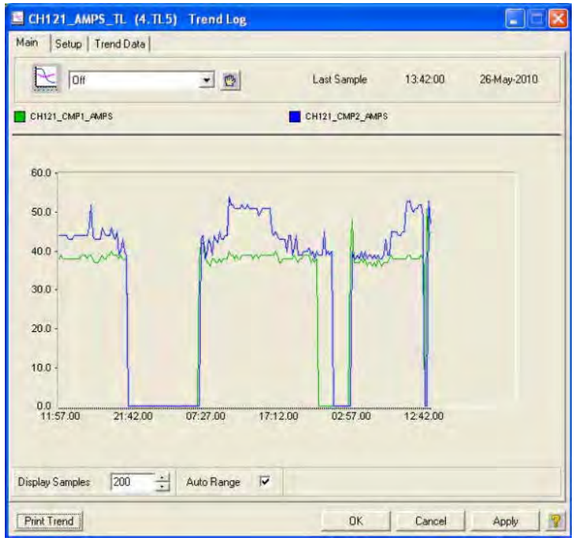
TREND LOGS



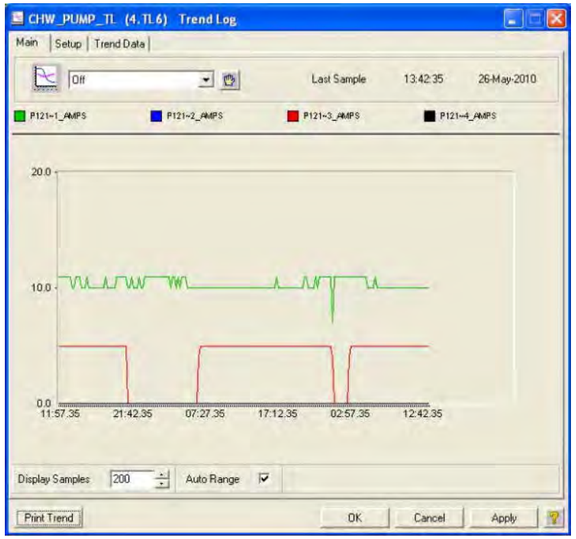
BOILER TREND



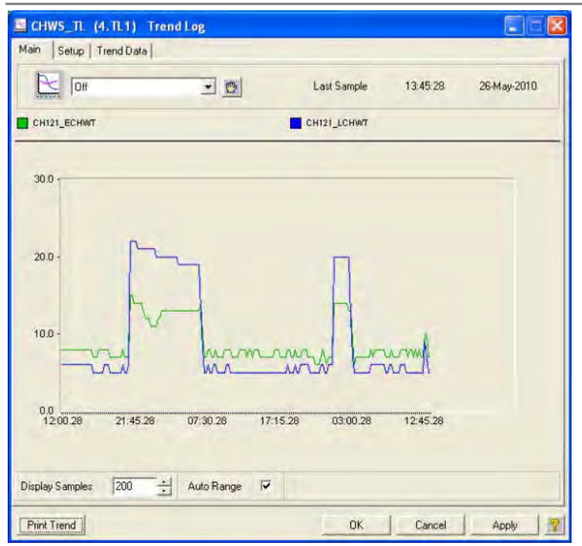
CHILLER LOG



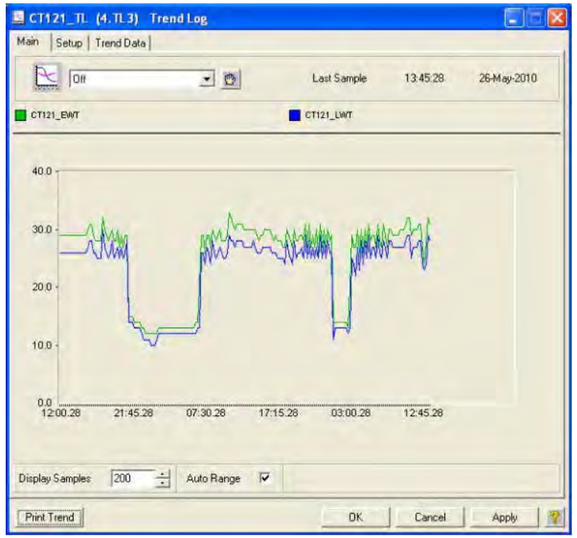
CHILLER TREND LOG



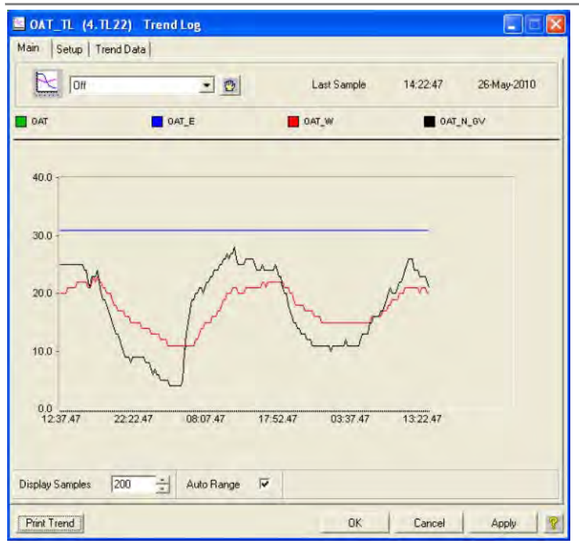
CHILLER PUMPS



CHILLER TEMP LOG



COOLING TOWER TEMP



OAT TREND

APPENDIX C

LUMINAIRE AND LIGHTING AUDIT DATA

Luminaire Schedule		Kelowna Airport Lighting Audit		C03048				
	Luminaire Configuration	Lamps Per Fixture	Lamps max	Lamp Type	Lamp Wattage	Mounting Type	Image Number	
A	2x2 Parabolic	2	2	Twin Tube	40	Rec	411	
A1	2x2 Parabolic	3	3	Twin Tube	40	Rec/Sus	410	
A2	2x2 Lensed	2	2	Twin Tube	40	Rec		
A3	1x4 Lensed	2	2	T8	32	Wall	420	
A4								
A5	Downlight with Cross Baffle	1	1	DTT CFL	32	Rec		
A6	Downlight with Cross Baffle	2	2	DTT CFL	26	Rec		
A7	4' Lensed Vandal	2	2	T8	32	Rec	425	
A8	2x4 Parabolic	3	3	T8	32	Rec	430	
A9	1x4 Lenses	2	2	T8	32	Rec	431	
A10	Downlight Cross Baffle	2	2	DTT CFL	13	Rec		
A11	2x4 Lensed	3	3	T8	32	Rec	436	
A12	1x4 Lensed	2	2	T8	32	Rec	437	
A13	2x4 Lensed	3	3	T8	32	Rec	438	
A14	2 lamp Strip	2	2	T8	32	Sus	439	
A15	Downlight - No lens	2	2	DTT CFL	26	Rec	455	
A16	4" Linear with Cross Baffle	1	1	T8	32	Rec	501	
A17	2x4 Lensed	4	4	T8	32	Rec	582	
A18	Downlight	1	1	Inc	75	Rec		
A19	Wall Light	1	1	Inc	100	Wall		
B	4' Wraparound	2	2	T8	32	Sur	419	
B1	4' Vanity	2	2	T8	32	Wall	421	
B2	4' Strip in Cove	2	2	T8	32	Wall	433	
B3	4' Vanity	2	2	T8	32	Wall	441	
B4	4' Strip	2	2	T8	32	Sur		
B5	4' Vanity	2	2	T8	32	Wall	442	
B6	4' Strip	1	1	T8	32	Sur		
B7	4' Linear	2	2	T8	32	Sus		
B8	4' Indirect/Direct	2	2	T8	32	Sus	460	
B9	4' Indirect/Direct	2	2	T8	32	Sus	461	
B10	4' Indirect/Direct	2	2	T8	32	Sus		
B11	1x4 Surface Lensed	2	2	T8	32	Sur	463	
D1	Metal Halide Canopy	1	1	MH	100	Sur	574	
D2	Metal Halide Canopy	1	1	MH	100	Sur	575	
D3	Weather Proof 4' Strip	2	2	T12	40	Sur	576	

Project #	03048C04	Project Name:	Kelowna Aiport	Project Location:	Kelowna, BC																	Date:	May 26, 2010 - May 27, 2010		
Existing Room Information							Existing Luminaire Information																Illumination Levels (lux)		
Room Number	Room Name	Room Type	Room Description	Room Dimensions	System Voltage	Switching Controls	Luminaire Type	Luminaire Condition	Luminaire Quantity	Luminaire Configuration	Hours of Use Day time	Possible Hours of Daylight Harvesting	Lamps per Luminaire	Lamps per Fixture Max	Lamp Type	Lamp Wattage	Mounting Type	Luminaire Height	Ceiling Type	Ceiling Condition	Between	Under	Wall Margin
new arrivals	Baggage pick up				120		A	Good	48	2x2 Parabolic	18		2	2	Twin Tube	40	Rec	10	T-Bar	Good	420	520	
					120		A5	Good	2	Downlight with Cross Baffle	18		1	1	DTT CFL	32	Rec	10	Drywall	Good			
existing arrivals	Baggage pick up				120		A1	Good	110	2x2 Parabolic	18	6	3	3	Twin Tube	40	Rec/Sus	10	T-Bar	Good	650	810	
					120		A2	Good	4	2x2 Lensed	18	6	2	2	Twin Tube	40	Rec	12	Arch	Good			
022	West Jet Baggage Services	Office			120	L-Switch	A	Good	3	2x2 Parabolic	18		2	2	Twin Tube	40	Rec	8	T-Bar	Good		330	
021	Jazz Baggage Services	Office			120	L-Switch	A	Good	3	2x2 Parabolic	18		2	2	Twin Tube	40	Rec	8	T-Bar	Good	450	550	
019	Commissionaire Security	Office			120	L-Switch	A1	Good	2	2x2 Parabolic	18		3	3	Twin Tube	40	Rec/Sus	8	T-Bar	Good		700	
020	Commissionaire Storage	Storage			120	L-Switch	A2	Fair	1	2x2 Lensed	18		2	2	Twin Tube	40	Rec	8	T-Bar	Good	350	500	
017	Customs Office	Office			120		A	Good	20	2x2 Parabolic	18		2	2	Twin Tube	40	Rec	8	T-Bar	Good	600	700	
	Customs Storage	Storage			120	Occ Sen	A2	Good	1	2x2 Lensed	18		2	2	Twin Tube	40	Rec	8	Drywall	Good		480	
	Customs Lunch Room	Office			120	L-Switch	B	Good	2	4' Wraparound	18		2	2	T8	32	Sur	8	Drywall	Good	370	530	
	Mens Locker Room	Locker Room			120	Occ Sen	B1	Good	1	4' Vanity	18		2	2	T8	32	Wall	7	Drywall	Good	440	525	
	Mens Locker Room	Locker Room			120	Occ Sen	A3	Good	3	1x4 Lensed	18		2	2	T8	32	Wall	8	Drywall	Good			
	Mens Locker Room	Locker Room			120	Occ Sen	A6	Good	1	Downlight with Cross Baffle	18		2	2	DTT CFL	26	Rec	8	Drywall	Good			
	Womens Locker Room	Locker Room			120	Occ Sen	A3	Good	2	1x4 Lensed	18		2	2	T8	32	Wall	8	Drywall	Good	430	500	
	Womens Locker Room	Locker Room			120	Occ Sen	B1	Good	1	4' Vanity	18		2	2	T8	32	Wall	7	Drywall	Good			
011	Process	Office			120	L-Switch	A1	Good	11	2x2 Parabolic	18		3	3	Twin Tube	40	Rec/Sus	8	T-Bar	Good	200	625	
010	Office	Office			120	L-Switch	A	Good	3	2x2 Parabolic	18		2	2	Twin Tube	40	Rec	8	T-Bar	Good	200	530	
009	DOC	Office			120	L-Switch	A	Good	2	2x2 Parabolic	18		2	2	Twin Tube	40	Rec	8	T-Bar	Good	380	440	
012	Detention				120		B2	Good	2	4' Strip in Cove	18		2	2	T8	32	Wall	8	Drywall	Good	410	520	
008	Hold				120		A7	Good	2	4' Lensed Vandal	18		2	2	T8	32	Rec	8	Drywall	Good	330	380	
005	Storage	Storage			120	L-Switch	A2	Fair	1	2x2 Lensed	18		2	2	Twin Tube	40	Rec	8	T-Bar	Good		470	
006	Comms Room	Service			120	L-Switch	A2	Good	2	2x2 Lensed	18		2	2	Twin Tube	40	Rec	8	T-Bar	Fair	460	640	
004	Corridor				120	L-Switch	A	Good	3	2x2 Parabolic	18		2	2	Twin Tube	40	Rec	8	T-Bar	Good		400	
027	Main Concourse	Lobby			120		A1	Good	172	2x2 Parabolic	18	12	3	3	Twin Tube	40	Rec/Sus	25	Arch	Good	1200	1500	
027	Main Concourse	Lobby			120		Signage	Good	39		18	12	2	2	T12	40	Wall	12	Arch	Good			
102	Airline Counter	Office			120		A1	Good	19	2x2 Parabolic	18		3	3	Twin Tube	40	Rec/Sus	8	Open	Fair	950	1000	
104	Air Canada Office	Office			120	L-Switch	A8	Good	2	2x4 Parabolic	18		3	3	T8	32	Rec	7.5	T-Bar	Good	500	730	
105	Lockers	Locker Room			120	L-Switch	A8	Good	2	2x4 Parabolic	18		3	3	T8	32	Rec	7.5	T-Bar	Good	1100	1300	
106	Lunch Room	Office			120	L-Switch	A8	Good	4	2x4 Parabolic	18		3	3	T8	32	Rec	7.5	T-Bar	Good	600	1000	
107a	Air Canada	Storage			120	L-Switch	A8	Good	2	2x4 Parabolic	18		3	3	T8	32	Rec	7.5	T-Bar	Good	680	760	
107b	Office	Office			120	L-Switch	A8	Good	2	2x4 Parabolic	18		3	3	T8	32	Rec	7.5	T-Bar	Good	650	850	
107c	Office	Office			120	L-Switch	A8	Good	2	2x4 Parabolic	18		3	3	T8	32	Rec	7.5	T-Bar	Good	750	1000	
103	Corridor	Corridor			120	L-Switch	A9	Good	4	1x4 Lenses	18		2	2	T8	32	Rec	7.5	T-Bar	Good	100	500	
107d	Office	Office			120	L-Switch	A8	Good	2	2x4 Parabolic	18		3	3	T8	32	Rec	7.5	T-Bar	Good	580	1000	
100	Handi-Cap Washroom	Washroom			120	L-Switch	B	Good	1	4' Wraparound	18		2	2	T8	32	Sur	8	Drywall	Good	350	650	
100	Handi-Cap Washroom	Washroom			120	L-Switch	B2	Good	2	4' Strip in Cove	18		2	2	T8	32	Wall	7	Drywall	Good			
099	Mens Washroom	Washroom			120	L-Switch	B	Good	2	4' Wraparound	18		2	2	T8	32	Sur	7	Drywall	Good	160	350	
099	Mens Washroom	Washroom			120	L-Switch	B2	Good	2	4' Strip in Cove	18		2	2	T8	32	Wall	7	Drywall	Good			
099	Mens Washroom	Washroom			120	L-Switch	A10	Good	1	Downlight Cross Baffle	18		2	2	DTT CFL	13	Rec	8	Drywall	Good			
101	Womens Washroom	Washroom			120	L-Switch	B	Good	3	4' Wraparound	18		2	2	T8	32	Sur	7	Drywall	Good	160	350	
101	Womens Washroom	Washroom			120	L-Switch	B2	Good	2	4' Strip in Cove	18		2	2	T8	32	Wall	7	Drywall	Good			
101	Womens Washroom	Washroom			120	L-Switch	A10	Good	1	Downlight Cross Baffle	18		2	2	DTT CFL	13	Rec	8	Drywall	Good			
098	West Jet Airline	Office			120		A1	Good	43	2x2 Parabolic	18		3	3	Twin Tube	40	Rec/Sus	8	T-Bar	Good	200	1600	
073	Land Lines	Storage			120	L-Switch	A8	Good	1	2x4 Parabolic	18		3	3	T8	32	Rec	8	T-Bar	Good	320	580	
072	Telecom	Service			120		B	Good	8	4' Wraparound	18		2	2	T8	32	Sur	7	Open	Fair			
	First Aid	Examination			120	L-Switch	A11	Good	2	2x4 Lensed	18		3	3	T8	32	Rec	8	T-Bar	Good	900	1000	
075	Office	Office			120	L-Switch	A1	Good	2	2x2 Parabolic	18		3	3	Twin Tube	40	Rec/Sus	8	T-Bar	Good	500	1000	
078a	Office	Office			120	L-Switch	A11	Good	3	2x4 Lensed	18		3	3	T8	32	Rec	8	T-Bar	Good	390	550	
007	Bond Room	Storage			120	L-Switch	A2	Fair	2	2x2 Lensed	18		2	2	Twin Tube	40	Rec	8	T-Bar	Good	260	310	
078	Lunch Room	Office			120	L-Switch	A8	Good	2	2x4 Parabolic	18		3	3	T8	32	Rec	8	T-Bar	Good	630	840	
080	Storage	Storage			120	L-Switch	A12	Good	1	1x4 Lensed	18		2	2	T8	32	Rec	8	T-Bar	Good	270	400	
081	Training Room	Office			120	L-Switch	A8	Good	3	2x4 Parabolic	18		3	3	T8	32	Rec	8	T-Bar	Good	420	560	
082	Office	Office			120	L-Switch	A8	Good	3	2x4 Parabolic	18		3	3	T8	32	Rec	8	T-Bar	Good	600	1050	
083	Office	Office			120	L-Switch	A8	Good	3	2x4 Parabolic	18		3	3	T8	32	Rec	8	T-Bar	Good	620	950	
077a	Corridor	Corridor			120		A13	Good	3	2x4 Lensed	18		3	3	T8	32	Rec	8	T-Bar	Good		760	
079	Corridor	Corridor			120		A13	Good	2	2x4 Lensed	18		3	3	T8	32	Rec	8	T-Bar	Good		460	
077	Corridor	Corridor			120		A12	Good	2	1x4 Lensed	18		2	2	T8	32	Rec	8	T-Bar	Good		460	
096	Corridor	Corridor			120		A9	Good	2	1x4 Lenses	18		2	2	T8	32	Rec	8	T-Bar	Good		480	
097	Lunch Room	Office			120	L-Switch	A8	Good	4	2x4 Parabolic	18		3	3	T8	32	Rec	8	T-Bar	Good	820	1100	
094	Retail Storage	Storage			120						18												
092	Lunch Room	Office			120	L-Switch	A13	Good	2	2x4 Lensed	18		3	3	T8	32	Rec	8	T-Bar	Good	200	630	
091	Security Office	Office			120	L-Switch	A8	Good	2	2x4 Parabolic	18		3	3	T8	32	Rec	8	T-Bar	Good	630	720	
093	CBSA	Office			120	L-Switch	A8		2	2x4 Parabolic	18		3	3	T8	32	Rec	8	T-Bar	Good	490	1000	
095	Locker Room	Locker Room			120	L-Switch	A8		4	2x4 Parabolic	18		3	3	T8	32	Rec	8	T-Bar	Good		1400	
021	KAO Comms	Service			120	L-Switch	A14		4	2 lamp Strip	18		2	2	T8	32	Sus	8	Open	Good			
128	Black and Mac Office	Office			120	L-Switch	A1		4	2x2 Parabolic	18		3	3	Twin Tube	40	Rec/Sus	8	T-Bar	Good	1000	1300	
070	Black and Mac Office	Office			120	L-Switch	A8		2	2x4 Parabolic	18		3	3	T8	32	Rec	8	T-Bar	Good	550	1500	
048	Mens Washroom	Washroom			120		A6		7	Downlight with Cross Baffle	18		2	2	DTT CFL	26	Rec	8	Drywall	Good	250	350	
048	Mens Washroom	Washroom			120		B3	Poor	2	4' Vanity	18		2	2	T8	32	Wall	7	Drywall	Good			
052	Janitor	Service			120		B4		1	4' Strip	18		2	2	T8	32	Sur	8	Drywall	Good			
049	Handi-Cap Washroom	Washroom			120	Occ Sen	B5		1	4' Vanity	18		2	2	T8	32	Wall	7	Drywall	Good	250	400	
050	Womens Washroom	Washroom			120		A6		8	Downlight with Cross Baffle	18		2	2	DTT CFL	26	Rec	8	Drywall	Good	350	400	
050	Womens Washroom	Washroom			120		B3		3	4' Vanity	18		2	2	T8	32	Wall	7	Drywall	Good			

051	Elevator Machine Room	Service			120	Occ Sen	B6		2	4' Strip	18		1	1	T8	32	Sur	7	Drywall	Good		360	
	South Water Feature Pump room	Service			120	L-Switch	A14		1	2 lamp Strip	18		2	2	T8	32	Sus	7	Open	Good			
046	Lounge	Lounge			120		D1		24	Metal Halide Canopy	18	12	1	1	MH	100	Sur	20	Arch	Good	See Plans for detailed analysis		
046	Lounge	Lounge			120		A6		60	Downlight with Cross Baffle	18	12	2	2	DTT CFL	26	Rec	25	Drywall	Good			
046	Lounge	Lounge			120		A14		12	2 lamp Strip	18	12	2	2	T8	32	Sus	8	T-Bar	Good			
046	Lounge	Lounge			120		A1		27	2x2 Parabolic	18		3	3	Twin Tube	40	Rec/Sus	8	T-Bar	Good			
	Lounge Bar	Restaurant			120		B7		4	4' Linear	18		2	2	T8	32	Sus	7	Open	Fair			
	Lounge Bar	Restaurant			120		A6		2	Downlight with Cross Baffle	18		2	2	DTT CFL	26	Rec	8	Open	Good			
	Skyway Gourmet	Storage			120		A8		2	2x4 Parabolic	18		3	3	T8	32	Rec	8	T-Bar	Good			
036	Duty Manager	Office			120		A1		2	2x2 Parabolic	18		3	3	Twin Tube	40	Rec/Sus	8	T-Bar	Good	800	1000	
035	RCMP	Office			120		A1		2	2x2 Parabolic	18		3	3	Twin Tube	40	Rec/Sus	8	T-Bar	Good	800	1000	
034	Airport Ambassodor	Office			120		A1		2	2x2 Parabolic	18		3	3	Twin Tube	40	Rec/Sus	8	T-Bar	Good	800	1000	
028/029	Car Rentals	Office			120		A1		13	2x2 Parabolic	18		3	3	Twin Tube	40	Rec/Sus						
075	Janitor	Service			120		A14		1	2 lamp Strip	18		2	2	T8	32	Sus	7	Open	Good			
026	Mens Washroom	Washroom			120		B2		3	4' Strip in Cove	18		2	2	T8	32	Wall	7	Drywall	Good	250	950	
026	Mens Washroom	Washroom			120		A15		7	Downlight - No lens	18		2	2	DTT CFL	26	Rec	8	Drywall	Good			
024	Womens Washroom	Washroom			120		B2		3	4' Strip in Cove	18		2	2	T8	32	Wall	7	Drywall	Good	250	750	
024	Womens Washroom	Washroom			120		A15		7	Downlight - No lens	18		2	2	DTT CFL	26	Rec	8	Drywall	Good			
	Control Tower	Office			120		A18		14	Downlight	18		1	1	Inc	75	Rec	8	T-Bar	Good			
	Control Tower Washroom	Washroom			120		A19		1	Wall Light	18		1	1	Inc	100	Wall	6	Drywall	Poor			
218	Weather Office	Office			120	L-Switch	B8		6	4' Indirect/Direct	18		2	2	T8	32	Sus	8	T-Bar	Good	630	1000	
230	Storage	Storage			120	Occ Sen	A13		2	2x4 Lensed	18		3	3	T8	32	Rec	8	T-Bar	Good	230	350	
	Washroom	Washroom	2xT8 Vanity, 1x32 Surface Round, and		120	Occ Sen					18												
220	Corrridor	Corridor			120	L-Switch	A		8	2x2 Parabolic	18		2	2	Twin Tube	40	Rec	8	T-Bar	Good	350	600	
214	General Office	Office			120	L-Switch	B8		7	4' Indirect/Direct	18		2	2	T8	32	Sus	7	T-Bar	Good	470	810	
	General Office Closet				120	L-Switch	A6		1	Downlight with Cross Baffle	18		2	2	DTT CFL	26	Rec	8	T-Bar	Good			
216	Operations Super Intendant	Office			120	L-Switch	B8		4	4' Indirect/Direct	18		2	2	T8	32	Sus	7	T-Bar	Good	550	730	
216	Operations Super Intendant	Office			120	L-Switch	A6		2	Downlight with Cross Baffle	18		2	2	DTT CFL	26	Rec	8	T-Bar	Good			
217	Tower Manager	Office			120	L-Switch	B8		4	4' Indirect/Direct	18		2	2	T8	32	Sus	7	T-Bar	Good	500	950	
217	Tower Manager	Office			120	L-Switch	A6		2	Downlight with Cross Baffle	18		2	2	DTT CFL	26	Rec	8	T-Bar	Good			
219	Training Room	Office			120	L-Switch	B8		2	4' Indirect/Direct	18		2	2	T8	32	Sus	7	T-Bar	Good	550	600	
206	Office	Office			120	L-Switch	B9		4	4' Indirect/Direct	18		2	2	T8	32	Sus	7	T-Bar	Good	700	1400	
207	Office	Office			120	L-Switch	B9		6	4' Indirect/Direct	18		2	2	T8	32	Sus	7	T-Bar	Good	700	1900	
208	Office	Office			120	Occ Sen	B9		4	4' Indirect/Direct	18		2	2	T8	32	Sus	7	T-Bar	Good	550	1250	
205	Office	Office			120		B9		2	4' Indirect/Direct	18		2	2	T8	32	Sus	7	T-Bar	Good	570	100	
204	Office	Office			120	Occ Sen	B9		2	4' Indirect/Direct	18		2	2	T8	32	Sus	7	T-Bar	Good	500	850	
209	Office	Office			120	Occ Sen	B9		2	4' Indirect/Direct	18		2	2	T8	32	Sus	7	T-Bar	Good	500	1000	
203	Lunch Room	Office			120	Occ Sen	B9		4	4' Indirect/Direct	18		2	2	T8	32	Sus	7	T-Bar	Good	800	1000	
210a	Office	Office			120	L-Switch	B9		4	4' Indirect/Direct	18		2	2	T8	32	Sus	7	T-Bar	Good	500	1000	
210b	Office	Office			120	L-Switch	B9		2	4' Indirect/Direct	18		2	2	T8	32	Sus	7	T-Bar	Good	600	750	
211	Office	Office			120	L-Switch	B9		2	4' Indirect/Direct	18		2	2	T8	32	Sus	7	T-Bar	Good	600	750	
213	Boardroom	Office			120	L-Switch	A6		5	Downlight with Cross Baffle	18		2	2	DTT CFL	26	Rec	8	T-Bar	Good	460	640	
213	Boardroom	Office			120	L-Switch	A8		4	2x4 Parabolic	18		3	3	T8	32	Rec	8	T-Bar	Good			
213	Boardroom	Office			120	L-Switch	B9		3	4' Indirect/Direct	18		2	2	T8	32	Sus	7	T-Bar	Good			
205	Storage	Storage			120	L-Switch	A8		2	2x4 Parabolic	18		3	3	T8	32	Rec	8	T-Bar	Good	650	850	
205	Comms Room	Service			120	L-Switch	A13		2	2x4 Lensed	18		3	3	T8	32	Rec	8	T-Bar	Good		500	
205	General Office	Office			120	L-Switch	B10		17	4' Indirect/Direct	18		2	2	T8	32	Sus	7	T-Bar	Good	550	810	
205	General Office	Office			120	L-Switch	A13		2	2x4 Lensed	18		3	3	T8	32	Rec	8	T-Bar	Good			
205	General Office	Office			120	L-Switch	A10		3	Downlight Cross Baffle	18		2	2	DTT CFL	13	Rec	8	T-Bar	Good			
201	Corridor	Corridor			120	L-Switch	B10		6	4' Indirect/Direct	18		2	2	T8	32	Sus	7	T-Bar	Good	150	650	
203	Mens Washroom	Washroom			120	Occ Sen	B11		1	1x4 Surface Lensed	18		2	2	T8	32	Sur	7	Drywall	Good	150	650	
204	Womens Washroom	Washroom			120	Occ Sen	B11		2	1x4 Surface Lensed	18		2	2	T8	32	Sur	7	Drywall	Good	300	420	
	CATSA Screening	Examination			120		A16		50	4" Linear with Cross Baffle	18		1	1	T8	32	Rec	8	T-Bar	Good	220	300	
	CATSA Screening	Examination			120		A10		20	Downlight Cross Baffle	18		2	2	DTT CFL	13	Rec	8	T-Bar	Good			
	Ground Side Exterior				120		D1		14	Metal Halide Canopy	18		1	1	MH	100	Sur	8					
	Ground Side Exterior				120		D2		1	Metal Halide Canopy	18		1	1	MH	100	Sur	8					
	Ground Side Exterior				120		D3		33	Weather Proof 4' Strip	18		2	2	T12	40	Sur	12					
	Ground Side Exterior				120		A6		11	Downlight with Cross Baffle	18		2	2	DTT CFL	26	Rec	10					
	Boarding Lounge				120		A1		128	2x2 Parabolic	18		3	3	Twin Tube	40	Rec/Sus	8	T-Bar	Good	See plans for detailed analysis		
	Boarding Lounge				120		A6		80	Downlight with Cross Baffle	18		2	2	DTT CFL	26	Rec	8	Drywall	Good			
121	Airside Corridor 1 and 2				120		A1		34	2x2 Parabolic	18	12	3	3	Twin Tube	40	Rec/Sus	8	T-Bar	Good	550	950	
	Airside Corridor 3				120		A1		15	2x2 Parabolic	18	12	3	3	Twin Tube	40	Rec/Sus	8	T-Bar	Good	550	1200	
	Airside Corridor 4				120		A1		27	2x2 Parabolic	18	12	3	3	Twin Tube	40	Rec/Sus	8	T-Bar	Good	700	1600	
	Airside Corridor 5				120		A1		10	2x2 Parabolic	18	12	3	3	Twin Tube	40	Rec/Sus	8	T-Bar	Good	200	700	
	International Departures				120		A1		26	2x2 Parabolic	18		3	3	Twin Tube	40	Rec/Sus	8	T-Bar	Good			
	International Departures				120		A6		42	Downlight with Cross Baffle	18		2	2	DTT CFL	26	Rec	8	Drywall	Good			
113	Arrivals Ramp (high)				120		A1		15	2x2 Parabolic	18		3	3	Twin Tube	40	Rec/Sus	8	T-Bar	Good	250	700	
113	Arrivals Ramp (low)				120		A1		10	2x2 Parabolic	18		3	3	Twin Tube	40	Rec/Sus	8	Open	Good		900	
	Baggage Hall				120		A14		94	2 lamp Strip	18		2	2	T8	32	Sus	10	Open	Good		460	
112	Visual Inspection	Office			120		A1		2	2x2 Parabolic	18		3	3	Twin Tube	40	Rec/Sus	8	T-Bar	Good			
086	Storage	Storage			120	Occ Sen	A14		2	2 lamp Strip	18		2	2	T8	32	Sus	10	Open	Good			
085	Storage	Storage			120	Occ Sen	A14		11	2 lamp Strip	18		2	2	T8	32	Sus	10	Open	Good			
087a	Baggage Hall Mens Washroom	Washroom			120	Occ Sen	B5		1	4' Vanity	18		2	2	T8	32	Wall	7	Drywall	Good		250	
087b	Baggage Hall Womens Washroom	Washroom			120	Occ Sen	B5		1	4' Vanity	18		2	2	T8	32	Wall	7	Drywall	Good		250	
114	Corridor	Corridor			120		B5		7	4' Vanity	18		2	2	T8	32	Wall	7	Drywall	Good		470	
115	Office	Office			120	L-Switch	A17		2	2x4 Lensed	18		4	4	T8	32	Rec	8	T-Bar	Good	450	1000	
116	Storage	Storage			120	L-Switch	A17		2	2x4 Lensed	18		4	4	T8	32	Rec	8	T-Bar	Good	370	680	
117	Office	Office	2 of 3 lamps turned off		120	L-Switch	A8		2	2x4 Parabolic	18		3	3	T8	32	Rec	8	T-Bar	Good	280	350	
	Comms Closet	Service			120	L-Switch	A14		1	2 lamp Strip	18		2	2	T8	32	Sus	7	Open				
119	Airline Lunchroom	Office			120	L-Switch	A8		4	2x4 Parabolic	18		3	3	T8	32	Rec	8	T-Bar	Good		720	
118	Airline Office	Office			120	L-Switch	A8		2	2x4 Parabolic	18		3	3	T8	32	Rec	8	T-Bar	Good	560	720	
	North Baggage Drop Off	Service			120	Occ Sen	A14		10	2 lamp Strip	18		2	2	T8	32	Sus	7	Open				
	North Baggage Vestibule	Service			120		B5		2	4' Vanity	18		2	2	T8	32	Wall	7	Drywall	Good			
089	Storage	Storage			120	Occ Sen	A14		2	2 lamp Strip	18		2	2	T8	32	Sus	7	Open	Good			
088	Storage	Storage			120	Occ Sen	A14		2	2 lamp Strip	18		2	2	T8	32	Sus	7	Open	Good			
	Under Ramp Storage	Storage			120	Occ Sen	A14		5	2 lamp Strip	18		2	2	T8	32	Sus	5	Open	Good			
	N. Baggage Room Built Out Storage	Storage			120	L-Switch	A14		2	2 lamp Strip	18		2	2	T8	32	Sus	7	Open	Good			
	S. Baggage Room Built Out Storage	Storage			120	L-Switch	A14		2	2 lamp Strip	18		2	2	T8	32	Sus	7	Open	Good			

APPENDIX D

HEATING AND COOLING CALCULATIONS

	Peak Date	Peak Time	Air temperature (°C)	Space conditioning sensible (kW)	Internal gain (kW)	Solar gain (kW)	External conduction gain (kW)	Internal conduction gain (kW)	Air system input sensible (kW)	Infiltration gain (kW)
Multi-Zone	Jul	15:30	26	-110.6	68.3	33.1	5.3	0.4	10.7	3.5
Pre-Screening 105	Jul	14:30	26	-20.0	17.9	0.0	1.3	0.1	2.5	0.7
Well Fishing Area 104	Jul	17:30	26	-41.1	15.2	28.2	-2.1	-0.8	2.2	0.6
Departure Concourse 045	Jul	16:30	26	-60.3	28.0	30.2	0.4	-0.2	4.4	1.8
Check-In Area	Jul	16:30	26	-57.4	24.9	27.5	3.0	-0.3	12.7	2.3
International Arrival 013	Jul	14:30	26	-40.6	36.3	0.1	2.3	0.6	5.2	1.4
Airline Operation	Jul	15:30	26	-15.9	12.0	0.0	0.3	2.6	4.8	1.0
Baggage Makeup 084	Sep	5:30	30.0	-8.7	32.1	0.0	-10.0	-1.8	-8.7	-12.1
International Departure Floor	Jul	15:30	26	-36.9	32.7	0.3	2.4	0.0	5.1	1.4
Top Secret Room	Jul	14:30	26	-12.5	13.9	0.1	-2.4	0.5	2.0	0.5
Airside Corridor	Jul	8:30	26	-27.9	4.9	29.2	-5.9	-0.3	-0.4	-0.1
Airside Corridor	Jul	9:30	26	-74.5	28.0	63.5	-19.3	3.5	-1.3	-0.4
Custom General Office 017	Jul	17:30	26	-11.2	4.0	7.0	0.2	-0.3	1.4	0.3
Departure Floor 062	Jul	14:30	26	-65.6	63.6	0.0	-1.8	1.7	9.0	2.1
Office	Jul	15:30	26	-48.0	17.3	12.9	13.5	3.4	7.0	1.0
Total Existing Cooling Loads (kW):				**-631.1**					**56.6**	
Total Existing Cooling Loads (tons):				**-179.5**					**16.1**	
North Expansion	Jul	15:30	26	-91.4	55.0	7.4	26.4	0.2	8.6	2.4
Baggage Hall Expansion	Sep	5:30	34.1	-9.4	27.4	0.0	-8.3	-1.3	-9.4	-8.7
North Expansion - Beyond Plan	Jul	17:30	26	-58.1	26.7	28.4	2.0	-0.1	3.8	1.1
South Expansion - Beyond Plan	Jul	15:30	26	-102.9	52.1	34.4	14.2	-0.1	8.2	2.3
South Expansion	Jul	16:30	26	-406.4	216.5	107.8	72.6	0.1	33.9	9.4
Total Existing Cooling Loads (kW):				**-668.3**					**45.1**	
Total Existing Cooling Loads (tons):				**-190.1**					**12.8**	

	Air temperature (°C)	Space conditioning sensible (kW)	External conduction gain (kW)	Internal conduction gain (kW)	Air system input sensible (kW)	Infiltration gain (kW)	Dry resultant temperature (°C)	Aux vent gain (kW)	Natural vent gain (kW)	DHW heating demand (kW)
Multi-Zone	21	85.1	-70.9	0.2	-43.8	-14.4	23.1	0.0	0.0	0.0
Pre-Screening 105	21	15.2	-12.1	0.1	-11.5	-3.2	22.9	0.0	0.0	0.0
Well Fishing Area 104	21	28.5	-25.9	0.1	-9.7	-2.7	22.8	0.0	0.0	0.0
Departure Concourse 045	21	52.8	-45.6	0.2	-17.9	-7.5	22.9	0.0	0.0	0.0
Check-In Area	21	73.1	-63.3	-0.5	-51.9	-9.3	24.5	0.0	0.0	0.0
International Arrival 013	21	31.6	-25.1	-0.1	-23.3	-6.5	23.1	0.0	0.0	0.0
Airline Operation	21	20.1	-16.5	0.5	-19.7	-4.1	23.1	0.0	0.0	0.0
Baggage Makeup 084	21	55.6	-25.1	-0.8	-21.4	-29.7	24.6	0.0	0.0	0.0
International Departure Floor	21	28.9	-23.3	0.2	-21.0	-5.8	23.0	0.0	0.0	0.0
Top Secret Room	21	6.0	-4.1	0.1	-8.9	-2.1	22.9	0.0	0.0	0.0
Airside Corridor	21	20.0	-19.3	0.2	-3.2	-0.9	22.3	0.0	0.0	0.0
Airside Corridor	21	83.5	-79.3	0.8	-17.9	-5.0	22.6	0.0	0.0	0.0
Custom General Office 017	21	13.8	-12.5	0.1	-6.4	-1.3	22.9	0.0	0.0	0.0
Departure Floor 062	21	44.1	-34.7	0.1	-40.8	-9.4	23.3	0.0	0.0	0.0
Office	21	40.1	-35.8	-0.3	-28.5	-4.0	23.7	0.0	0.0	0.0
Total Existing Heating Loads (kW):		**598.5**			**-325.9**					
Total Existing Heating Loads (MBH):		**2043.2**			**-1112.5**					
North Expansion	21	85.0	-75.0	-0.2	-35.3	-9.8	23.4	0.0	0.0	0.0
Baggage Hall Expansion	21	51.3	-34.0	-0.4	-18.3	-16.9	24.6	0.0	0.0	0.0
North Expansion - Beyond Plan	21	45.9	-41.1	0.0	-17.1	-4.7	23.1	0.0	0.0	0.0
South Expansion - Beyond Plan	21	80.9	-71.6	0.0	-33.4	-9.3	23.4	0.0	0.0	0.0
South Expansion	21	346.0	-307.0	-0.4	-138.8	-38.6	23.6	0.0	0.0	0.0
Total Existing Heating Loads (kW):		**609.0**			**-242.9**					
Total Existing Heating Loads (MBH):		**2079.1**			**-829.3**					

APPENDIX E

EXISTING MECHANICAL EQUIPMENT

TAG	Equipment	Make	Cooling Capacity (btu)	Cooling Capacity (tons)	Cooling Capacity (kW)	Heating Capacity (btu)
BLR-01/02	Buderus Boiler	Buderus	0	0		2,876,000
BLR-03/04	Fulton Boiler	Fulton	-	0		-
DHW-01	State Turbo Sand Blaster DHW	State	-	0		
BLR-05	Atmospheric Boiler	A.O. Smith	-	0		1,350,000
DHW-02	Atmopheric Water heater (DHW)	0	-	0		
BLR-06	Bryan Boiler	Bryan	-	0		350,000
CHL-01	Chiller	Mcquay	1,860,000	155	93	-
DHW-03	Domestic Hot water boiler	A.O.Smith	-	0		
SPLT-01/14	Split unit	Mr. Slim	336,000	28	33.6	-
RTU-1	RTU-1	Lennox	48,000	4	4.8	120,000
RTU-2	RTU-2	TRANE	36,000	3	3.6	-
RTU-4	RTU-4	Lennox	36,000	3	3.6	90,000
RTU-5	RTU-5	Lennox	48,000	4	4.8	120,000
RTU-6	RTU-6	TRANE	600,000	50	60	-
RTU-7	RTU-7	Lennox	-	0	0	-
RTU-8	RTU-8	TRANE	150,000	12.5	15	250,000
RTU-9	RTU-9	TRANE	150,000	12.5	15	250,000
RTU-10	RTU-10	TRANE	60,000	5	6	130,000
RTU-11	RTU-11	TRANE	120,000	10	12	250,000
RTU-12	RTU-12	TRANE	120,000	10	12	250,000
RTU-13	RTU-13	TRANE	150,000	12.5	15	250,000
RTU-14	RTU-14	TRANE	180,000	15	18	350,000
RTU-027-04	RTU-027-04	Lennox	150,000	12.5	15	375,000
RTU-15	RTU-15	TRANE	24,000	2	2.4	50,000
ENG-A-1	ENG-A-1	ENG-A	108,000	9	10.8	250,000
ENG-A-2	ENG-A-2	ENG-A	360,000	30	36	350,000
	TOTAL		**4,536,000**	**378**	**361**	**7,661,000**
		Tons	**378**		**MBH @ 80%:**	**6,129**

Black & McDonald

Here is a list of the fan and pump we would like to have a amperage reading on:

WEST MECHANICAL ROOM
1. PUMP P-1: water pump – 120volt, 5.1amps
2. F1: Return Fan – 575volt, 3-phase (4.7A, 4.6A, 4.8A)
3. MZ1: Multi-Zone Unit – 575volt, 3-phase (12.1A, 12.2A, 12.1A)

EAST MECHANICAL ROOM
1. P-90-1 – 575volt, 3-phase (7.5A, 7.3A, 7.3A)
2. P-90-2 – pumps 1&2 alternate and share the same load

3. AHU-090: Supply fan – 575volt, 3-phase (4.3A, 4.4A, 4.4A)

2ND FLOOR MECHANICAL ROOM (CONTROL TOWER)
1. CC-1 : SUPPLY – 208volt, 1-phase, 6.7amps

CHILLER ROOM
1. P-121-1: Evaporator pump – 575volt, 3-phase (10.3A, 10.4, 10.7A)
2. P-121-2: Evaporator pump - pumps 1&2 alternate and share the same load
3. P-121-3: Condenser pump – 575volt, 3-phase (5.9A, 5.4A, 5.7A)
4. P-121-4: Condenser pump - pumps 3&4 alternate and share the same load

ROOF MECHANICAL ROOM
1. AHU-045-SUPPLY – 575volt, 3-phase (9.1A, 9.1A, 10.1A)
2. AHU-045-RETURN – 575volt, 3-phase (3.8A, 3.9A, 3.8A)

● Page 1

APPENDIX F

ENERGY CONSERVATION MEASURES

Operating Schedule Revision

Reduce operation time of ventilation units to match Aiport operating time.

		Estimated Fan Power (kW)	Estimated CFM
	RTU-1	2.22	2,222
	RTU-2	1.67	1,667
	RTU-4	1.67	1,667
	RTU-5	2.22	2,222
	RTU-6	27.78	27,778
	RTU-7	-	-
	RTU-8	6.94	6,944
	RTU-9	6.94	6,944
	RTU-10	2.78	2,778
	RTU-11	5.56	5,556
	RTU-12	5.56	5,556
	RTU-13	6.94	6,944
	RTU-14	8.33	8,333
	RTU-027-04	1.39	1,389
	RTU-15	1.11	1,111
	ENG-A-1	5.00	2,256
	ENG-A-2	16.67	3,000
	P-90-1	7.50	
	AHU-90	4.5	7,500
	Pump P-1	0.60	
	MZ-1 Supply	12.2	12,000
	MZ-1 return	4.50	
	CC-1	1.4	1,500
	P-121-1	10.40	
	P-121-3	5.4	
	AHU-045 S	9.10	1,000
	AHU-045 R	3.9	
	TOTAL	162.28	108,367

Hours	168	hrs/week
Yearly Consumption	1,134,127	kWh/yr
Monthly Consumption	94,511	kWh/mth
Reduced Hours	112	hrs/week
Yearly Consumption	756,085	kWh/yr
Monthly Consumption	63,007	kWh/mth

Control Saving (Fans)		
Yearly Energy Saving	**378,042**	**kWh**
Yearly Cost Savings	**26,121.23 $**	
Heating Reduction		
Yearly Energy Saving	**1,264**	**gj**
Yearly Cost Savings	**14,129 $**	

RETScreen Energy Model - Energy efficiency measures project

Fuels & schedules ☑ Show data

Fuel		Fuel type 1	Fuel type 2	Fuel type 3	Fuel type 4	Fuel type 5	Fuel type 6
Fuel type		Electricity					
Fuel consumption - unit		MWh					
Fuel rate - unit		$/kWh					
Fuel rate		0.069					
Schedule	**Unit**	**Schedule 1**	**Schedule 2**	**Schedule 3**	**Schedule 4**	**Schedule 5**	**Schedule 6**
Description		24/7					
			Occupied	Occupied	Occupied	Occupied	Occupied
Temperature - space heating	°C	21.0					
Temperature - space cooling	°C	25.0					
Temperature - unoccupied	+/-°C						
Occupancy rate - daily		h/d					
Monday		24					
Tuesday		24					
Wednesday		24					
Thursday		24					
Friday		24					
Saturday		24					
Sunday		24					
Occupancy rate - annual	h/yr	8,760					
	%	100%					
Heating/cooling changeover temperature	°C	16.0					
Length of heating season	d	252					
Length of cooling season	d	113					

Facility characteristics ☐ Show data

Summary ☑ Show data

	Fuel		Base case		Proposed case		Fuel cost savings	
Fuel type	**Fuel consumption - unit**	**Fuel rate**	**Fuel consumption**	**Fuel cost**	**Fuel consumption**	**Fuel cost**	**Fuel saved**	**Fuel cost savings**
Electricity	MWh	$ 69.000	185.0	$ 12,762	95.9	$ 6,615	89.1	$ 6,147

Project verification Fuel type	**Fuel consumption - unit**	**Fuel consumption - historical**	**Fuel consumption Base case**	**Fuel consumption - variance**
Electricity	MWh		185.0	

Energy	**Heating GJ**	**Cooling GJ**	**Electricity GJ**	**Total GJ**
Energy - base case			666	666
Energy - proposed case			345	345
Energy saved			321	321
Energy saved - %			48.2%	48.2%

Benchmark		
Energy unit	GJ	
Reference unit	m²	

Emission Analysis

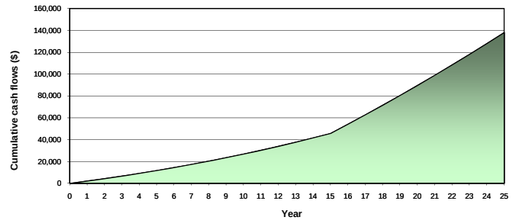
Base case electricity system (Baseline) Country - region	Fuel type	GHG emission factor (excl. T&D) tCO2/MWh	T&D losses %	GHG emission factor tCO2/MWh
Canada	All types	0.196	10.0%	0.218

GHG emission					
Base case	tCO2	40.3			
Proposed case	tCO2	20.9			
Gross annual GHG emission reduction	tCO2	19.4			
GHG credits transaction fee	%				
Net annual GHG emission reduction	tCO2	19.4	is equivalent to	3.6	Cars & light trucks not used
GHG reduction income					
GHG reduction credit rate	$/tCO2				

Financial Analysis

Financial parameters			
Inflation rate	%	2.0%	
Project life	yr	25	
Debt ratio	%	100%	
Debt interest rate	%	3.00%	
Debt term	yr	15	
Initial costs			
Energy efficiency measures	$	50,000	100.0%
Other	$		0.0%
Total initial costs	$	50,000	100.0%
Incentives and grants	$		0.0%
Annual costs and debt payments			
O&M (savings) costs	$	0	
Fuel cost - proposed case	$	6,615	
Debt payments - 15 yrs	$	4,188	
Other	$		
Total annual costs	$	10,803	
Annual savings and income			
Fuel cost - base case	$	12,762	
Other	$		
Total annual savings and income	$	12,762	
Financial viability			
Pre-tax IRR - equity	%	positive	
Pre-tax IRR - assets	%	6.9%	
Simple payback	yr	8.1	
Equity payback	yr	immediate	

Cumulative cash flows graph



RETScreen Energy Model - Heating project

Heating project

		Base case	Proposed case		Incremental initial costs
Heated floor area for building	m²	9,900			
Energy efficiency measures			0%		
Heating load for building	W/m²	94	94		
Domestic hot water heating base demand	%	10%	10%		
Total heating	MWh	2,164	2,164		
Base load heating system					
Technology		Conventional	Boiler		
Capacity	kW	925.7	925.7	100.0%	$ 30,000
Heating delivered	MWh	2,164.1	2,164.1	100.0%	
Fuel type		Natural gas - GJ	Natural gas - GJ		
Seasonal efficiency	%	80%	93%		
Fuel consumption - annual	GJ	9,738	8,377	GJ	
Fuel rate	$/GJ	11.180	11.180	$/GJ	
Fuel cost	$	108,876	93,657		
Peak load heating system					
Technology					
Suggested capacity	kW		0.0		
Capacity	kW			0.0%	
Fuel type			Natural gas - m³		
Seasonal efficiency	%				
Fuel consumption - annual	m³		0		
Heating delivered	MWh		0.0	0.0%	
Fuel rate	$/m³				
Fuel cost	$		0		

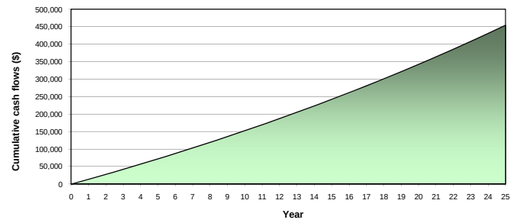
Emission Analysis

GHG emission					
Base case	tCO2	484.2			
Proposed case	tCO2	416.5			
Gross annual GHG emission reduction	tCO2	67.7			
GHG credits transaction fee	%				
Net annual GHG emission reduction	tCO2	67.7	is equivalent to	12.4	Cars & light trucks not used
GHG reduction income					
GHG reduction credit rate	$/tCO2				

Financial Analysis

Financial parameters			
Inflation rate	%	2.0%	
Project life	yr	25	
Debt ratio	%	100%	
Debt interest rate	%	3.00%	
Debt term	yr	25	
Initial costs			
Heating system	$	30,000	100.0%
Other	$		0.0%
Total initial costs	$	30,000	100.0%
Incentives and grants	$		0.0%
Annual costs and debt payments			
O&M (savings) costs	$		
Fuel cost - proposed case	$	93,657	
Debt payments - 25 yrs	$	1,723	
Other	$		
Total annual costs	$	95,379	
Annual savings and income			
Fuel cost - base case	$	108,876	
Other	$		
Total annual savings and income	$	108,876	
Financial viability			
Pre-tax IRR - equity	%	positive	
Pre-tax IRR - assets	%	48.2%	
Simple payback	yr	2.0	
Equity payback	yr	immediate	

Cumulative cash flows graph



RETScreen Energy Model - Cooling project

Cooling project

		Base case	Proposed case		Incremental initial costs
Cooled floor area for building	m²	10,000			
Energy efficiency measures			0%		
Cooling load for building	W/m²	63	63		
Non-weather dependant cooling	%	0%	0%		
Total cooling	MWh	785	785		
Base load cooling system					
Technology			Compressor		
Capacity	kW	631.0	631.0	100.0%	$ 75,000
Cooling delivered	MWh	784.7	784.7	100.0%	
Fuel type		Electricity	Electricity		
Coefficient of performance - seasonal		2.90	7.00		
Fuel consumption - annual	MWh	271	112	MWh	
Fuel rate	$/kWh	0.069	0.069	$/kWh	
Fuel cost	$	18,670	7,735		
Peak load cooling system					
Technology					
Suggested capacity	kW		0.0		
Capacity	kW			0.0%	
Fuel type			Electricity		
Coefficient of performance - seasonal					
Fuel consumption - annual	MWh		0		
Cooling delivered	MWh		0.0	0.0%	
Fuel rate	$/kWh				
Fuel cost	$		0		

Emission Analysis

Base case electricity system (Baseline) Country - region	Fuel type	GHG emission factor (excl. T&D) tCO2/MWh	T&D losses %	GHG emission factor tCO2/MWh
Canada	All types	0.196	10.0%	0.218

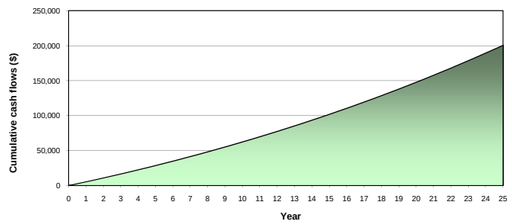
GHG emission					
Base case	tCO2	59.0			
Proposed case	tCO2	24.4			
Gross annual GHG emission reduction	tCO2	34.6			
GHG credits transaction fee	%				
Net annual GHG emission reduction	tCO2	34.6	is equivalent to	6.3	Cars & light trucks not used
GHG reduction income					
GHG reduction credit rate	$/tCO2				

Financial Analysis

Financial parameters		
Inflation rate	%	2.0%
Project life	yr	25
Debt ratio	%	100%
Debt interest rate	%	3.00%
Debt term	yr	25
Initial costs		
Cooling system	$	75,000
Other	$	
Total initial costs	$	75,000
Incentives and grants	$	
Annual costs and debt payments		
O&M (savings) costs	$	1,500
Fuel cost - proposed case	$	7,735
Debt payments - 25 yrs	$	4,307
Other	$	
Total annual costs	$	13,542
Annual savings and income		
Fuel cost - base case	$	18,670
Other	$	
Total annual savings and income	$	18,670
Financial viability		
Pre-tax IRR - equity	%	positive
Pre-tax IRR - assets	%	8.1%
Simple payback	yr	7.9
Equity payback	yr	immediate

100.0%	
0.0%	
100.0%	
0.0%	

Cumulative cash flows graph



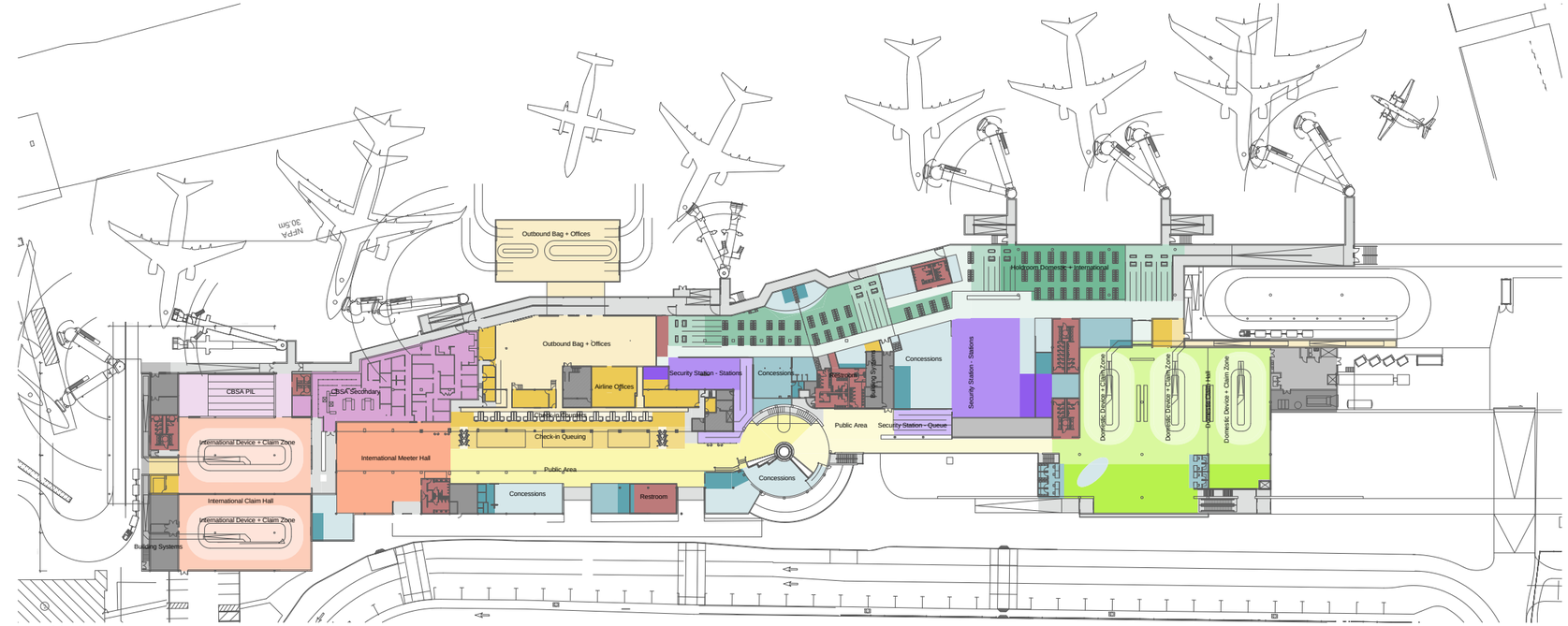
Building Area Legend

- 1A Check-in Counters
- 1B1 Check-in Queueing
- 1B2 Outbound Bag + Offices
- 1B3 Airline Offices
- 1B4 Check-in circulation
- 1C Public Area
- 1D1 Security Station - Queue
- 1D2 Security Station - Stations
- 1D3 Security Station - Offices
- 2A CBSA PIL
- 2B CBSA Secondary
- 2E1 International Device + Claim Zone
- 2F International Claim Hall
- 2G International Meeter Hall
- 2H1 Domestic Device + Claim Zone
- 2H3 Baggage Service Offices
- 2I Domestic Claim Hall
- 2J Domestic Meeter Hall
- 3A1 Holdroom Domestic + International
- 3A2 Holdroom Trans Border
- 3A3 Podium & Gate Control
- 3B Holdroom Circulation
- 4A Restroom
- 4B Concessions - Food
- 4C1 Concessions - Retail
- 4C2 Concessions - Support
- 5A Administrative / Operational Spaces
- 6A Building Systems
- Circulation
- Public Area

YLW 2025 Building Area	
Name	Area
1 Departures	
Check-in Counters	141 m²
Check-in Queuing	320 m²
Outbound Bag + Offices	1427 m²
Airline Offices	436 m²
Check-in circulation	120 m²
Public Area	808 m²
Security Station - Queue	207 m²
Security Station - Stations	608 m²
Security Station - Offices	116 m²
2 Arrivals	
CBSA PIL	334 m²
CBSA Secondary	772 m²
International Device + Claim Zone	781 m²
International Claim Hall	582 m²

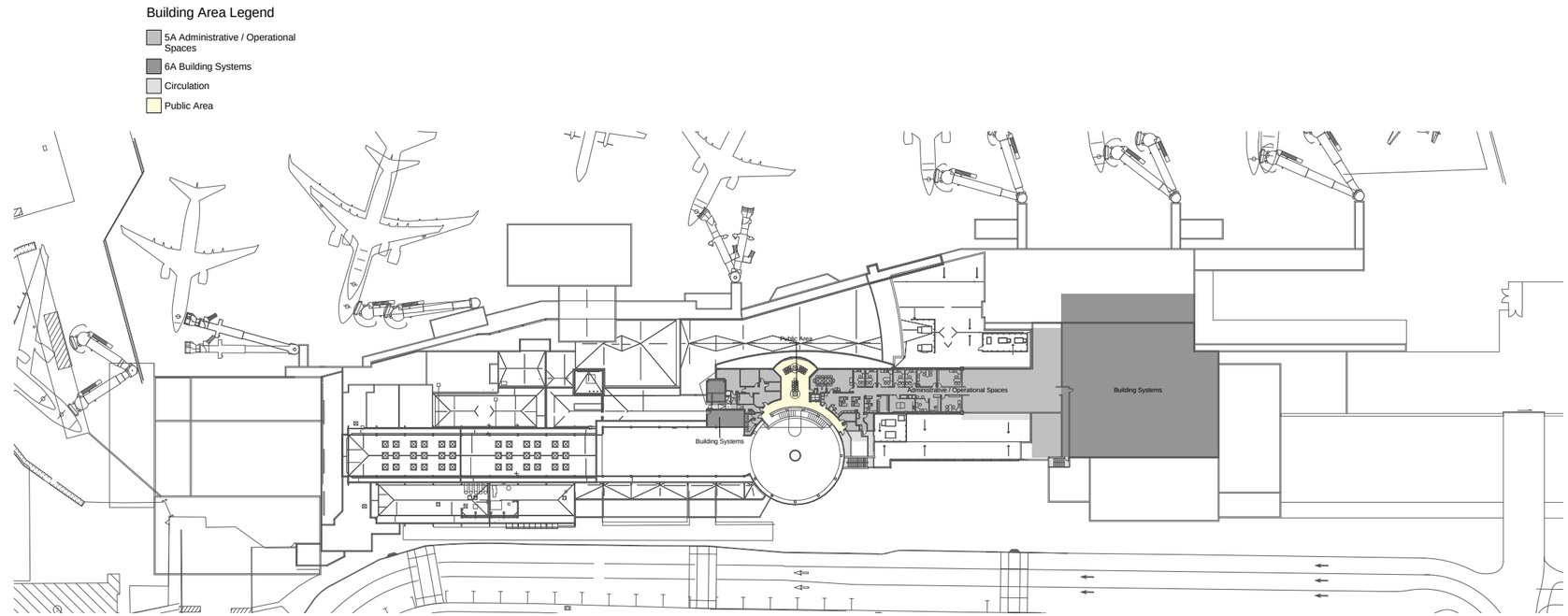
YLW 2025 Building Area	
Name	Area
International Meeter Hall	611 m²
Domestic Device + Claim Zone	844 m²
Baggage Service Offices	58 m²
Domestic Claim Hall	668 m²
Domestic Meeter Hall	458 m²
3 Concourses	
Holdroom Domestic + International	449 m²
Holdroom Trans Border	455 m²
Podium & Gate Control	461 m²
4 Public Spaces	
Concessions	1026 m²

YLW 2025 Building Area	
Name	Area
Concessions	499 m²
Concessions	222 m²
5 Aviation Dept	
Administrative / Operational Spaces	1582 m²
6 Building Systems	
Building Systems	2364 m²
N/A	
Circulation	1964 m²
Public Area	569 m²
Structure & Features	86 m²



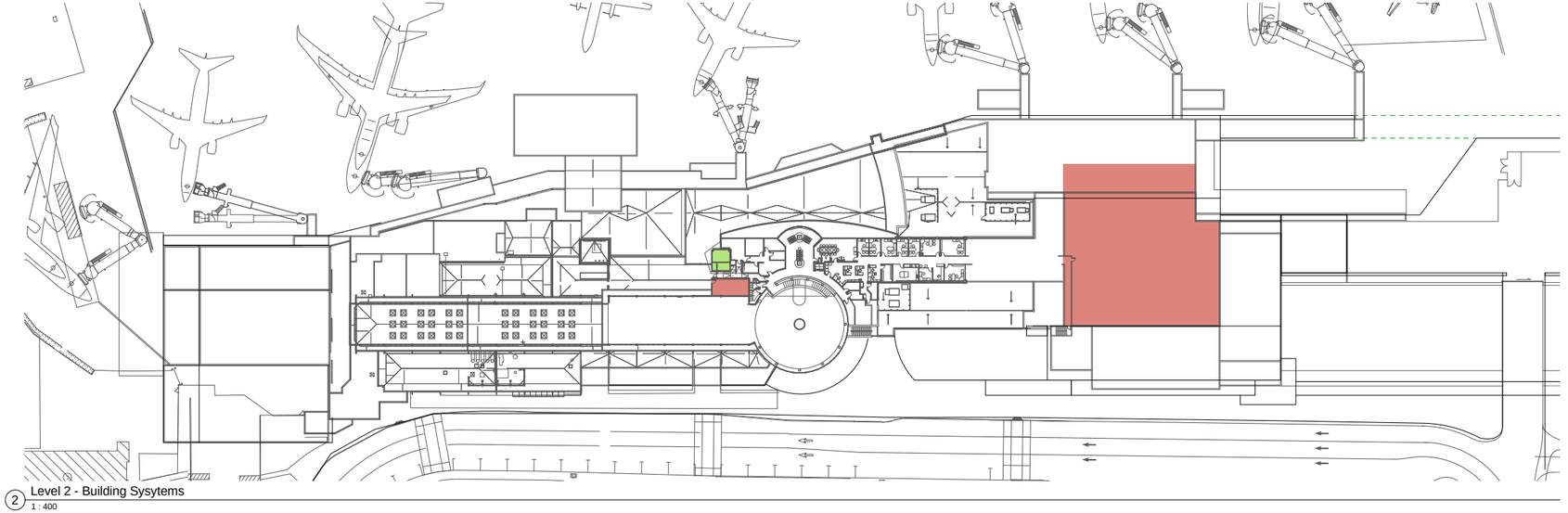
Level 1 - Areas

Concept Plan Area Reconciliation



Level 2 - Areas
1 : 400

Concept Plan Area Reconciliation

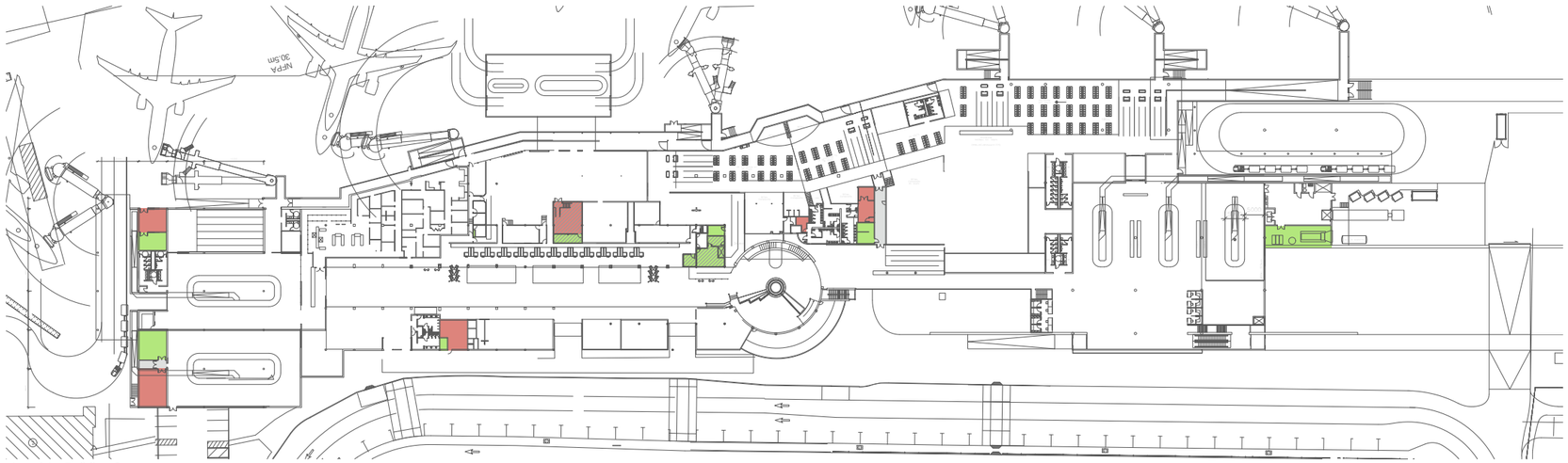


2 Level 2 - Building Sysytems
1 : 400

Building Area Legend

- Circulation
- Electrical
- Mechanical

Building system areas			
Util Sub Type	Level	Area	Name
Circulation	Level 1 - Areas	62 m²	Building Systems
		62 m²	
Electrical	Level 1 - Areas	317 m²	Building Systems
Electrical	Level 2 - Areas	31 m²	Building Systems
		348 m²	
Mechanical	Level 1 - Areas	283 m²	Building Systems
Mechanical	Level 2 - Areas	1671 m²	Building Systems
		1954 m²	
		2364 m²	



Level 1 - Building Sysytems

Concept Plan Area Reconciliation

JACOBS Consultancy

Memorandum

To: **Janice Liebe**

From: **Jim Slavin**

CC.: **Henry Castorf**

Date: **12 May 2010**

Re: **Primary security line-Kelowna Development program**

Attached please find a mark-up of the concept diagrams that shows the security line between airside and groundside. Any portal at this line will be subject to security control requirements and CCTV/access control equipment is implied.

The design team will need to attend to staff crossing points for:

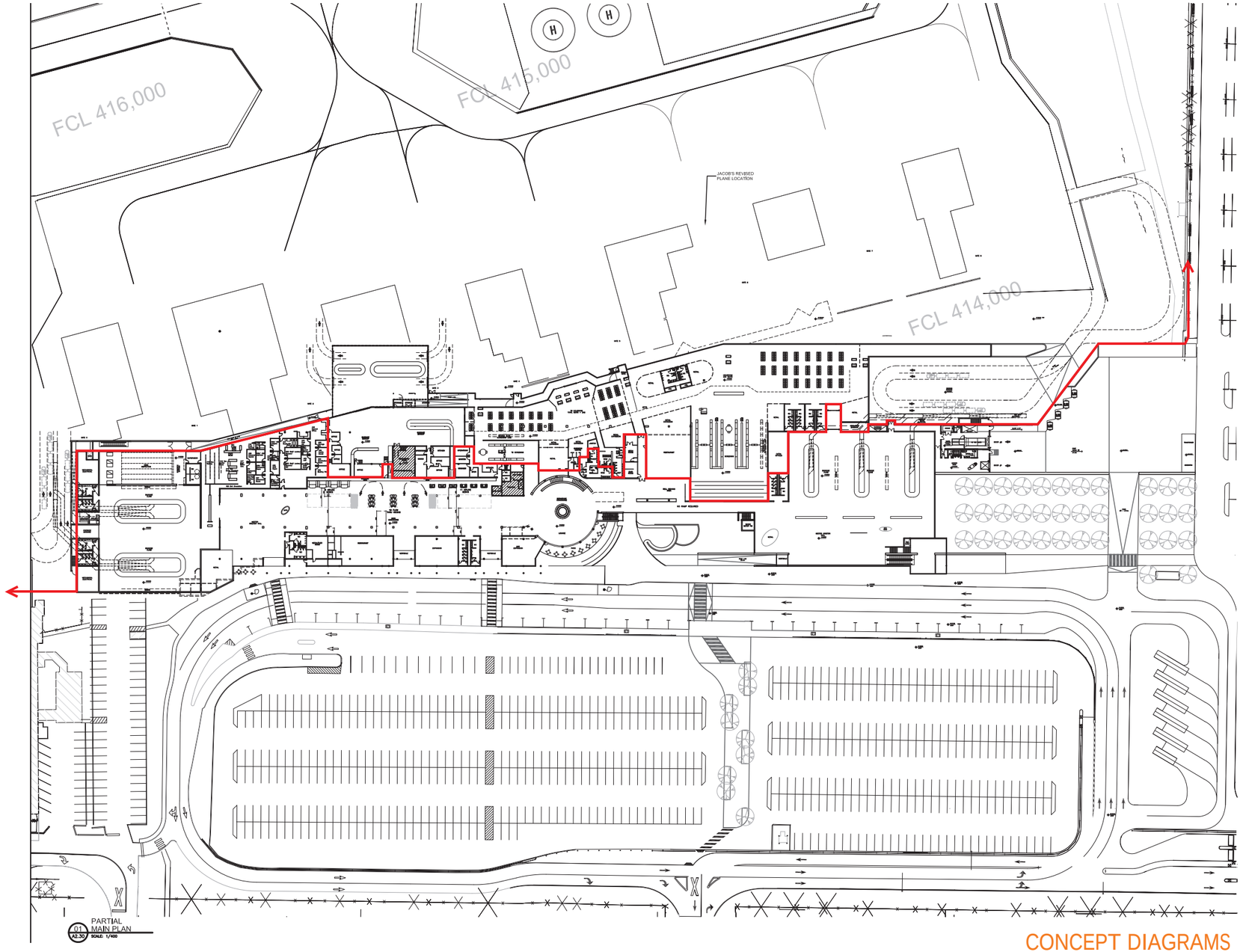
- Baggage agents- they will need to pass across the passenger corridor to get to their work locations and return.
- Airline agents-they will need an access to the domestic holdroom and return.
- Concession staff-and more importantly materials/logistics for post security locations.
- CBSA security-they have their own access/entry control requirements and the blue line denotes their similar, but separate, boundary. If we recall the statement of requirements correctly, CBSA are entitled to an apron access location and nearby vehicle parking site.

Sincerely,

Jim Slavin

Associate Director

Jacobs Consultancy



CONCEPT DIAGRAMS