Appendix I : Air Terminal Building Expansion Schematic Design

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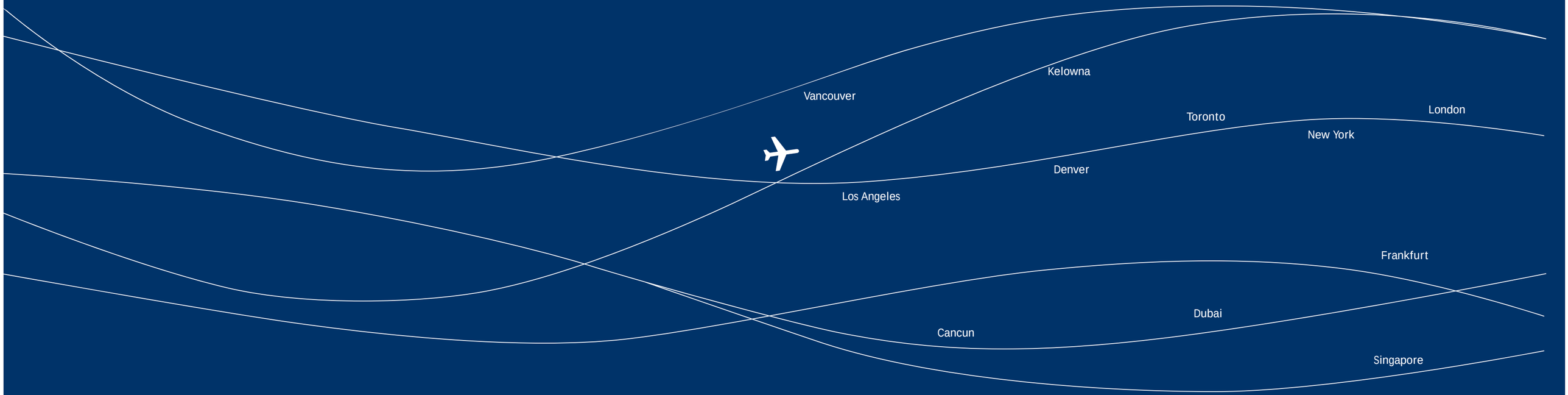
Kelowna International Airport

Air Terminal Building Expansion
Schematic Design Report

November 2010

YLW
Kelowna International Airport



Report prepared by:

DIALOG

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Your Link to the World

1.0 INTRODUCTION

The Schematic Design Report for the Kelowna International Airport Air Terminal Building Expansion Project represents the completion of the initial phase of design. It is the bridge between the Master-plan and the Design Development stages and provides the Kelowna International Airport with the information to build a greater understanding of the relationship of the programme elements, building systems, organization within and relationship to the apron and airfield design, initial architectural design and preliminary cost estimates for the scope proposed.

The scope of this document includes concept design information on all major building systems inclusive of architectural, structural, mechanical, electrical, civil, baggage, building code and sustainability considerations. The information included herein was authored by the larger consultant team as follows:

Programme Manager	|	Leigh Fischer
Airfield Masterplanning	|	Leigh Fischer
Retail	|	Leigh Fischer
Architecture	|	Dialog
Structural Engineering	|	Dialog
Mechanical Engineering	|	Dialog
Electrical Engineering	|	Dialog
Sustainability Consulting	|	Dialog
Terminal Planning	|	Suehiro Architecture
Signage and Wayfinding	|	Entro
Cost Estimating	|	Hanscomb Ltd.

All work was developed in coordination with the Kelowna International Airport Authority, various internal stakeholders, agencies, airlines as well as the Airport Advisory Committee and the Accessibility Advisory Committee.

Schematic Design terminal expansions to meet passenger demand projected for the year 2025. To facilitate and calibrate this work, a Functional Programme Analysis was prepared that reviewed existing facilities against the growth projections and determined the required space needs using IATA LOS C standards. Further, a review of the existing mechanical and electrical systems was completed and an audit report completed for the sequential updating of these systems in conjunction with a defined phased programme of works. A sustainability study prepared several options for an integrated systems approach to meet CO2 reductions targets set by the City of Kelowna. Finally, the schematic design was divided into five phases of work, the first four of which are intended to be delivered by 2016 in concert with demand requirements and within defined financial constraints. The building design is to facilitate the defined aircraft parking layout prepared by Leigh Fischer.

2.0 DESIGN PARAMETERS

2.1 Airport Master Plan Forecast

The Kelowna International Airport Master Plan 2025, February 2007 records the enplaned and deplaned million annual passenger (MAP) for 2009 and forecasts the same for 2015 and 2025 as follows:

Passenger Forecast

2009 1.367 MAP (actual)
2015 1.630 MAP
2025 2.400 MAP

This data forms the basis for all programming and functional requirements for the air terminal building expansion project.

2.2 Functional Programme Analysis

Prior to the design process, the "Design Phase Air Terminal Facilities Programme Analysis*" was developed. Its' purpose was to establish a functional programme for the air terminal building expansion. It used an analysis of existing and future needs and was based on the Master Plan annual passenger growth projections to determine estimated passenger planning activity levels for the peak month, design day, design hour and surges within the design hour using IATA calibrations. Its' findings and requirements were prepared with guidance from the YLW airport authority and the airport development manager.

Further, the analysis used an assessment of aviation demand based on extraction of passenger activity from existing peak month, design day airline flight schedules that identify design hour and peak 20 minute data. A projected flight schedule was developed to generate passenger activity for 2015 and 2025 planning horizons.

Design hour passenger activity was further segregated into three travel sectors for analysis and was recorded as follows:

DEPARTURES PEAK HOUR PASSENGERS BY SECTOR		
2015	Domestic Departures	285 Passengers
2015	International Departures	110 Passengers
2015	Transborder Departures	115 Passengers
2025	Domestic Departures	345 Passengers
2025	International Departures	235 Passengers
2025	Transborder Departures	190 Passengers

ARRIVALS PEAK HOUR PASSENGERS BY SECTOR		
2015	Domestic Arrivals	340 Passengers
2015	International/Transborder Arrivals	325 Passengers
2025	Domestic Arrivals	450 Passengers
2025	International/Transborder Arrivals	405 Passengers

The full Design Phase Air Terminal Facilities Programme Analysis can be found in the Kelowna ATB Development Concept Design, May 31, 2010. Submitted by Jacobs Engineering

Using the data a detailed analysis was prepared to determine the Functional Programme areas required to service the passenger flows. The following is a summary of the programme areas:

FUNCTIONAL PROGRAMME FOR 2025 DEMAND	
AREA	***SM***
Check-in Counters	140
Check-in Queuing	321
Outbounding Bag & Offices	1338
Airline Offices	436
Check-in Circulation	117
Public Area	786
Public Area not in program	
Security Station - Queue	117
Security Station - Stations	660
Security Station - Offices	120
CBSA PIL	334
CBSA Secondary	765
International Device & Claim Zone	786
International Claim Hall	601
International Meeter Hall	640
Domestic Device & Claim Zone	871
Baggage Service Office	55
Domestic Meeter Hall	477
Holdroom D+I+TB	905
Holdroom TB only	457
Podium & Gate Control	440
Concessions Food	1056
Concessions Retail	528
Concessions Support	238
Admin/Operational Spaces	1690
Building Systems	2029

- *It should be noted that the services of an Air Terminal Retail Consultant were provided after the development of the Functional Programme. The Retail Programme requirements and variances from the above are described later in this document.*

2.3 Level of Service

Levels of Service designations describe the comfort and quality of the passenger experience. Levels of service define the maximum waiting times within process areas, and the design standards for amount of area allotted per passenger within each service area. The industry standard measure of level of service (as defined by IATA) is LOS C. The Schematic Design of the Kelowna International Airport is based upon achieving a LOS C for all passenger areas within the terminal.

2.4 Area Reconciliation

The design team used the functional programme to develop a concept plan*. The concept plan was reviewed and accepted by the Kelowna International Airport Authority, and forms the basis of the Schematic Design.

**Refer to the Kelowna ATB Development – Concept Design, May 31, 2010*

3.0 SITE MASTER PLAN CONSIDERATIONS

3.1 Site Constraints

The existing air terminal has significant site constraints on all sides.

To the west, the existing groundside roadway, parking areas and site topography present different challenges to the expansion plans. It was a requirement of the project that the existing groundside roadway, access from the western parking lot and pedestrian crossings were to remain. An approximate 3 meter grade difference exists from the south end of the rotunda to the south parking lot. Re-grading of the curbside is not desirable.

To the east, aircraft parking and airfield operations and obstacle limitation surfaces define expansion capabilities. The Jacobs “May 27, 2010 Aircraft Parking Layout, Kelowna International Airport” appended to this report describes the parameters in detail.

The greatest expansion capacity for the terminal building is to the south. This will require the replacement of the parking lot immediately to the south of the existing terminal. Grading from east to west must be studied as there is a considerable slope down from the airfield to the curbside.

To the north, expansion will be defined by planned future Gate 0 operations and current access to the fire hall.

3.2 Future Parkade

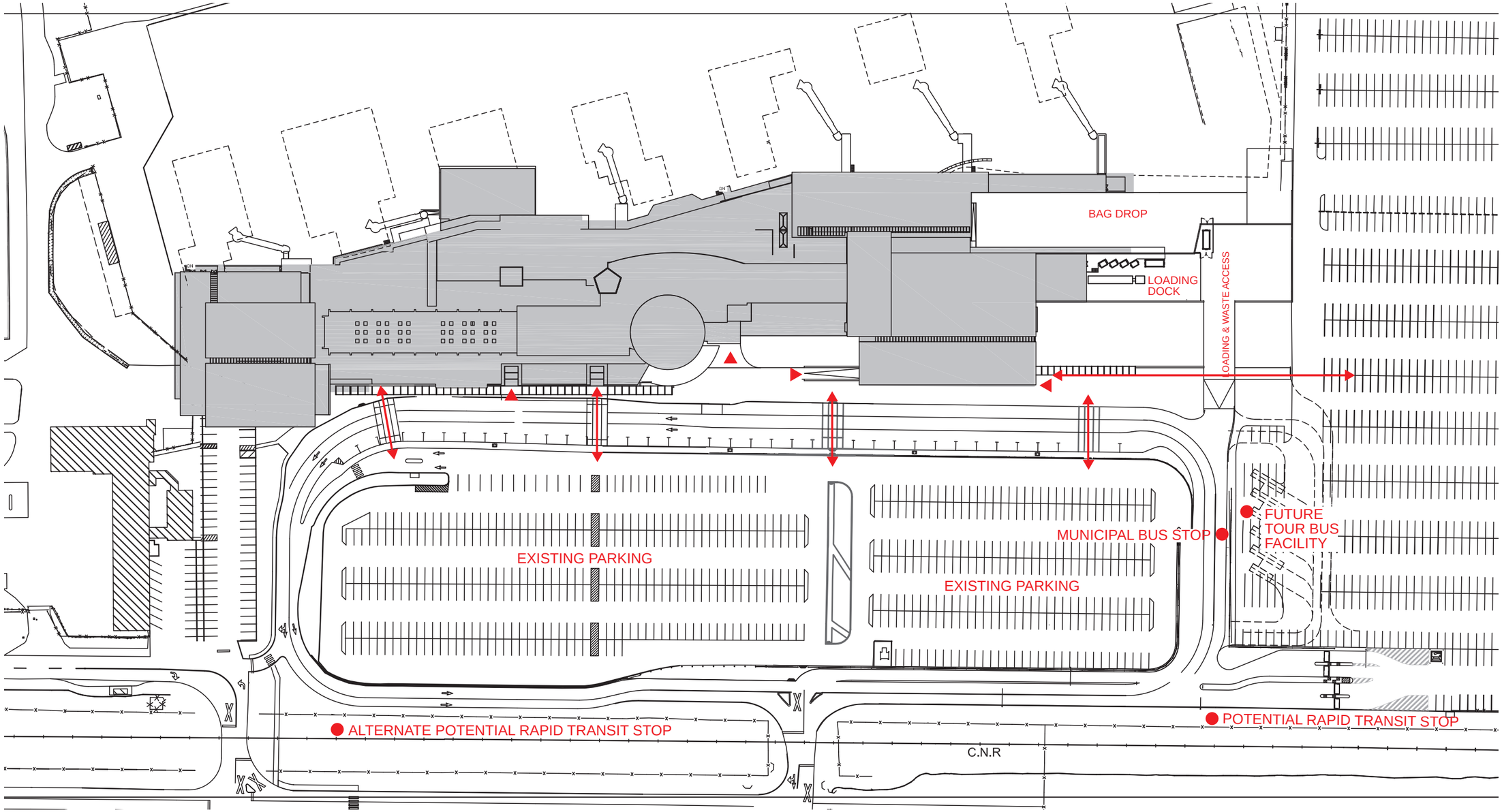
There are long term plans for a parkade to be built on the site of the west parking lot. At this time, there are no specific design plans that indicate pedestrian or vehicle access locations.

3.3 Pedestrian Crossings at Curbside

The four existing pedestrian crossings at the curbside roadway are located to connect directly with the existing entry points to the terminal. This condition will continue as is for the two northerly crossings.

The new Domestic Arrivals facility will provide two entry points. The south entry point will give direct access south to the south parking lot as well as functioning for curbside drop off and pick ups. As the grade is 3 meters lower than the floor elevation of the Domestic Meeter Greeter facility, two escalators, a stair and an elevator are provided just inside of the entry point. As it is anticipated that the majority of passengers using this entry point will be moving between the terminal and the south parking lot, no pedestrian crossing is provided to the west parking lot across the curbside roadway.

The north entry point to the Domestic Arrivals facility is accessed by a 5% grade up from the curbside roadway. Slopes 5% and smaller are not considered ramps. The north end of the entry point to the terminal is slightly to the north of the existing pedestrian crossing from the west parking lot. In order to minimize rework to the existing roadway direction was received to maintain this walkway location. In the future, a direct pedestrian connection from the new parkade may be considered that directly aligns the walkway with the north entry to the Domestic Arrivals facility.


BAG DROP
LOADING DOCK
LOADING & WASTE ACCESS
EXISTING PARKING
EXISTING PARKING
MUNICIPAL BUS STOP
FUTURE TOUR BUS FACILITY
ALTERNATE POTENTIAL RAPID TRANSIT STOP
POTENTIAL RAPID TRANSIT STOP
C.N.R
N

SITE PLAN

3.4 Curbside

The concept plan identifies a new Domestic Arrivals Facility to the south of the project, separate from the International Arrivals Facility to the north. This has an obvious impact on the design of curbside operations with demand for drop off and pick up now in two locations. The following drawing indicates the available pick-up/drop-off positions. The number will increase from the existing as the bus lay by will be removed. Specific allocations for taxi, personal vehicles will be determined in later phases of the design.

3.5 Tour Bus Loading Facility

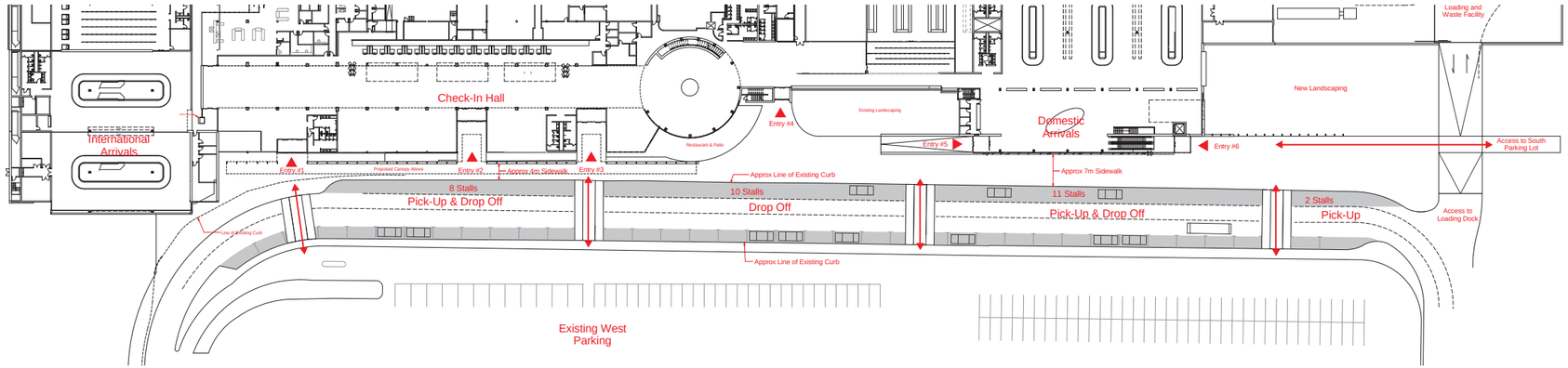
The existing bus lay by on the curbside roadway will be removed at the time of construction of the Domestic Arrivals facility. The opposite site plan indicates a location for tour bus loading directly to the south of the south curbside access road with capacity for six full size coaches. Space has been provided for safe queuing of passengers and for the provision of a roofed shelter. The shelter can also serve city busses stopping at a proposed bus stop just to the north of the Tour Bus area.

3.6 Rapid Transit Connection

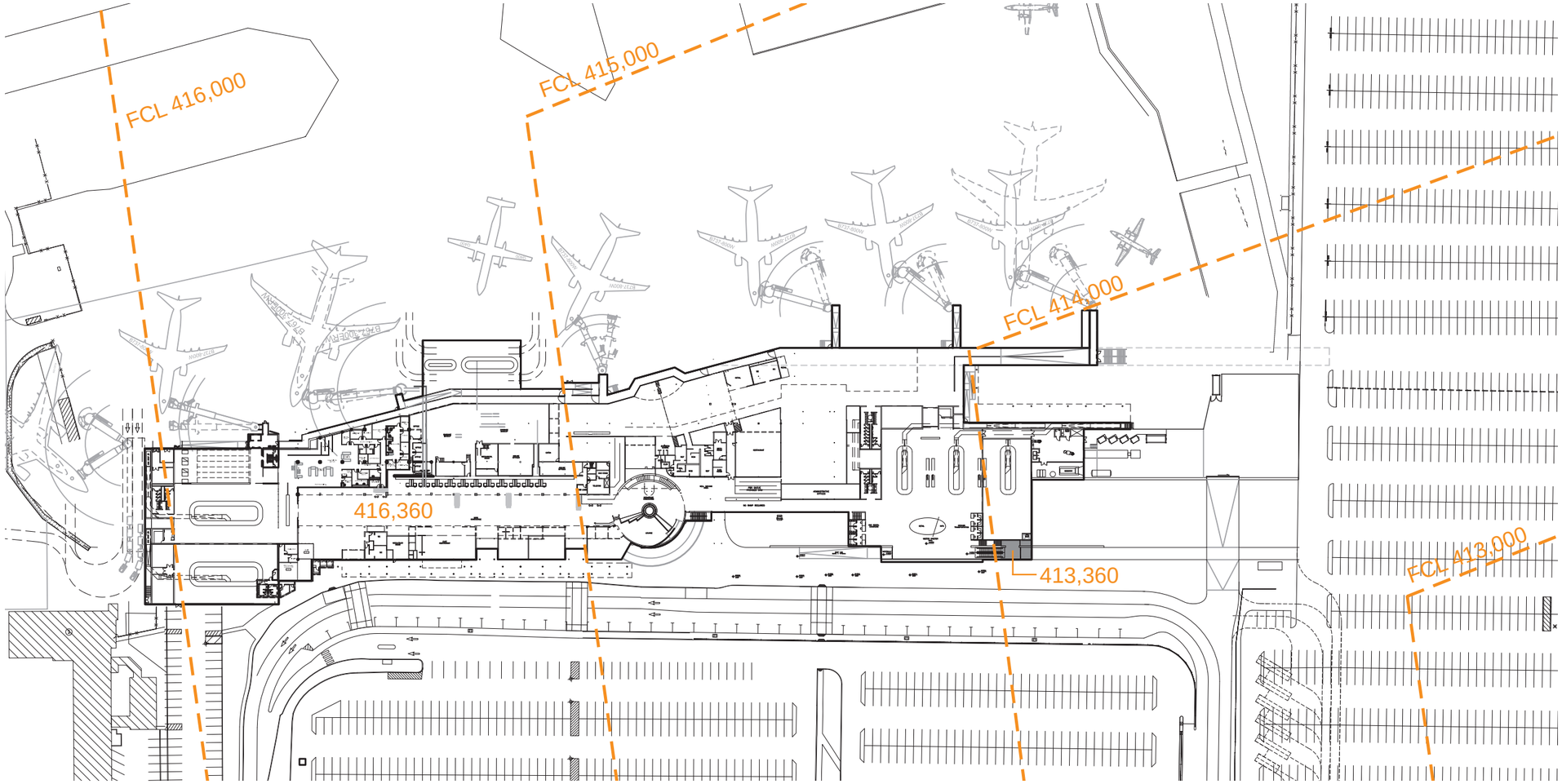
It is recognized that there is a long term potential to connect the air terminal with a rapid transit system. It is understood that the system would utilize the existing rail corridor running along the western edge of the west parking lot. The Schematic Design identifies a potential location for a future rapid transit stop directly to the west of the tour bus loading area. There are advantages to co-locate the bus, rail and pedestrian access to the terminal in the same general location. Future study will be required to understand the implication of the vehicle access to the south parking area in the same area on pedestrian movement, safety, and potential congestion for vehicles accessing the parking lot. It may be desirable to locate the rail stop further to the north away from the parking access to segregate pedestrians from the intersection.

3.7 Traffic Study

The current site and curbside master plan has not been confirmed by a specialized traffic consultant. To ensure appropriate access and movement control throughout the site that anticipates proposed development, further study by a traffic consultant is recommended.



CURBSIDE DRAWING



FLOOD CONSTRUCTION LEVEL DRAWING

3.8 200 Year Flood Plain

The Province of British Columbia has mandated that all municipalities develop provisions within their bylaws to protect buildings built within the 200 year flood plain. The City of Kelowna is in the process of preparing a bylaw to comply. A final copy of the bylaw is not yet available and the boundary drawing with defined Flood Construction Levels (FCL) is in draft form only. The consultant team has determined that the air terminal lands are within the boundary controlled by this bylaw and that the existing main floor level of the terminal is above the 200 year level. However, the existing grade drop toward the south has implications for built elements at the south end of the project area that require grade access or have floor levels below the defined FCL. Further, elements such as conveyor tunnels may require special construction considerations.

4.0 AIRSIDE PLANNING

4.1 Aircraft Parking Layout / Gate Matrix

The Aircraft Parking Layout was developed for the Kelowna International Airport by Jacobs Engineering. The full study entitled “Aircraft Parking Layout, Kelowna International Airport, May 27, 2010 was included in the Concept Design submission, May 31, 2010 for reference. The following is a summary of the study provisions:

The 2016 Schematic Design provides a total of 8 gates plus one future gate(titled gate 0). Gates 1,2,4,5,6, and 7 are equipped with Passenger Boarding Bridges. While all Gates have ground loading capability, Gates 3 and 8 are ground load only positions. The attached matrices (labelled figures 1.2 and 1.3 from the May 27th Aircraft Parking Layout Report) indicate the aircraft gauge that can be accommodated at each position, whether the bridge is new or relocated; and, fixed link lengths needed to connect to the ATB.

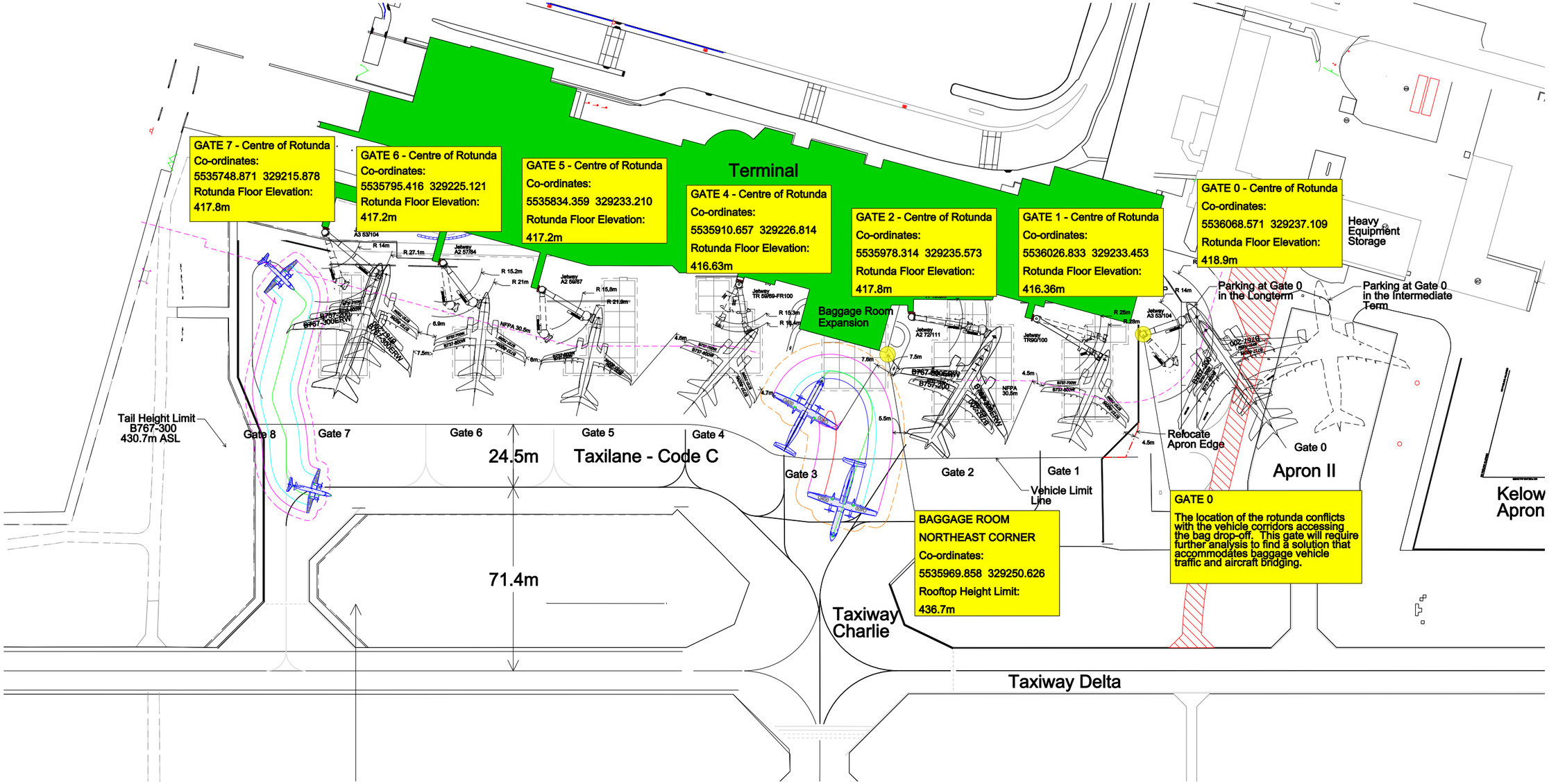
New Passenger Boarding Bridges (PBBs) will be required to service Gates 0 and 7. All other gates will re-use existing bridges.

To achieve the proposed layout, adjustments to bridge placement, rotunda locations and elevations are required. Design Rotunda elevations required to service the planned aircraft at Gate are indicated on the attached plans.

A future gate expansion is anticipated in the long term to the North for Gate 0 and South to accommodate 2025 master plan requirements. A future Gate 0 to the north could accommodate code E aircraft. As indicated on the diagram, a high level loading corridor is anticipated to span the access to baggage loading area.

GATE MATRIX

AIRCRAFT	0	1	2	3	4	5	6	7	8
1	Future			Non Bridged					Non Bridged
A310-300 (Widebody)			x					x	
B767-200 (Widebody)			x					x	
B767-300/300W (Widebody)			x					x	
B757-200/200W			x					x	
A318		x	x			x	x	x	
A319		x	x			x	x	x	
A320		x	x			x	x	x	
B737-600		x	x		x	x	x	x	
B737-700/700W		x	x		x	x	x	x	
B737-800/800W		x	x		x	x	x	x	
EMB190		x	x		x	x	x	x	
CRJ100		x	x		x	x	x	x	
CRJ200		x	x		x	x	x	x	
CRJ705		x	x		x	x	x	x	



AIRCRAFT PARKING LAYOUT

EXHIBIT I-2: BRIDGE SLOPES (%)

AIRCRAFT	GATE 0	GATE 1	GATE 2	GATE 4	GATE 5	GATE 6	GATE 7
A318	-0.81	-4.92	-3.59	-11.47	-7.54	-7.90	-3.52
A319	-0.85	-4.95	-3.63	-11.52	-7.58	-7.95	-3.56
A320	-0.90	-5.06	-3.73	-11.69	-7.71	-8.08	-3.68
B737-600	+2.61	-2.26	-1.14	-7.55	-4.39	-4.98	-0.19
B737-700/700W	+2.61	-2.26	-1.14	-8.00	-4.39	-4.98	-0.19
B737-800/800W	+2.61	-2.26	-1.16	-8.00	-4.56	-4.98	-0.19
EMB190	+2.56	-2.17	-0.99	-7.78	-4.19	-4.79	-0.22
CRJ 100/200	+6.95	+2.00	+3.07	-2.05	+0.99	+1.02	+3.77
CRJ705	+5.35	+0.64	+1.74	-3.03	-0.73	-0.91	+2.34
B757-200 L1 Door	-4.44	N/A	-5.64	N/A	N/A	N/A	-5.96
B757-200 L2 Door	-3.47	N/A	-5.46	N/A	N/A	N/A	-4.83
A310-300	-7.44	N/A	-7.69	N/A	N/A	N/A	-7.98
B767-200	-6.71	N/A	-7.35	N/A	N/A	N/A	-8.12
B767-300 L1 Door	-6.86	N/A	-7.13	N/A	N/A	N/A	-8.26
A330-200 L1 Door	-7.88	N/A	N/A	N/A	N/A	N/A	N/A
A330-200 L2 Door	-7.43	N/A	N/A	N/A	N/A	N/A	N/A
A330-300 L1 Door	-7.45	N/A	N/A	N/A	N/A	N/A	N/A
A330-300 L2 Door	-6.60	N/A	N/A	N/A	N/A	N/A	N/A

Source: Jacobs Consultancy 2010

FIGURE 1.2

EXHIBIT I-3: PRELIMINARY FIXED LINK LENGTHS

GATE	ROTUNDA FLOOR ELEVATION (METRES ASL)	BRIDGE MODEL	FIXED LINK LENGTH (METRES)	COMMENTS
0	418.9	Jetway A3 53/104 125R (Proposed)	To be determined	Switchback recommended
1	416.36	Jetway TR 90/100 FR100 (Relocated)	4.6	-
2	417.8	Jetway A2 72/111 125R (Relocated)	37.7	Switchback recommended
4	416.63	Jetway TR 59/69- FR100 (Existing)	4.07	Existing location
5	417.2	Jetway A2 59/87 125R (Relocated)	11.0	-
6	417.2	Jetway A2 57/84 125R (Relocated)	11.0	-
7	417.8	Jetway A3 53/104 125R (Proposed)	15.5	-

Source: Jacobs Consultancy 2010

FIGURE 1.3

4.2 Gate Flexibility / Sector Segregation

YLW operates three sectors; Domestic Departures and Arrivals, International Departures and Arrivals and Transborder Departures. YLW does not operate a Pre Clearance Facility, nor is there one planned in the foreseeable future. Transborder outbound passengers are screened with all other Domestic and International outbound passengers and arrive in the US as International Arrivals and process through Customs and Immigration in the US.

Recent events required YLW (and all other Tier 2 Airports in Canada) to construct a temporary Transborder Hold room to segregate passengers immediately post Pre Board Screening, and to maintain that segregation in the airside corridor. Early design studies identified a position for a completely separate Transborder screening facility however this is not currently a requirement. Should it be deemed necessary in the future, that plan as indicated on the approved Concept Plan could be implemented. Requirements for a fully segregated hold room have similarly been relaxed.

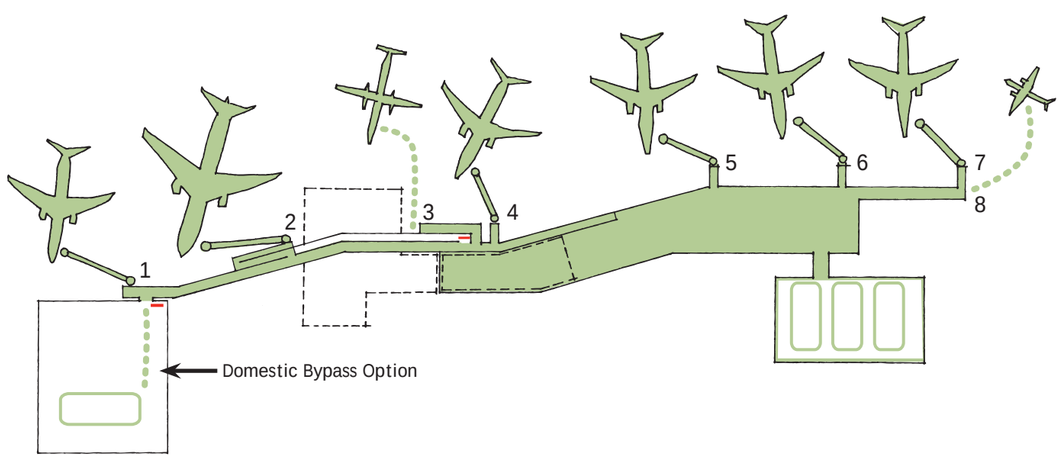
Current regulations for Tier 2 terminals call for a dedicated Full Body Scanner to be available adjacent to the Transborder Boarding Podiums in the hold room. Passengers identified to require this screening procedure will be pulled out of the boarding line prior to boarding the aircraft. A fully segregated hold room is not required. To anticipate the potential of a changing security environment, the Schematic Design includes a moveable partition that could segregate the hold room with 100 seats available for Transborder passengers. Provisions for more washroom facilities that would accompany a fully segregated hold room scenario have not been included at this time and would require further study.

Elsewhere in this document a description is provided of the development of a new Domestic Arrivals Facility to the south of the terminal, with International Arrivals facilities maintained at the north end. It is therefore for proximity reasons that Gates 1, 2, 3 and 4 are available for International Arrivals, with Domestic operations focused at the south. Transborder operations will share gates 1,2,3 and 4 in order to facilitate turns for International Arriving aircraft to depart Transborder.

The following diagrams demonstrate the ability of the facility to accommodate:

- A Maximum of 8 Simultaneous Domestic/International departures and Domestic arrivals Gates
- A maximum of 4 Simultaneous Transborder Departures Gates
- A maximum of 4 Simultaneous International Arrivals Gates

A desire was expressed early in the design process to eliminate the airside corridor to reduce confusion for passengers moving in opposite directions within the corridor. To that end the airside corridor was deleted between Gates 4, 5 and 6 when operating in Domestic modes. Domestic arrivals will transit through the hold room to domestic bag claim. For Gates 1, 2, 3 and 4, the airside corridor remains a requirement due to the location of the boarding podiums relative to the gate position, and in order to maintain segregation between international arriving passengers from Domestic / International / Transborder departures. Segregation is achieved through the use of doors within the corridor that “switch” the corridor between sectors.



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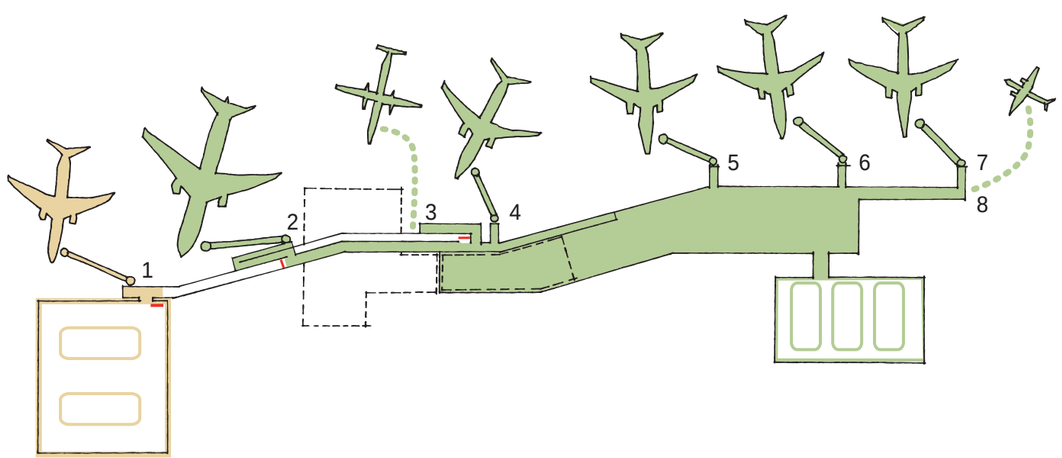

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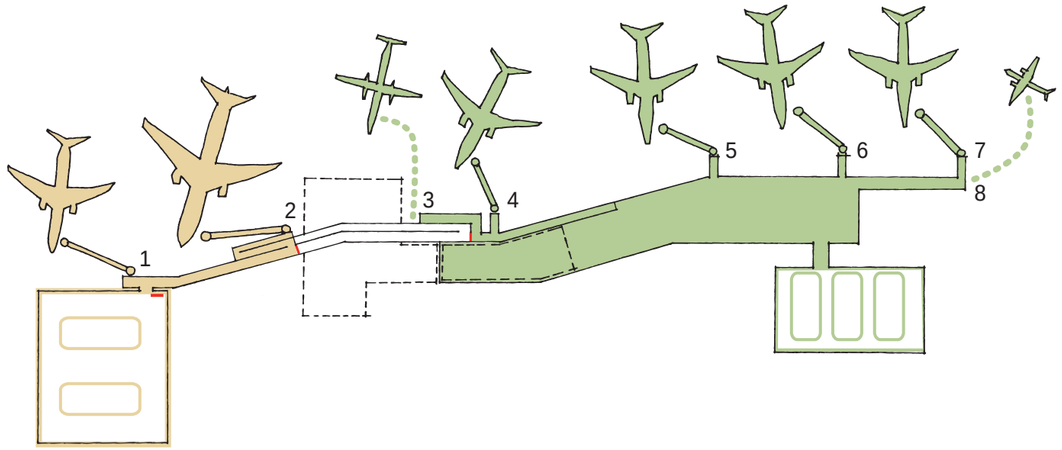

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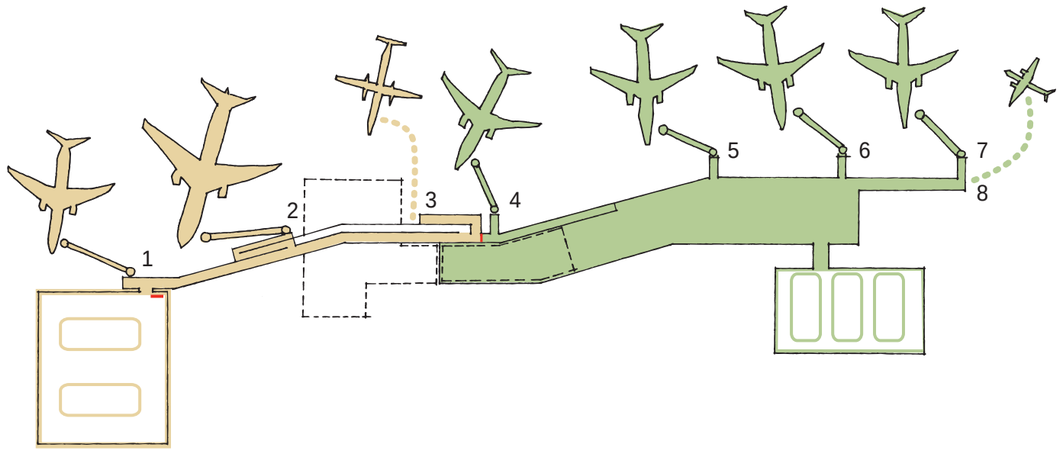


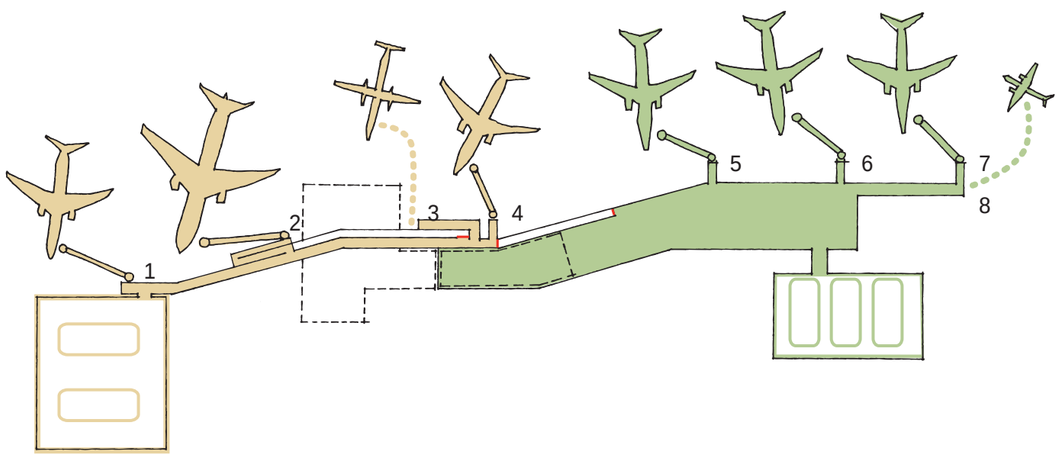
Configuration 4

FLEXIBILITY DIAGRAMS

Domestic Inbound + Domestic / International Outbound

Transborder Outbound

International Inbound



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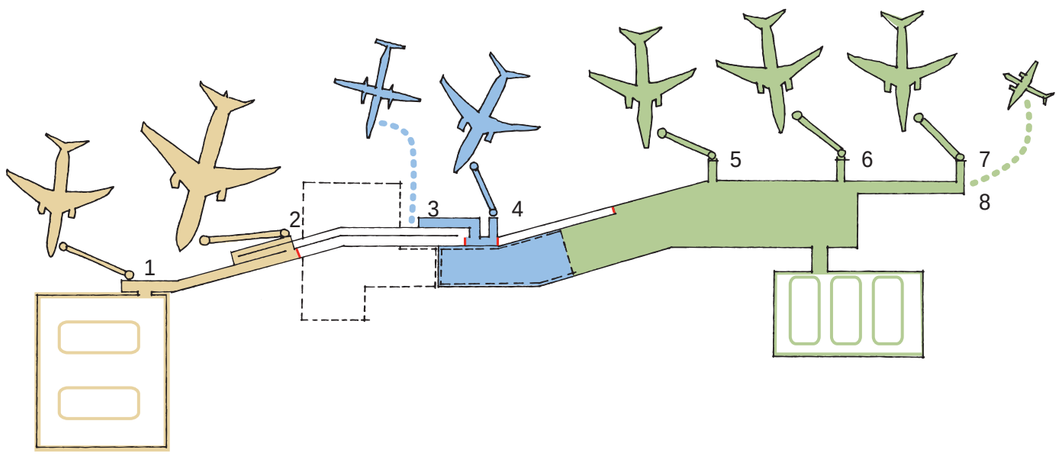

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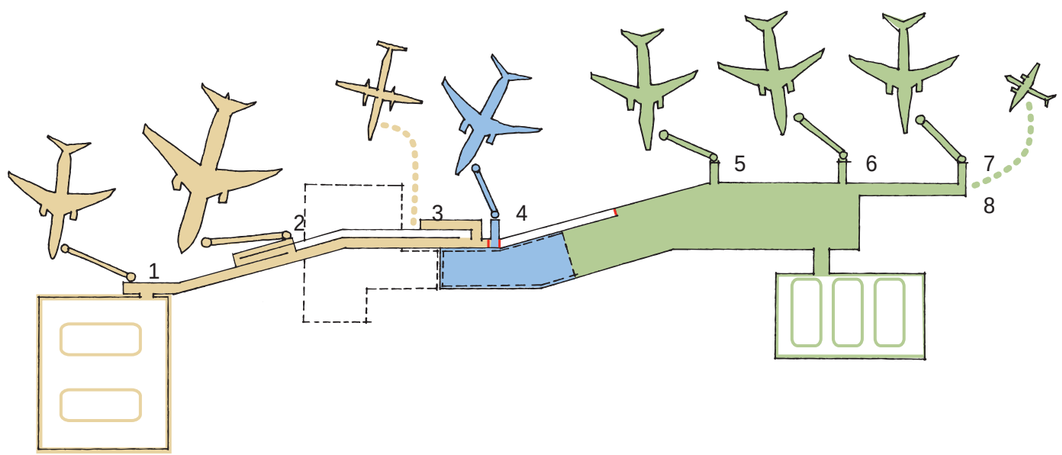

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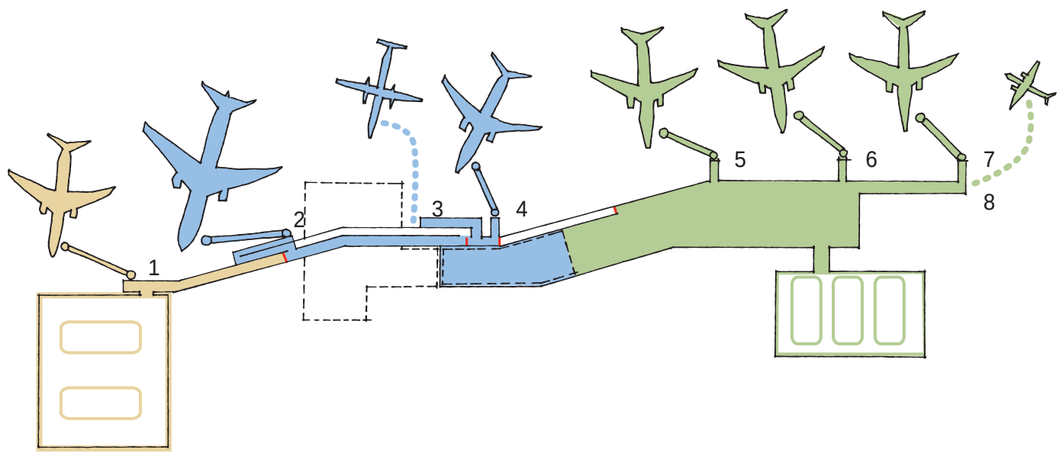


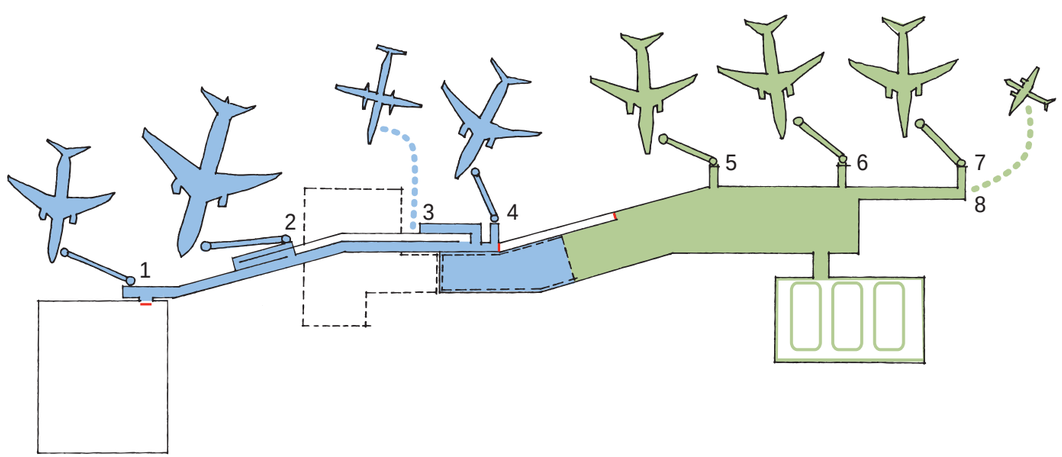
Configuration 8

FLEXIBILITY DIAGRAMS

Domestic Inbound + Domestic / International Outbound

Transborder Outbound

International Inbound



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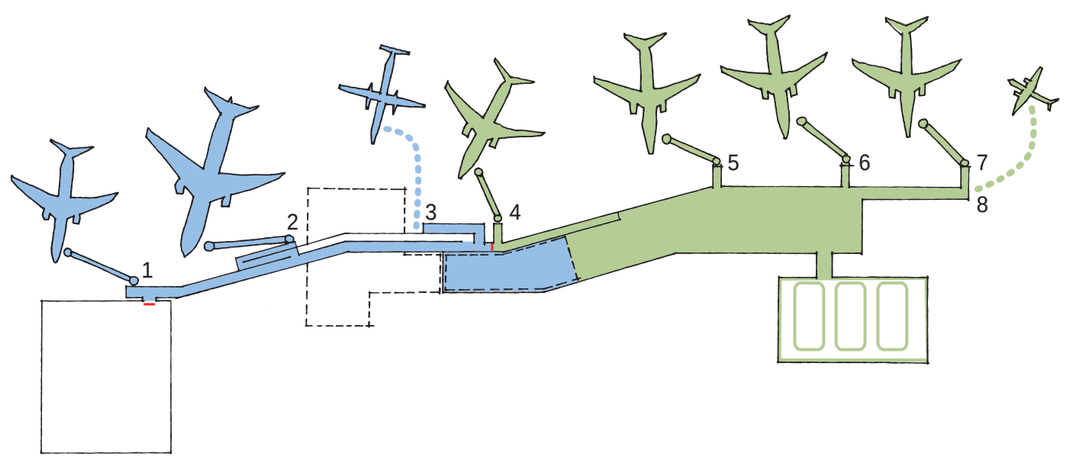

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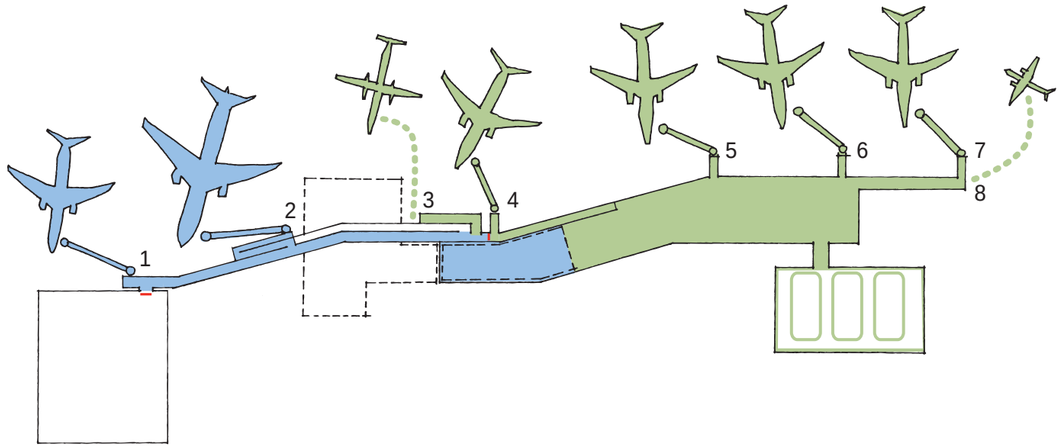

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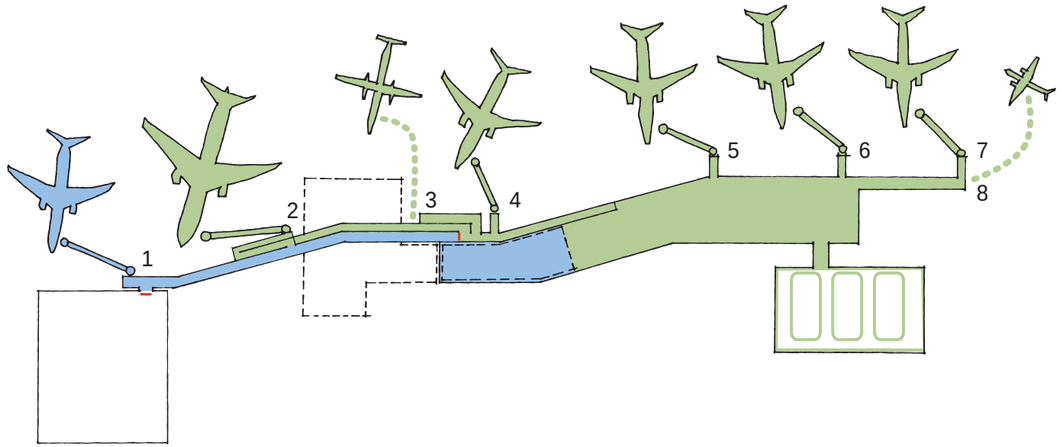


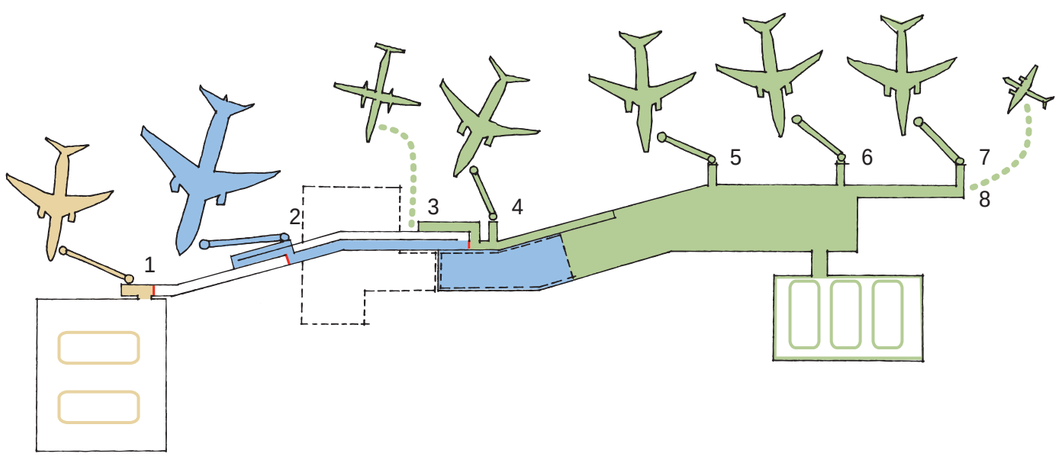
Configuration 12

FLEXIBILITY DIAGRAMS

Domestic Inbound + Domestic / International Outbound

Transborder Outbound

International Inbound



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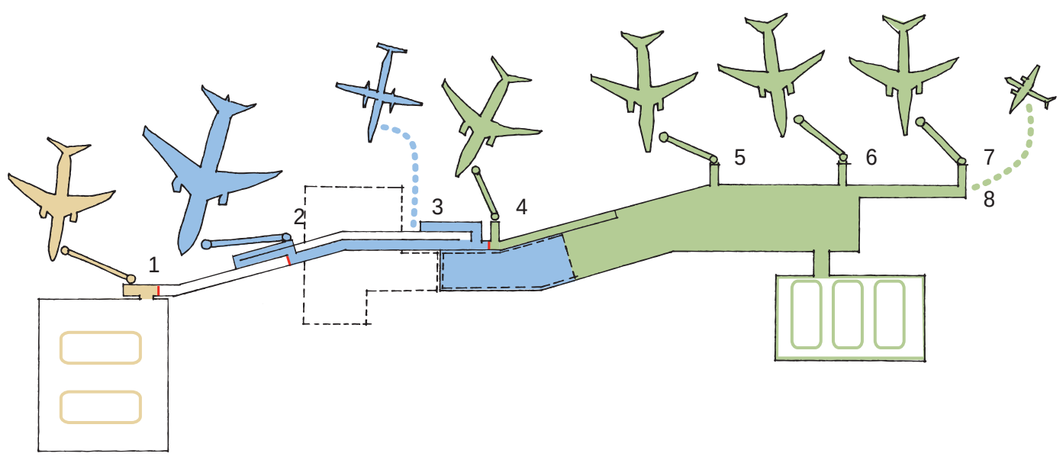

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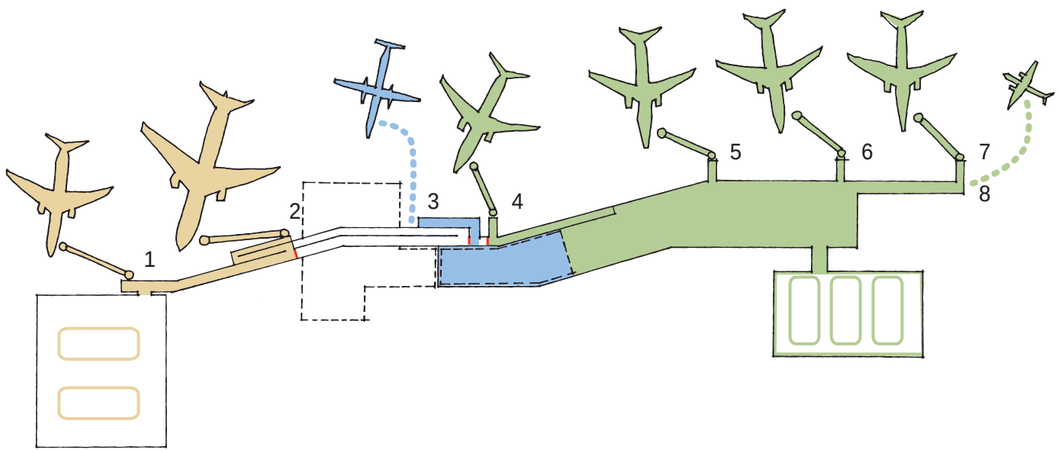


Configuration 14

FLEXIBILITY DIAGRAMS

Domestic Inbound + Domestic / International Outbound

Transborder Outbound

International Inbound

5.0 ARCHITECTURAL DESIGN PHILOSOPHY

5.1 The Importance of Identity

Air terminals serve a special purpose within their communities. They are commonly described as the modern gateway to the city - as the first and last point of contact with a particular place. It is here that the first impressions and last memories of a place are made. In Kelowna, where tourism is a significant economic driver, establishing a "sense of place" that is specific, identifiable and unique within the airport is of even greater significance.

Kelowna and the Okanagan region have historically been recognized as a unique geographical area within Canada. Scenic, rich in recreational and cultural activities, blessed with a good climate and quality of life, the region has long been a four season tourism destination and is increasingly becoming a full time residence for many. The combination of all of these assets and its unusual geography is what makes the area desirable and unique. Visitors have an expectation that their experience of the area will begin with their first steps in the airport; residents, business leaders and the airport authority have an expectation that their airport present an inviting, positive and memorable image of the Okanagan. Establishing this identity will differentiate Kelowna International Airport, making it part of the positive experience of being in the Okanagan.

The architectural tools that will be used to establish identity are:

- material selection that is based on local geographic materials, textures and colour palettes
- an architectural language representative of central British Columbia
- a built form that is responsive to the local climate
- a retail programme that promotes and highlights regional products and services
- landscaping that uses indigenous plants and landscape forms
- theme works incorporated throughout the project representative of themes specific to the Okanagan Valley
- rotatable theme works programme that is able to emphasize the best of each season

5.2 Themes

In June, 2010, a workshop was held with Airport Advisory Committee, airport authority officials and the design team to identity the key themes to be used to establish a unique Okanagan identity within the air terminal design.

The design team presented a series of precedents from other Canadian air terminals and significant Okanagan building examples to illustrate how architecture and theming work together to establish identity. The participants were then provided with several hundred images and asked to each choose three that spoke to them about their community. The following collage was created using the images chosen by the participants. The group then discussed the significance of the images and developed the following themes to be used to establish a unique Okanagan identity within the terminal expansion.

In no particular order:

- **Quality of Life**
- **Place names**
- **First Nations**
- **Climate - Four Season Lifestyle**
- **Wildlife**
- **Arts and Culture**
- **Geography**
- **History of Travel**
- **Diversity in Agriculture**
- **Regional Landscape**
- **Lake Okanagan**

Workshop Participants

Mayor Sharon Shepherd, City of Kelowna (Chair)

Mayor Marty Bootsma, City of Salmon Arm

Meryle Corbett, Kelowna Chamber of Commerce

Brian Wills, Greater Vernon Chamber of Commerce

Councillor David Knowles, District of West Kelowna

Colin Day, Kelowna City at Large

Len Novakowski, Westbank & District Chamber of Commerce

Mayor Wayne Lippert, City of Vernon

Terry Condon

Councillor Robert Hobson, Regional District of Central Okanagan (City of Kelowna)

Janice Liebe, Project Architect, DIALOG

Jim Slavin, Leigh Fischer

City of Kelowna Staff: Ron Mattiussi, City Manager

Paul Macklem, GM, Corporate Sustainability

Sam Samaddar, Airport Director

Henry Castorf, Airport Development Manager

Arlene McClelland, Recording Secretary

5.3 Architecture and Geography: Building a distinct Sense of Place

During the research for this project the design team reviewed thousands of images and culled it down to one photo that is most representative of the geography of the area. It contains four elements that are essential to a description of Okanagan geography:

Sand

Sand of course for the many beaches, but also for the sand cliffs that are seen along the lake, and in the ground of the dry hills and mountains. The palette of the colours found in the sandy soils establishes a base of beiges, pinks, greys and terracottas. These colours shift in intensity up and down the valley but the general palette is the same.

Wood

The Okanagan forests are distinctive for the Ponderosa pine. Tall, singular and sculptural, they are instantly recognizable.

Lake

Okanagan, Skaha, Kalamalka, Wood, Osoyoos, Vaseaux; the valley is always in view of water - and water of many colours. One can often distinguish a lake in the Okanagan simply by its hue.

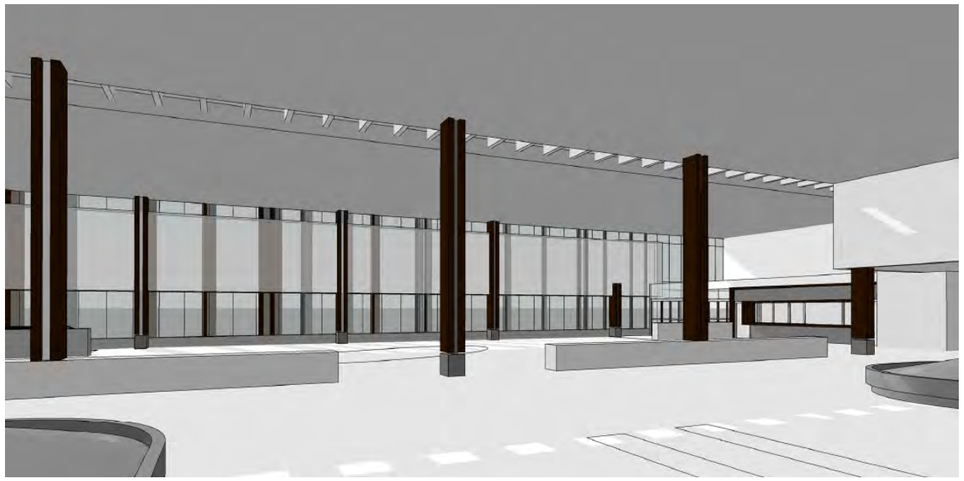
Sun

And of course the quality of light. In the summer it is the heat of the sun on the lake, in the winter the bright clarity of sun at the top of Big White. Without it the Okanagan would not be the place that it is.

Base Building Design Architecture is the base, or the frame for the rest of the project. It is a stage set, establishing a tone over which many other elements are layered. The establishment of this base is critical to tying the terminal to this particular place on the planet. For these reasons, the architecture will be based on the four distinctive Okanagan geographical elements described above:

Sand will be represented in distinctive feature walls of rammed earth. This type of construction is not actually soil, but pigmented concrete that is hand tamped into concrete forms, giving it a distinctive layered quality. It has the texture of sand and the colour palette will be specifically tuned to be of the colours found in the natural soil in Kelowna. To our knowledge it has never been used in an airport. The largest example of rammed earth construction is in the Okanagan, at the N'kMip Desert Cultural Center.

The iconic quality of the Ponderosa pine will be represented by the structural columns clad with timber. Wood will be used only in a vertical format, in a scale and weight that is similar to the singular pines. The front façade of the domestic arrivals hall will feature a "forest" of columns in an irregular rhythm, casting shadows light and shade into the interior.

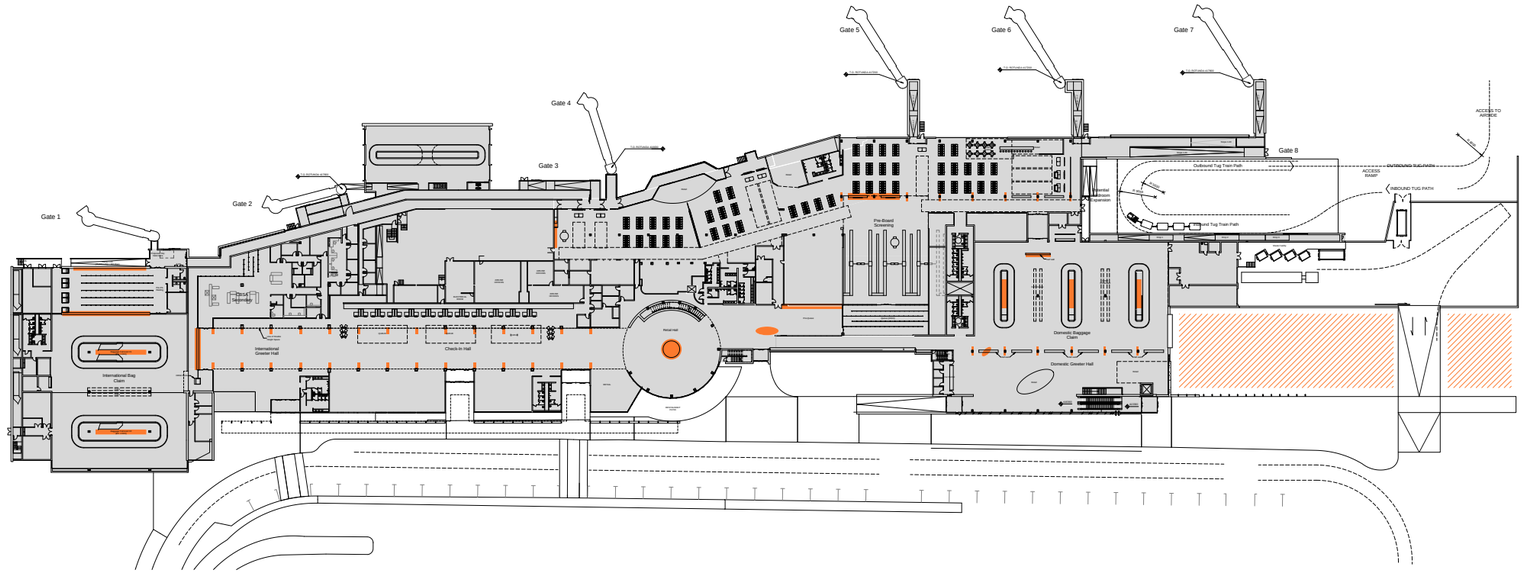


Lake blue, or rather the many hues of Lake blue will form a significant part of the palette. Blue is already in use in the flooring tile and carpet of the terminal, and in the etched glass of the Polaris sculpture in the centre of the Rotunda. Blue will be the focus of the flooring materials, will change and merge from north to south, representing the many lakes in the Okanagan.

Sunlight will be a central theme in the design. The lighting strategy using clerestory windows in the original terminal will be maintained and extended into the new areas. Some clerestory windows may be re-instated in the original where they have been closed over time. Letting in light can also mean letting in heat. Architectural strategies for controlling excessive solar heat are often defining features to warm climate architecture. Deep overhangs, punched windows in solid facades, bolder solid forms are some of the features one finds in desert architecture. These will be found in the design of the terminal as well.

Layered overtop of the architecture are many other elements, some more literal themed devices. The Kelowna International Airport already has some significant pieces that will be maintained in the future expansions, such as the Polaris sculptures and the Gallery Wall at the entry to pre-board screening. The design for the expansion has established key locations within the design for future thematic pieces.

Some of these may be fixed items that are part of the architecture. Others may change overtime, such as a rotating banner display that emphasizes the distinct attributes of the Okanagan seasons. The specifics of the theming programme will be developed in detail with the next phases of design and will be considered as part of each phase and each discipline including retail, signage and wayfinding, architecture and landscape design.



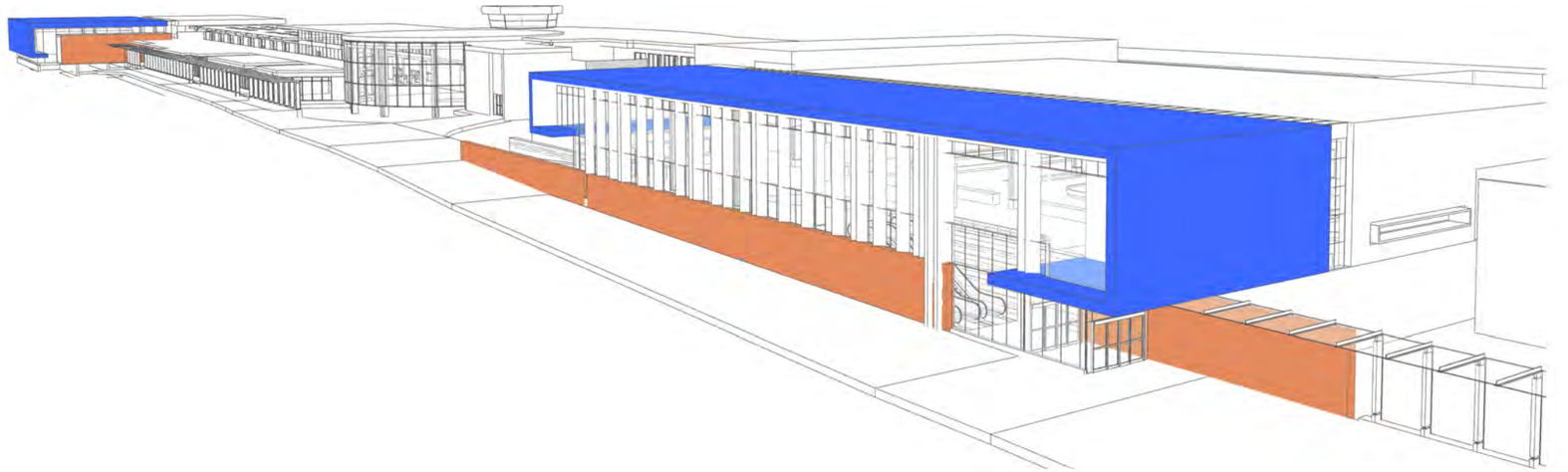
THEMEWORK POTENTIAL LOCATION PLAN

Cohesion The existing terminal building has been built over time and in a number of phases. The first additions were relatively similar to the original building using similar materials and building forms. Later additions are distinctly different in scale, form and material. As a result, the exterior view of the terminal clearly indicates at least five different of phases of work and architectural language.

The expansion project described in this document will approximately double the terminal in size with expansions on all sides of the existing terminal and will retrofit many of the existing areas. It is a goal of this project to establish a sense of cohesion between the various phases of the terminal.

The expansions to the north and south are designed to be of similar form. It is intended that they form “book ends” to the terminal, and are the first step at drawing the terminal architectural language together. As these forms are also similar uses (a domestic arrivals hall at the south end and an international arrivals hall at the north) the form gives an architectural clue to terminal’s internal organization.

The scale of the new arrivals halls is similar to the rotunda and existing south entry ramp enclosure. The scale of these forms is more suitable to the scale of the expanded airport.



The exterior elevation of the original terminal and the first expansion are more challenged due mechanical grilles and other utilitarian items placed directly at curbside. The existing canopy is very light in scale and presents some challenges with two rows of columns on the curbside and snow melt falling to the curb from its curved form.

The Schematic Design proposes that the canopy be replaced by a new design that is heavier in scale more in keeping with the scale of the newer forms, and one that has a single row of columns on the building side of the sidewalk. The canopy will tie the two ends of the terminal together creating a cohesive face across the many phases of expansion.

6.0 SCHEMATIC DESIGN DESCRIPTION OF KEY INTERIOR AREAS

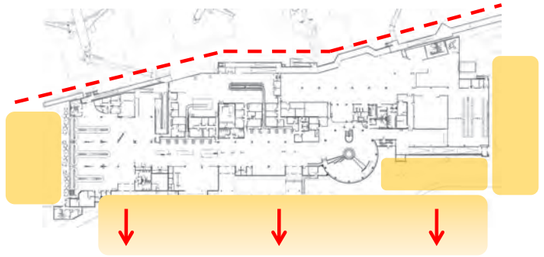
6.1 Design Principles

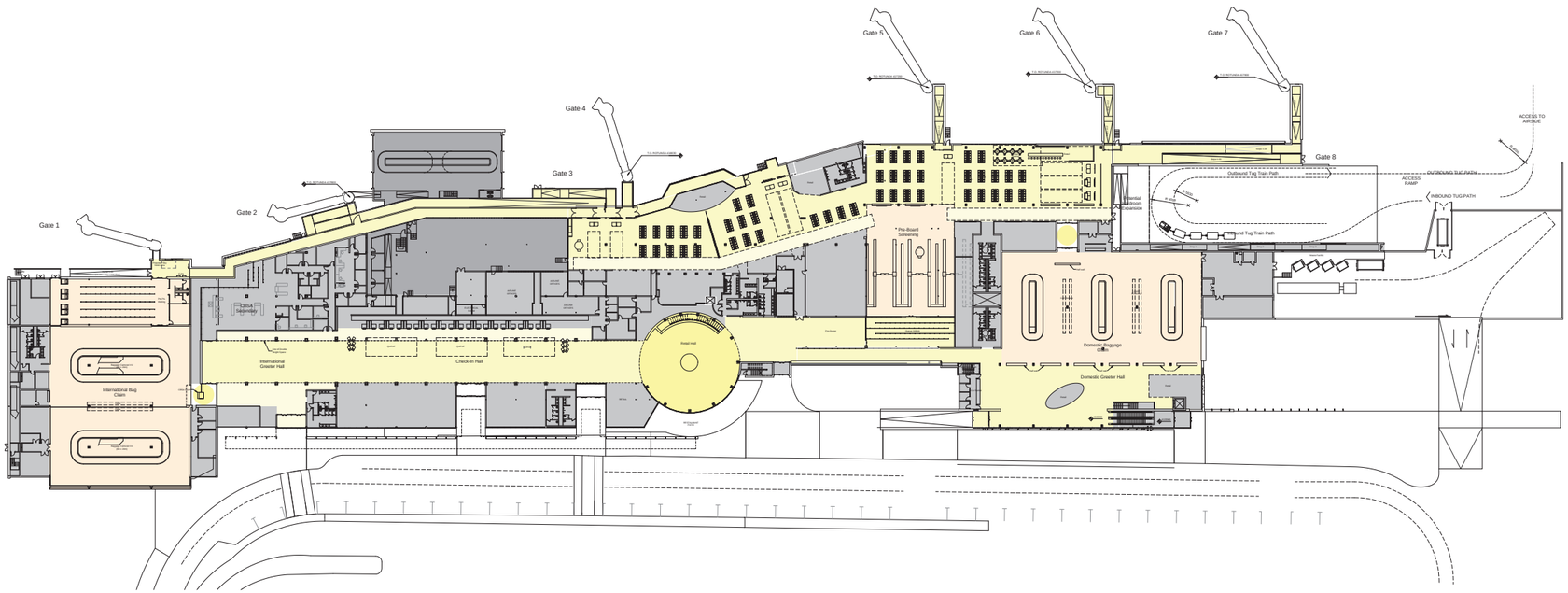
Spatial Clarity

The existing terminal has a clear organizational structure. Currently, the check in hall, the rotunda, the holdrooms all have distinctive volumes and forms. With the considerable change the terminal will undergo with the growth to separated International and Domestic Arrivals facilities, it is important that the original clarity remains and is strengthened. By designing each “process” area with a clear architectural form, passengers will have an intuitive sense of the organization of the terminal.

Preserving Beyond Plan Growth Opportunities

Key to the long term flexibility of the Kelowna International Airport is the preservation of growth areas beyond the current building footprint. The Schematic Design identifies space available for expansion of both the international and domestic claim halls for additional carousels and space to the west for additional pre security retail. These areas have been studied and included in the Phase 5 – Beyond Plan.





Flexibility

Air terminals experience significant change over time whether due to growth, changes in processes or regulation. The only certainty is that what is known today is likely to change sometime in the future. The design will takes this into account by planning for the most likely future expansions and ensuring no impediments to that expansion are placed in the current layout. Objects such as structure, mechanical/electrical rooms and vertical circulation elements will be carefully placed to reduce the number of immoveable objects in functional areas. Areas such as check in that are most likely to experience churn are provided with flexible access to power and data to allow for multiple plan changes in the same space.

Intuitive Wayfinding

Travelling can be stressful. Passengers are often in unfamiliar surroundings and most often simply want to know where they must go next. Being able to see the next step reduces anxiety and gives the passenger a sense of how much time is necessary to complete the process. It is a design principle to provide clear lines of sight and to view the design from the pasenger perspective.

Sustainability and Integrated Design

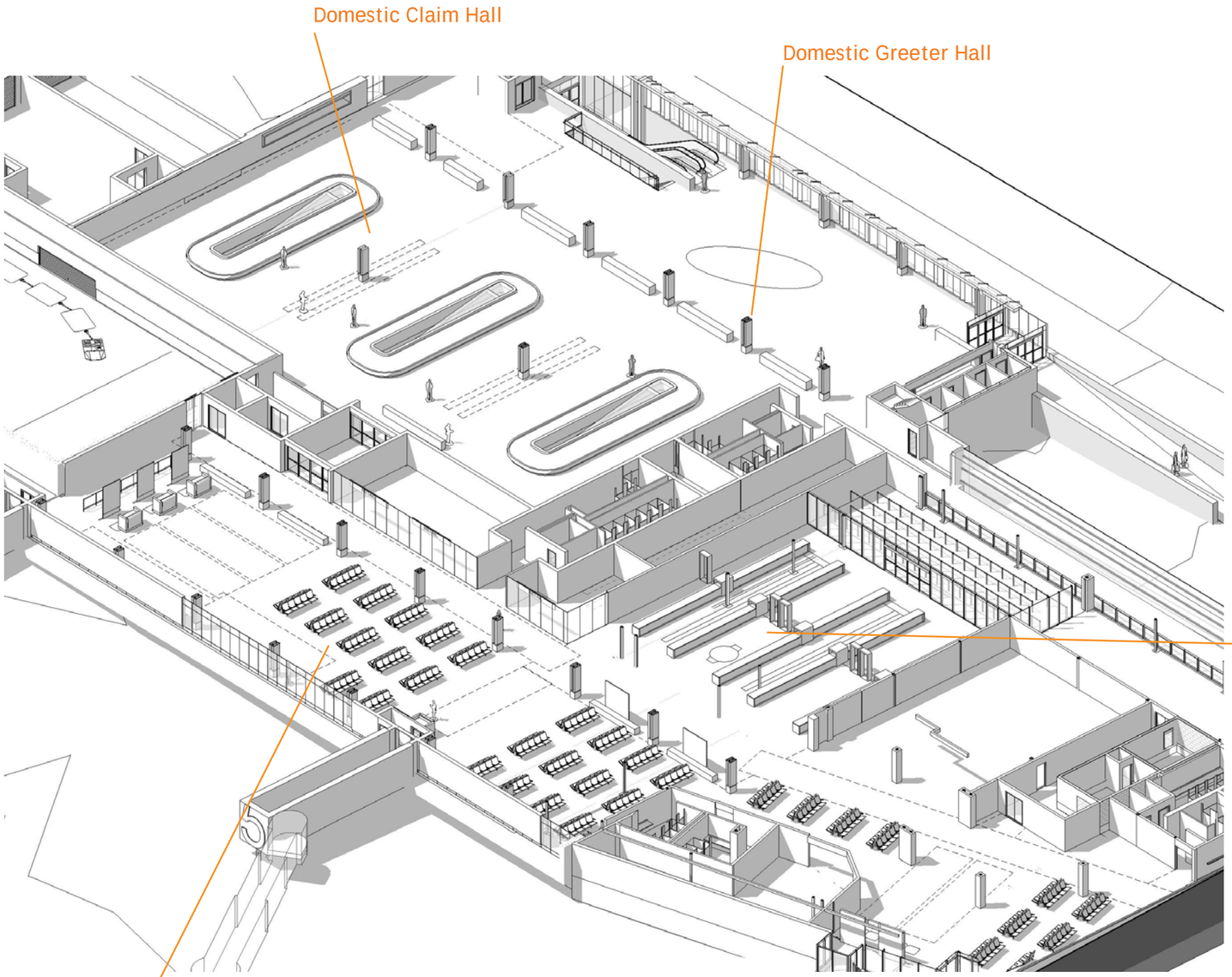
The building design is considered as a fully integrated system. Architectural, Structural, Mechanical and Electrical design decisions are made jointly. The goal is to design a sustainable development with the smallest carbon footprint possible within the budget objectives for the project. An example of this integration is the careful study of the amount of glazing to put into each elevation to ensure that there is enough light to allow for day lighting and access to views balanced with the impact of solar gain on the mechanical systems. This one decision involves input from the architect and, the mechanical and electrical engineers to ensure each system is in balance.

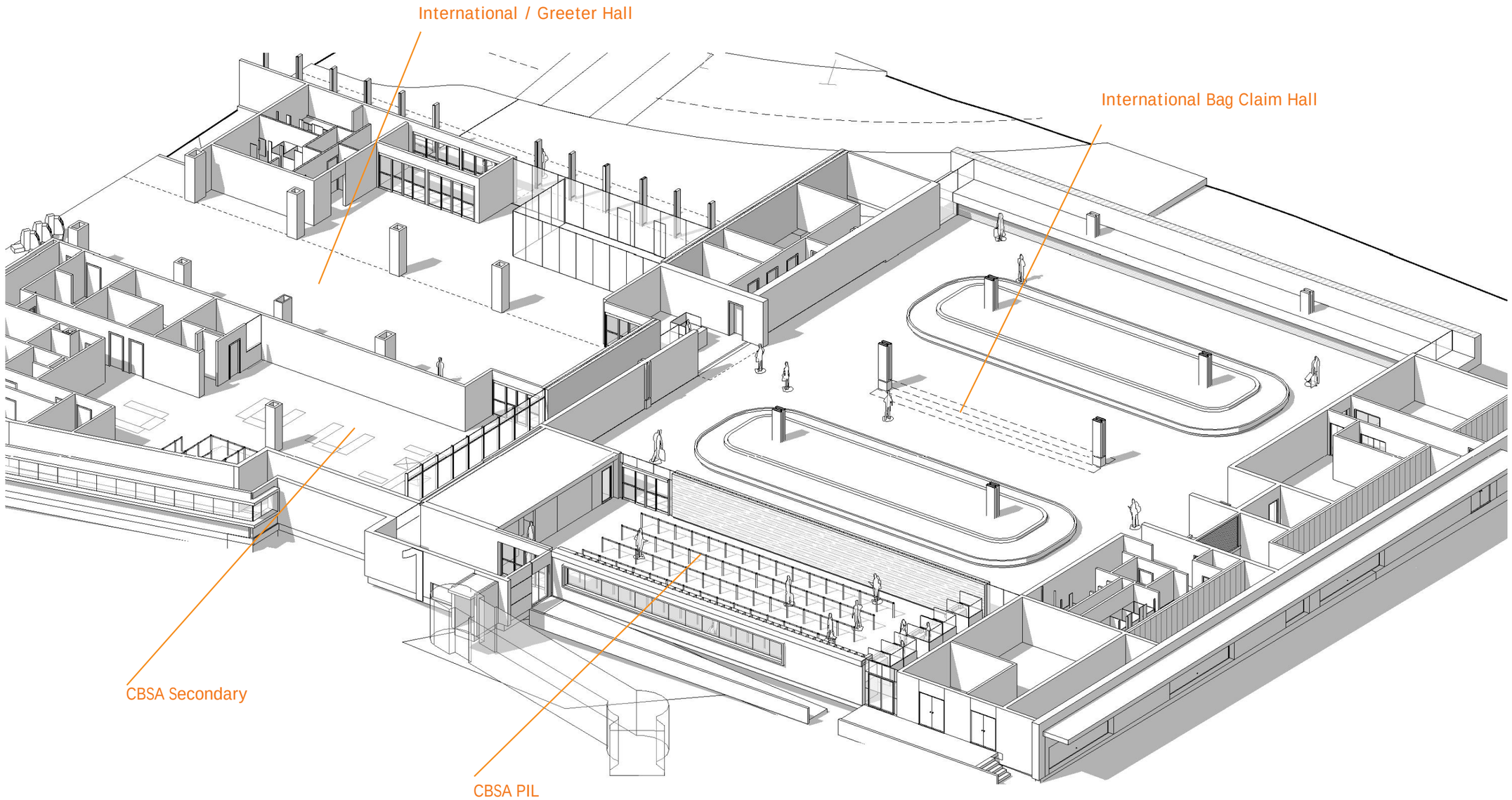
Passenger Flow and Vertical

Circulation Even minor changes in floor levels can be difficult for some passengers to navigate and may add time to the process. All expansions to the air terminal are provided on the same level as the existing main floor of the terminal. Only the new south entry to the domestic arrivals area which is three meters below the main floor will require a vertical transition and is provided with two escalators, an elevator and stairs. The schematic design provides for the levelling of the airside corridor. Further study is ongoing for the expansion options of the outbound baggage make up hall that may prove to be a challenge to the intent to level the airside corridor.

Universal Design

Air Terminals serve everyone in the community. While the most common considerations are for persons with sight, mobility or hearing impairments, the design team takes a universal approach and considers age distinctions, language and cultural challenges as well as person size and cognitive abilities as conditions equally important for consideration in the design. Many of these challenges are not sufficiently addressed by codes. The team will incorporate designs that meet best practices that in many cases exceed code requirements in consultation with the Accessible Advisory Committee.


Domestic Claim Hall
Domestic Greeter Hall
Preboard Screening
Holdroom Expansion


International / Greeter Hall
International Bag Claim Hall
CBSA Secondary
CBSA PIL

6.2 Schematic Design

Domestic Claim and Greeter Hall

The new Domestic Arrivals facilities will significantly change the look, feel and function of the terminal building. Once complete, it will transform the operation of the airport with a new domestic claim hall and greeter hall at the south end of the terminal, freeing up much needed space for an international facilities expansion at the north.

The claim hall is a large volume with high ceilings and a view through the greeter hall to the exterior view of the hills to the west. A large “punched” window to the south overlooks a xeriscaped garden using regional plants and land formations.

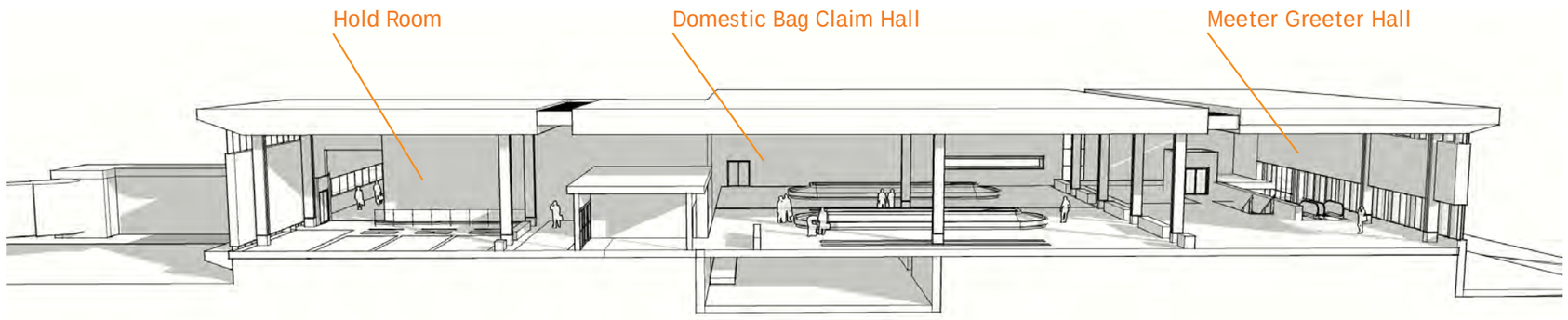
Access for arriving domestic passengers is via the expanded hold room. Walking distances for domestic passengers will be greatly reduced from the existing paths as the primary domestic gates are at the south end of the facility – in proximity to the new domestic claim hall.

The bag claim will provide two sloped plate carousels in its first phase with sufficient space for cart storage and passengers waiting to collect bags. And additional carousel will be added when demand requires. Baggage conveyors will feed the carousels from below leaving the ceiling volume clear.

The greeter hall is directly to the west of the claim hall. Low walls will define the boundary between the two spaces, encouraging greeters to remain outside of claim hall. Rental car counters define the north face and a large retail outlet the south. Space is available for an information counter and additional retail at the centre.

On the exterior, the south location of the domestic facilities will transform the appearance of the airport as it will be the first part of the building one approaches from the curbside roadway. As described in the previous section, this phase will establish an architectural language for the terminal that is specific to the Okanagan region with rammed earth walls in colours of the local environment, large wood columns representing the ponderosa forests and other architectural elements that will compliment and tie to the palette of the existing terminal.

Both spaces are largely day lit with strategically placed and sized windows and clerestory windows that are reflective of the existing terminal.


Hold Room
Domestic Bag Claim Hall
Meeter Greeter Hall

E ⟷ W


Domestic Bag Claim Hall
Mechanical Penthouse

S ⟷ N

Holdroom Expansion

The hold room expansion will be built at the same time as the domestic facilities noted previously. The expansion essentially doubles the size of the existing and includes a greatly expanded retail offering.

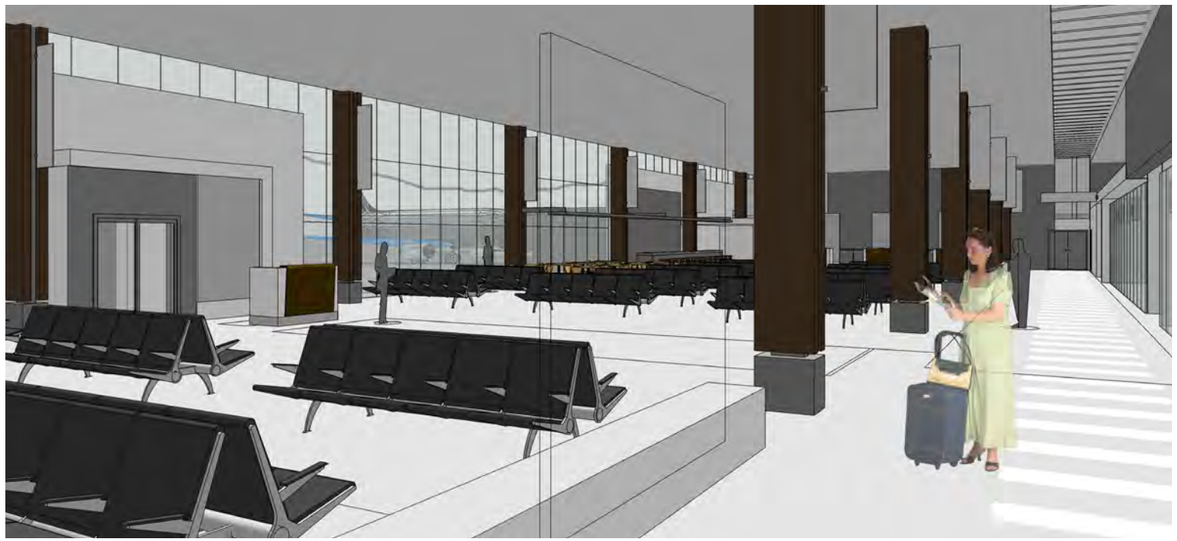
One characteristics of the new hold room that is distinct from the existing is an unimpeded view to the airfield and mountains to the east. The existing hold room view is compromised by the airside corridor and bridges folded against the terminal face. Further, the ceiling height of the new space is much higher creating a volume more comfortable and appropriate for this area.

Glazing on the exterior of the hold room is strategically sized and placed. The largest window is located adjacent to the largest seating area and key food and beverage unit. Opaque surfaces are provided primarily at gate boarding areas. The overall proportion of glazing to solid surface is engineered to provide sufficient daylight and view without overly heating the space. A skylight runs along the ceiling of the concourse providing daylight to the center of the space and high lights the circulation route below.

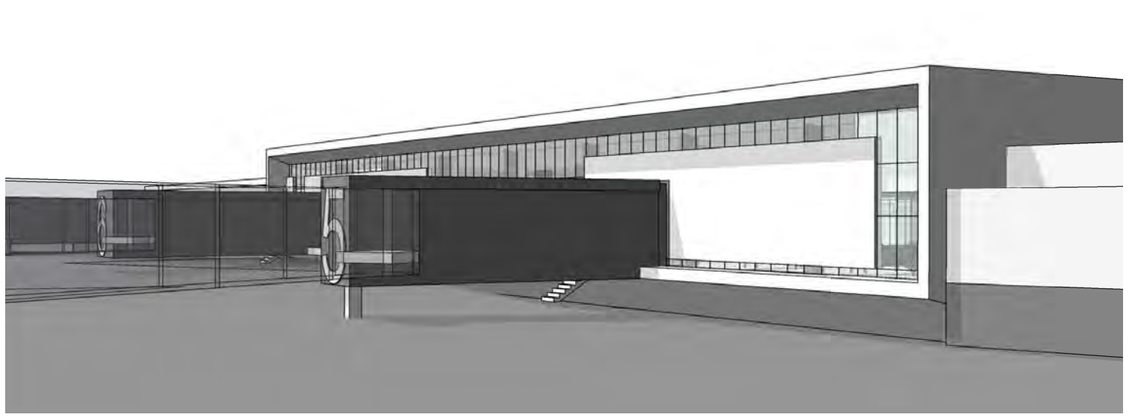
Pre board screening will exit at the centre of the expanded space, with a pausing area defined for passengers to check FIDS monitors, re-stow items removed for screening and determine in which direction they may find their gate.

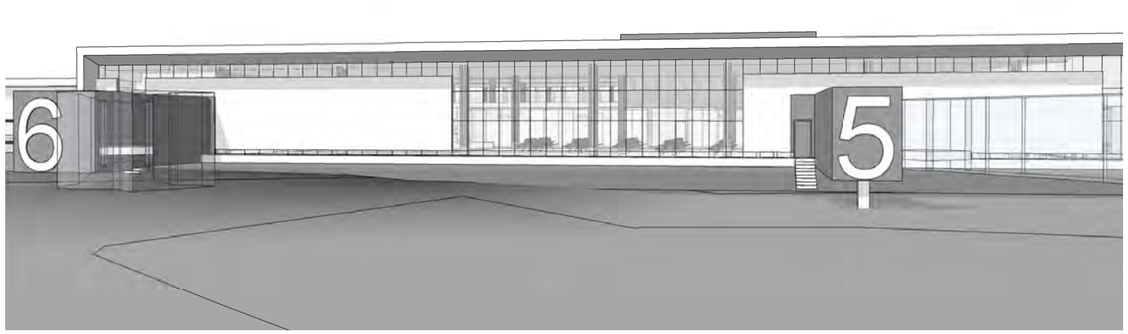
Retail / food and beverage outlets are clearly visible and distributed throughout. A key new food and beverage unit will be located on the glass of the new hold room where passengers can enjoy the view.

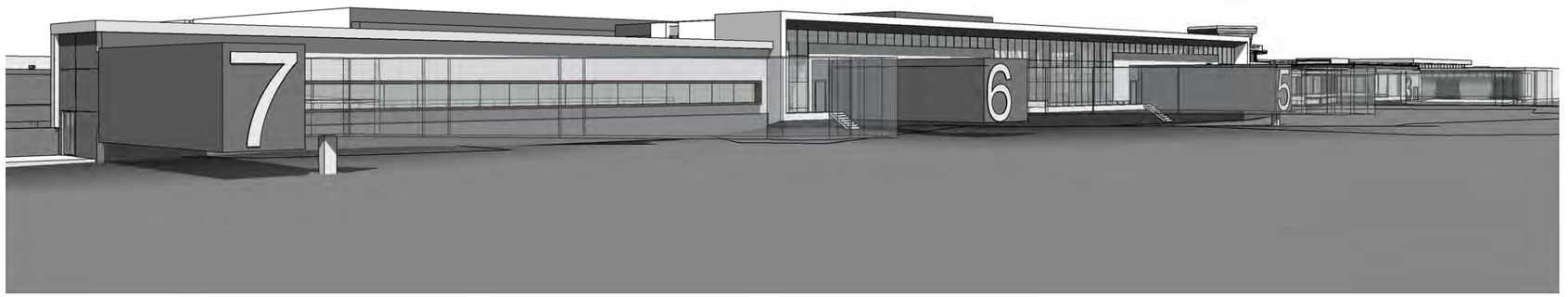
Fittings and furniture will be coordinated and upgraded as required for the entire hold room, including the existing at this time.



The volume and architecture of this expansion will be clearly identifiable from the airfield and to arriving passengers. This creates an understanding of the organization of the terminal on this elevation which was previously lacking. Branding opportunities on this elevation will be considered in the next design phase for the Kelowna International Airport. The architectural form of the roof and overhang is intentionally complimentary to the bold forms on the front of the domestic arrivals facility.



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6
5

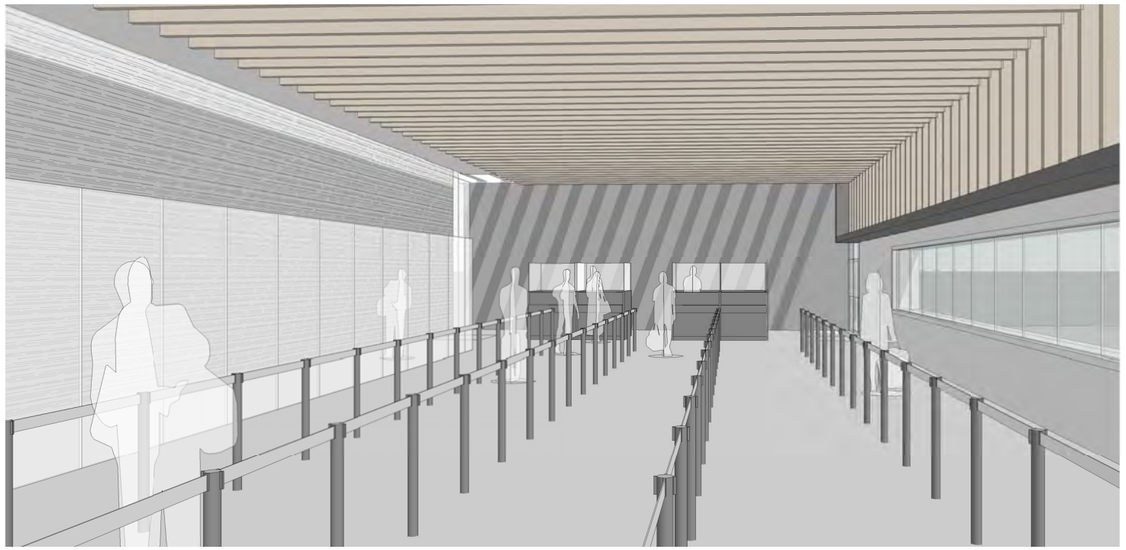
International Arrivals Facilities

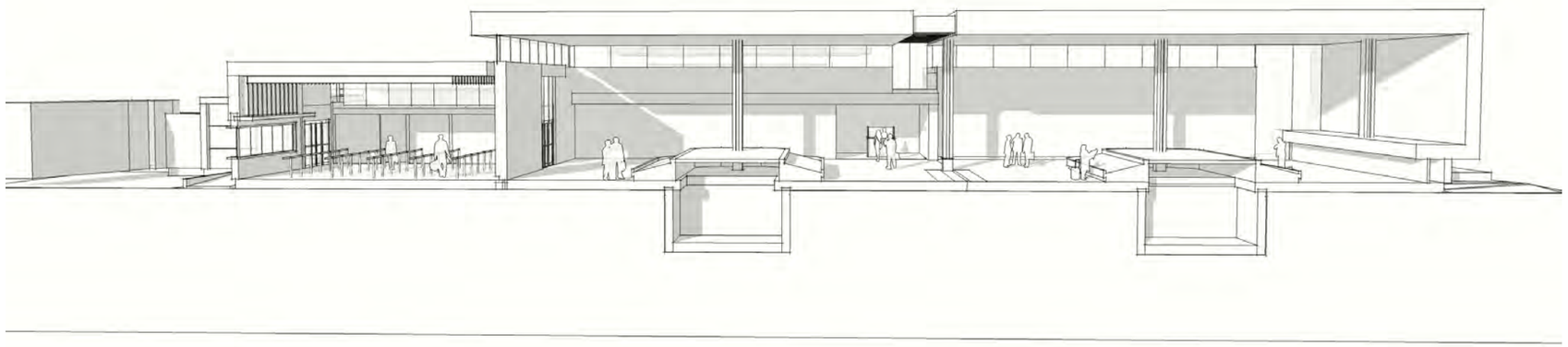
The first phase of expansion delivers a new CBSA PIL facility, changing the flow of arriving passengers to be screened prior to having access to their baggage in compliance with CBSA regulations. This functional area is new to the terminal and will be the first impression of the Okanagan to international visitors. As one of the best views from the terminal is directly to the east of this space, a large window is aligned along the queue. The opposite wall is intended to be a distinctive rammed earth construction reflecting the sandy, dry and rounded mountain geography visible from the windows. This type of construction is unique and rarely used in Canada. It is seen most often in the Okanagan making it a signature piece for the terminal and one that reflects the special geography of the valley.

As the bag claim hall is not constructed until a later date, passengers will flow from the PIL counters back to the existing claim devices. The corridor will be segregated from the queue by a temporary glazed wall. This wall will be removed once the International Claim Hall is constructed, leaving expansion space for two additional PIL counters. Passengers at that time will flow directly from the PIL counters to the Bag Claim hall.

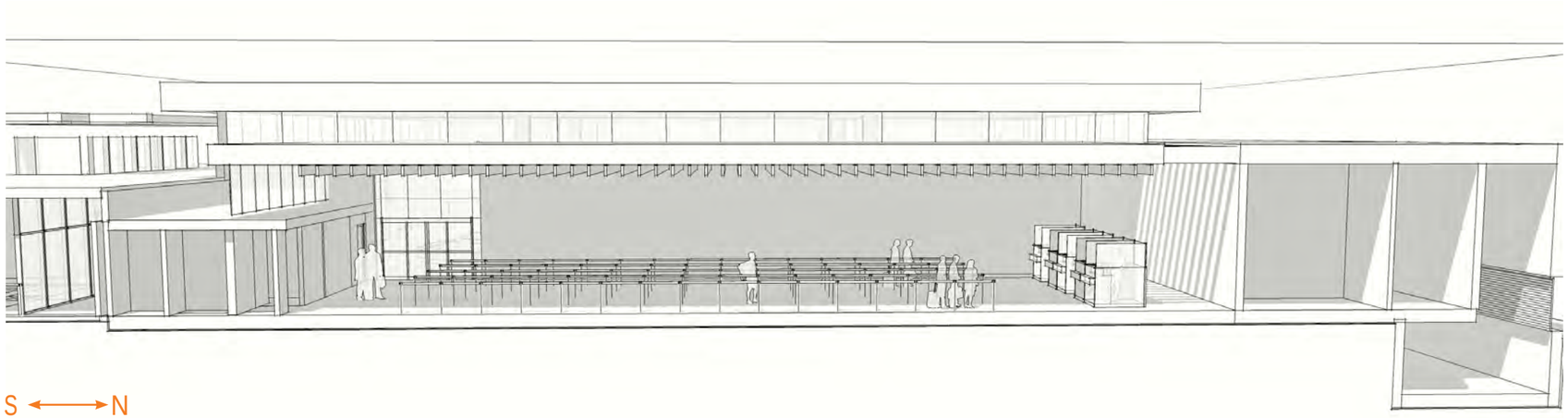
The International Claim hall will initially have one large sloped plate carousel, with baggage delivery from below. A Beyond Phase plan adds one additional carousel.

The rammed earth wall of the CBSA PIL which was an exterior wall in the first phase, becomes an interior wall of the International Claim area, adding its character to this space. Skylights introduce daylight, and in the final expansion, windows to the curbside will allow passengers a glimpse of their destination. At this stage, the architectural form and massing of the complete claim hall creates a “book end” to the terminal, as its form mirrors that of the Domestic Claim area to the south.

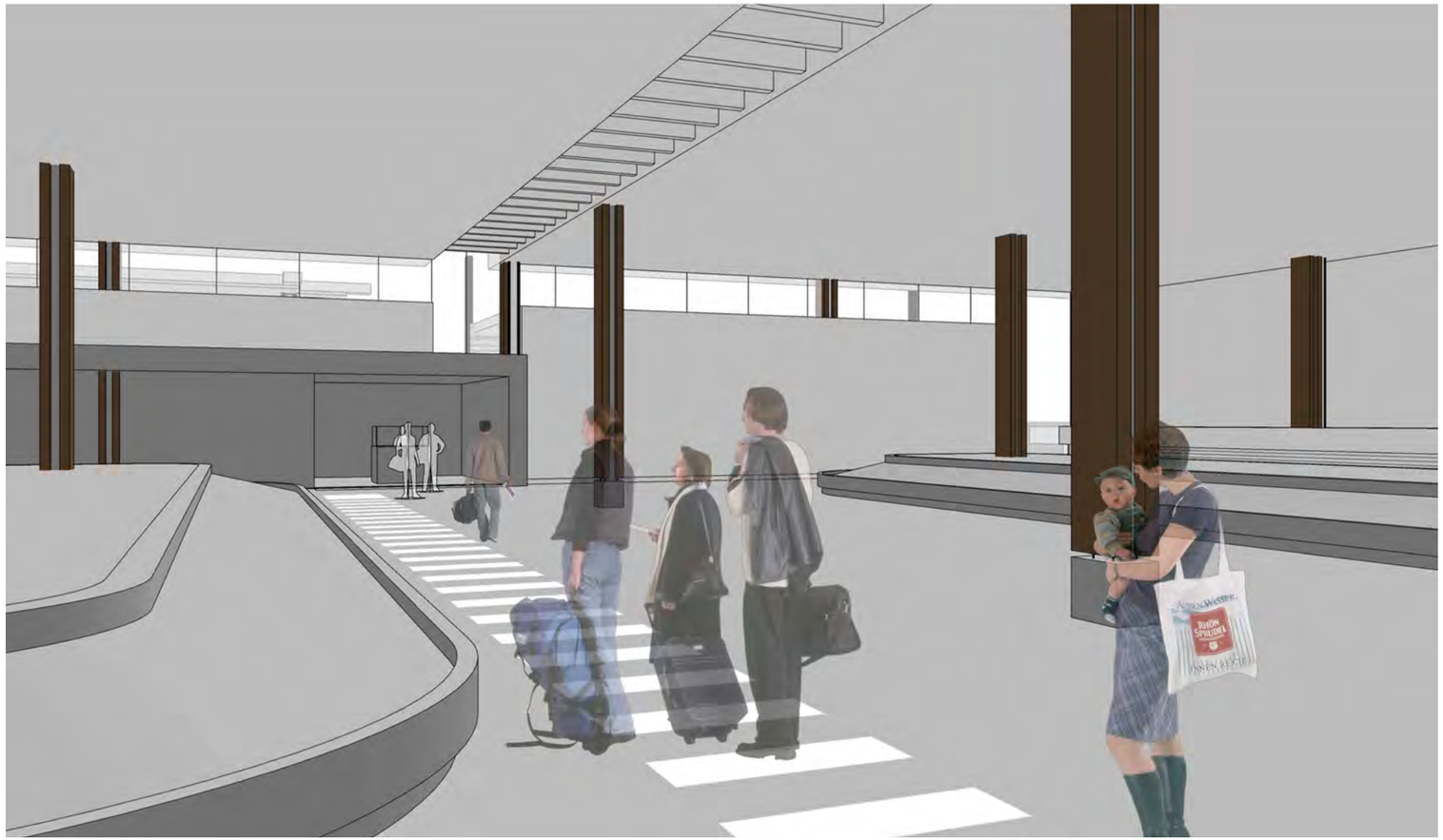




E ⟷ W



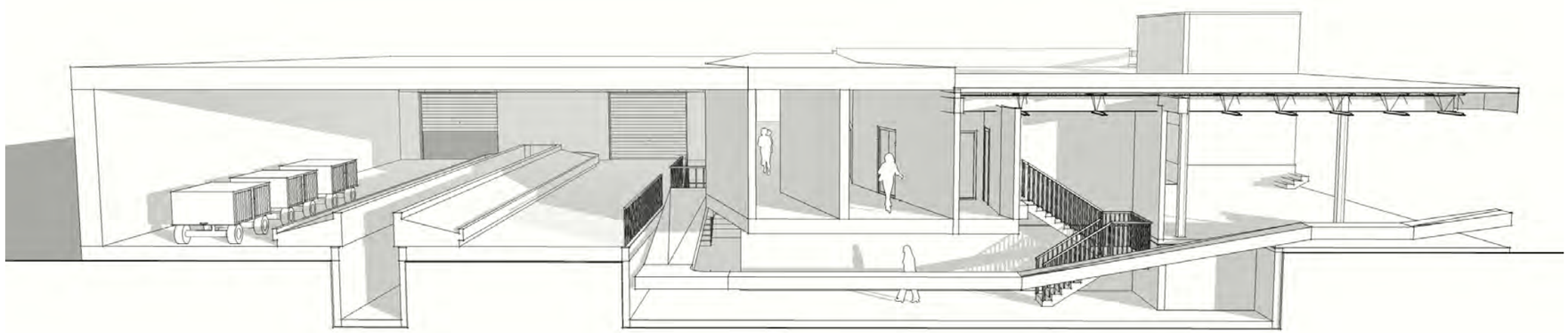
S ⟷ N



Outbound Baggage Make-up Hall

The new outbound baggage make-up hall expansion will provide for a two lane drive through facility for bag make up, leaving the existing hall available for an expanded baggage screening area – significant improvements for a currently congested function. As the only expansion area available is airside, these two spaces will be transected by the airside corridor.

There is a desire to level the airside corridor which currently ramps up and over the access doors to the baggage make up hall. In order to achieve this, conveyors would have to either move up and over the leveled airside corridor, or be tunneled slightly underneath. The Schematic Design illustrates the latter option as the up and over solution would require a much taller addition and has challenges with lengths of conveyor runs required to make the vertical transition. A version to maintain the airside corridor in its current ramped configuration has not been studied, but may prove to provide benefits for the access between the two components of the baggage make up hall and would be less costly to construct. This option will be reviewed at a later date.

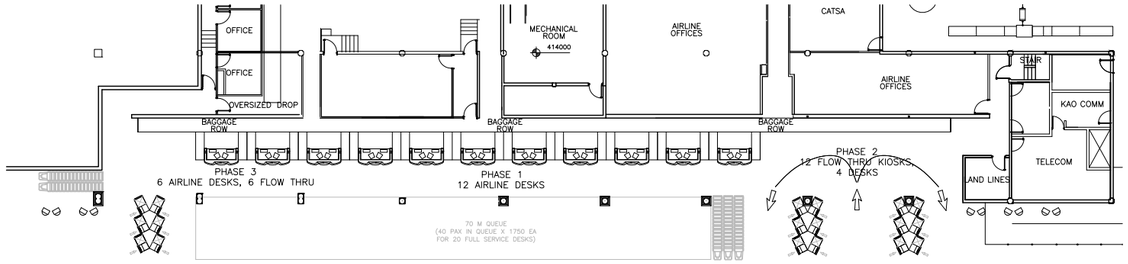


Check-in Hall Expansion

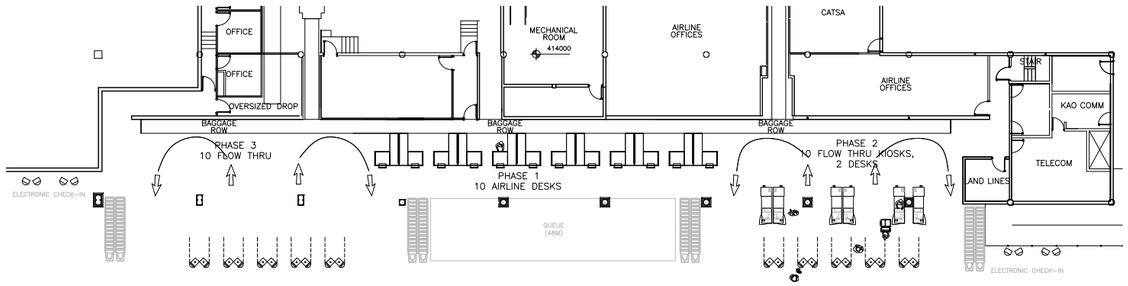
The existing check in hall experiences congestion in large part due to the proximity of the domestic arrivals ramp, the meeter greeter area and the claim carousels. This condition will be greatly improved with the provision of the domestic arrivals facility to the south and the movement of the claim devices into a new international claim hall to the north.

Expansion for more check in counters is not anticipated to be needed until after 2016. The Beyond Plan Phase of this report indicates the removal of the washrooms in the center of the check in counters to provide expansion space for more counters. Work completed in previous phases clears the way for the counters to be aligned with the West Jet counters, increasing queue space within the check in hall.

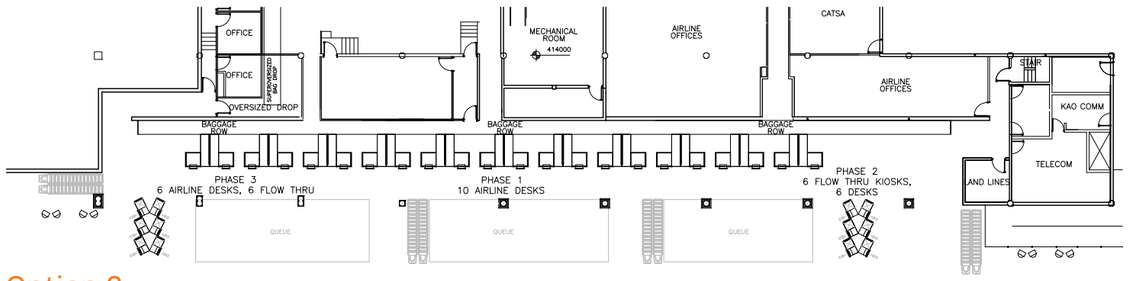
Check in processing is evolving, with arrangements of counters, bag drops, self serve kiosks ever changing. The following diagrammes illustrate options for layout that can be achieved within the expanded space.



Option 1



Option 2



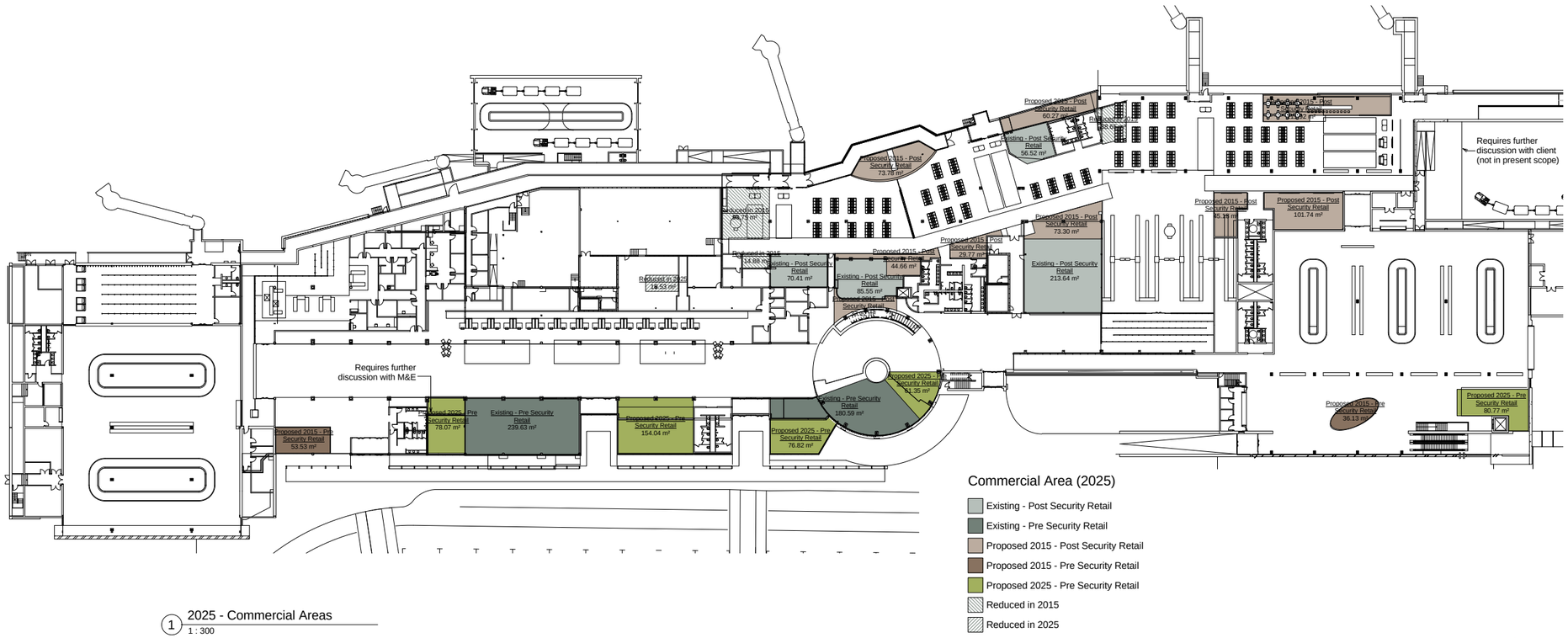
Option 3

Retail

A preliminary review of the existing terminal areas allocated to retail was undertaken by Leigh Fischer. This was followed by a review of the approved Concept Plan with recommendations for the distribution, size and retail type for each area of the terminal. These areas were then incorporated into the Schematic Design. Areas were achieved to the extent possible without expansion of the building footprint. The following plan indicates the retail area locations and their footprint sizes, and the chart compares the targeted retail sizes with the current allocations on the plans.

The key points of the retail review found the following:

- The Rotunda will become a central focus within the pre security terminal plan. It will be strategically located between the International and Domestic facilities and in the path of passenger flow between check in and pre board screening. Preliminary thoughts are that it could become an “Okanagan Market” themed area. Phase 5 design plans include the leveling of the rotunda floor and revisions to the feature stair to open up the space available to retail / food and beverage. Landscape plans are for an outdoor patio accessible from the rotunda to increase seating areas available and to provide the opportunity for an outdoor café environment.
- Retail offerings should focus on Okanagan regional products and services.
- The hold room expansion will allow for key exterior views to the mountains and airfield to the east. This is a desirable area for waiting passengers, and for a key food and beverage unit to be located while preserving and enjoying the views described above.



1 2025 - Commercial Areas
1 : 300

RETAIL PLAN

RETAIL AREAS

LOCATION	PROVIDED 2015	RECOMMENDED 2015	DIFFERENCE	PROVIDED 2025	RECOMMENDED 2025	DIFFERENCE
Pre Security Retail (Total)	691.43 sm	831 sm	-139.57 sm	960.93 sm	1245 sm	-284.07 sm
- Landside Check-In	521 sm	622 sm	-101 sm	790.5 sm	934 sm	-143.5 sm
- International Arrivals	53.53 sm	19 sm	+34.53 sm	53.53 sm	27 sm	+26.53 sm
- Domestic Arrivals	116.9 sm	190 sm	-73.1 sm	116.9 sm	284 sm	-167.1 sm
Post Security Retail (Total)	1003.86 sm	784 sm	+219.86 sm	1003.86 sm	1178 sm	-174.14 sm
- Domestic & International Departures	729.23 sm	697 sm	+32.23 sm	729.23 sm	1,048 sm	-318.77 sm
- Transborder Departures	274.63 sm	87 sm	+187.63 sm	274.63 sm	130 sm	+144.63 sm

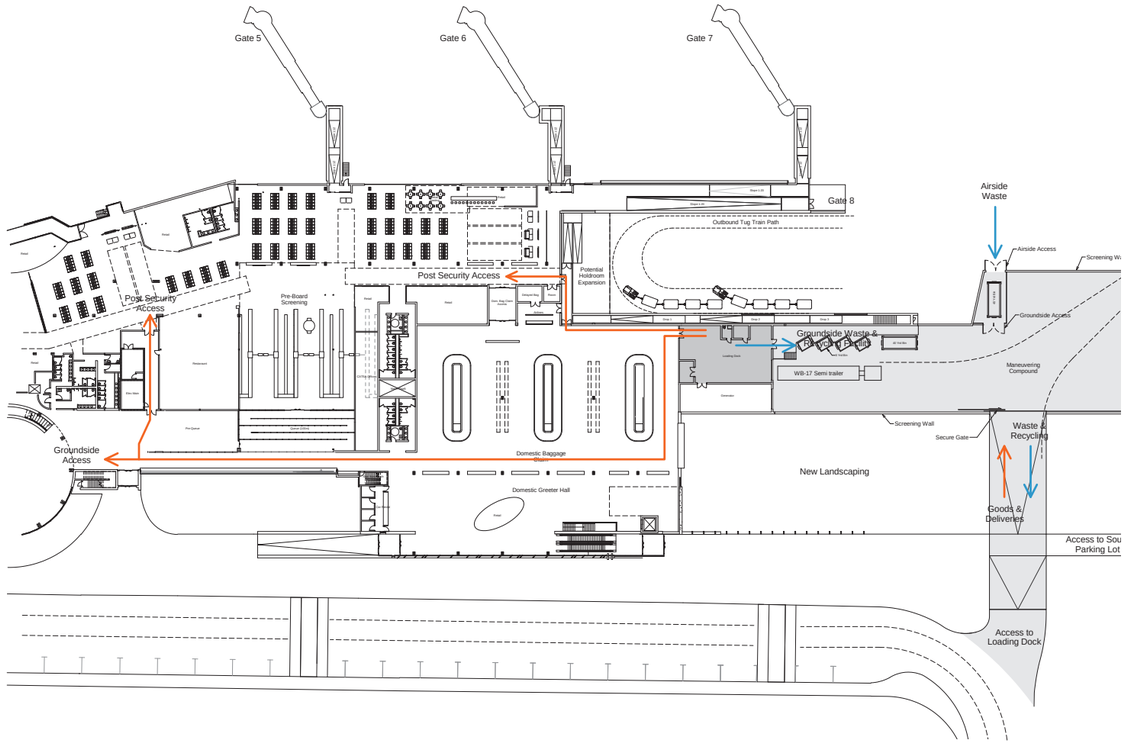
Material Management

The existing terminal does not have a dedicated loading or waste handling facility. Movement of goods and waste is via the curbside and directly through the main passenger entry doors.

The schematic design provides for an interior loading facility with one truck dock and an exterior area for waste bins, all within a new material management area to the south of the terminal expansion. An airside waste bin is strategically located along the airside fence. International waste will continue to use a bin on the north side of the terminal airfield. Truck access is off the curbside access roadway, removing movement of material away from the front entry doors.

Access doors to the loading and waste facility are at the south wall of the domestic claim hall. Movement of goods will be arranged for off peak times.

These facilities are to be provided over time. All exterior facilities and access to the terminal are planned to occur coincident with the Phase 3 expansion of the holdroom, domestic claim and meeter greeter facilities. The interior dock is included in the beyond phase plans.



6.3 Materials and Finishes Matrix

Durability will be considered a guiding design principle. The number of passengers using the facility mandates the performance of all materials be maximized. Material durability, ease of maintenance and long-term management are important to the success of an airport environment. Sustainability, Cost, obsolescence, acoustic and aesthetic characteristics are strong factors and will be carefully considered.

An Interior Finishes Matrix has been developed and is included on the following pages. The intent of this matrix is to systematically categorize numerous finish options and strategically apply them to meet the functional needs of particular spaces. This will allow viable materials to be explored in the design, performance, budgeting and specification phases. The process will involve as need testing on an area-by-area basis ... ultimately to arrive at an optimum solution.

In addition to the aforementioned considerations, particularly durability, the following will be explored:

Flooring

- Incorporation of safe, non slip surfaces
- Implementation of appropriate acoustic attenuation for movement of carts and personal baggage
- Consideration of navigation for the physically challenged

Baseboards

- Establishment of optimum and consistent heights to accept day-to-day bumps and reduce marring
- Consideration of the butting of adjacent horizontal and vertical surfaces

Partitions

- Development of wall protection to better accept traffic abuse, reduce marring and control vandalism
- Application of textures, particularly in the context of the Regional vocabulary
- Utilization of softening materials strategically place for sound deadening
- Use of glazing units to maximize light transference, yet respectful of security and safety mandates

Ceilings

- Application of acoustic panels for sound softening and attenuation
- Develop appropriate finishes to reduce obvious visual buildup of dust

Fittings

- Utilization of safe, solid, vandal proof materials (i.e. Washroom accessories and cubicles)
- Consideration of personal hygiene at 'touch' zones
- Appropriate use of hooks, ledges, shelves for passenger convenience and care of infants

Colour

- Use of 'response appropriate' colours (quiet vs. active, warm vs. cool, directional vs. decorative, cautionary vs. neutral)
- Consideration of navigation for the visually challenged
- Sensitivity to art, graphics and signage colours and appropriate placement to maximize impact
- Use of natural colour in natural materials ... not applied or tacit decoration

INTERIOR FINISHES MATRIX – A

LEGEND

SDT	Static Dissipative Tile
SF	Safety Flooring
GL	Glazing
SPF	Sports Flooring
ISP	Integral Safety Strip
MIR	Mirrors
EPX	Epoxy Flooring
DP	Demountable Partitions
HPP	High Performance Paint
MG	Metal Grate
AWT	Acoustic Wall Treatment
PB	Painted Base
•	Environmentally Preferred
FRW	Fire Rated Wood Backing

								Base					Wall				Ceiling			
			Porcelain Tile (Calibrated Rectified Edge)	Resilient Flooring: Linoleum	Resilient Flooring: Rubber Flooring	Resilient Flooring: Decorative	Carpet: 1.8m with Structured Backing	Specialty Material for Public Areas	Stainless Steel Base	Porcelain Tile/ Stone Base (Calibrated Rectified Edge)	Integral Resilient Base: With adjacent flooring	Applied Resilient Base: Rubber Cove Base	Specialty Material for Public Areas	Paint	Porcelain/ Ceramic Tile	Wall Protection	Specialty Material for Public Areas	Paint	Lay-in Acoustic Ceiling Tile	Exposed Structure	Specialty Material for Public Areas
TYPICAL ROOMS AND AREAS	**1.0**	**PUBLIC AREAS – FRONT OF HOUSE**																			
	1.1	Departures/ Arrivals Concourse	•						•				•	•		•	•	•	•	•	•
	1.2	Meeter Greeter Hall	•				•		•	•			•	•		•	•	•	•	•	•
	1.3	Concourses within Hold Rooms	•						•				•	•		•	•	•	•	•	•
	1.4	Public Washrooms	•						•	•					•				•		
	1.5	Elevators (Public)	•						•				•								
	1.6	Baggage Claim	•						•					•		•	•		•		•
	1.7	Holdrooms	•				•		•					•	•	•	•	•	•		•
	2.0	**PUBLIC AREAS – BACK OF HOUSE**																			
	2.1	Processing Corridors			•				•					•		•		•	•		
	2.2	Fixed Links/ Boarding Zones			•				•					•		•					
	3.0	**PUBLIC AREAS - AGENCY**																			
	3.1	CBSA Primary	•						•					•		•	GL	•	•		•
	3.2	CBSA Secondary	•						•					•		•		•	•		
	3.35	CATSA Pre-Board Screening	•						•					•		•	GL	•	•		
	4.0	**BASE BUILDING – FIT UP ONLY**																			
	4.1	Retail (Fit- up by Retailer)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4.2	Food Services (Fit-up by Retailer)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Exterior Finishes

- **Glazing** – Double Glazed High Performance Coatings High Visibility on Clear
- **Rammed Earth Construction** – Pigmented Concrete hand tamped in layers
- **Fibre Cement Panels** – Non-exposed fasteners
- **Roofing** – Single Ply Membrane TPO high albedo

INTERIOR FINISHES MATRIX – B

LEGEND

SDT	Static Dissipative Tile	DP	Demountable Partitions
SF	Safety Flooring	HPP	High Performance Paint
GL	Glazing	MG	Metal Grate
SPF	Sports Flooring	AWT	Acoustic Wall Treatment
ISP	Integral Safety Strip	PB	Painted Base
MIR	Mirrors	•	Environmentally Preferred
EPX	Epoxy Flooring	FRW	Fire Rated Wood Backing

		Floor						Base					Wall				Ceiling			
		Concrete: Sealed	Porcelain Tile (calibrated Recti-fied Edge)	Resilient Floor: Rubber Flooring	Carpet: 1.8m with Structured Backing	VCT/ Sheet Flooring	Speciality Materials	Stainless Steel Base	Porcelain Tile (calibrated Recti-fied Edge)	Integral Resilient Base: With adjacent Flooring	Applied Resilient Base: Rubber Cove Base	Speciality Materials	Paint	Porcelain/ Ceramic Tile	Wall Protection	Specialty Material	Paint	Lay-in Acoustic Ceiling Board	Exposed Structure	Specialty Material
TYPICAL ROOMS AND AREAS																				
5.0	**AGENCY OFFICE AREAS**																			
5.1	Private Offices				•						●		●				●	•		
5.2	General Offices/Clerical Workstations				•						●		●				●	•		
5.3	File/Supply/Workrooms			●		•					●		●				●	•		
5.4	Coffee Stations/ Lunchrooms			●		•					●		●	•	•		●	•		
5.5	Meeting Rooms/ Conference Rooms				•						●		●			AWT	•	•		
5.6	Staff Lounges			●	•						●		●					•		
5.7	Staff Lockers/ Showers/ Washrooms		•						•				●	•			•			
6.0	**SERVICE**																			
6.1	Loading Dock/Shipping/ Receiving	•									●		●						•	
6.2	Janitorial Rooms	•									●		●	•	•		•			
6.3	Electrical	•									●		●			FRW	•		•	
6.4	Mechanical	•									●		●				•		•	
6.5	IT Data	•				•	SDT				●		●			FRW	•	•		
6.6	Exit Stairs	•					ISP						●				●		•	
6.7	Service/ Utility Corridors	•										PB	●		•		●	•	•	
7.0	**BAGGAGE HANDLING**																			
7.1	Baggage Handling	•										PB	●		•		●		•	

7.0 PHASING

The Schematic Design is intended to be built in 5 phases of construction, the first four of which are currently scheduled to be complete by 2016. The fifth phase of development will be built as demand requires. The following drawings indicate the scope for each phase, as well as interim phases that will be required to accommodate continuing operations and sequencing of construction. A brief description of each phase is as follows:

Phase 1 – CBSA PIL / TRANSBORDER HOLDROOM
(Schedule to be determined following CBSA acceptance of concept design)

This first phase provides for an expansion to accommodate CBSA PIL. This is the first step in meeting regulatory requirements and will provide for passengers to be screened prior to accessing their baggage. This phase also includes minor retrofits to the hold room to remove the existing segregated Transborder hold room, install a moveable partition to position transborder passengers at the north end of the hold room, adjustments to the locations of some boarding podiums and one retail location.

Phase 2 – Outbound Bag Make –up Hall and Airside Corridor Retrofit
(tentative delivery 2012)

This phase expands the outbound baggage make up hall to the east of the airside corridor and provides for a drive through facility. Security screening systems for baggage will be located in the existing outbound bag hall. At the same time the airside corridor will be renovated to remove the ramp and provide a level corridor*. This phase will also see the inclusion of a new generator to the south of the terminal.

**See comment under 6.1 Passenger Flow and Vertical Circulation*

Phase 3 – Domestic Arrivals Facilities
(tentative delivery 2013)

This phase will be a major expansion to provide for a new and separate domestic arrivals facility. An expansion to the holdroom, a new domestic baggage claim hall, new domestic meeter greeter hall and the leveling of the existing ramp to the south parking lot as well as a new second floor mechanical room are the major components to this phase. Significant associated site work will be done to the south of the expansion to provide for a domestic bag drop area and a loading and waste pick up zone.

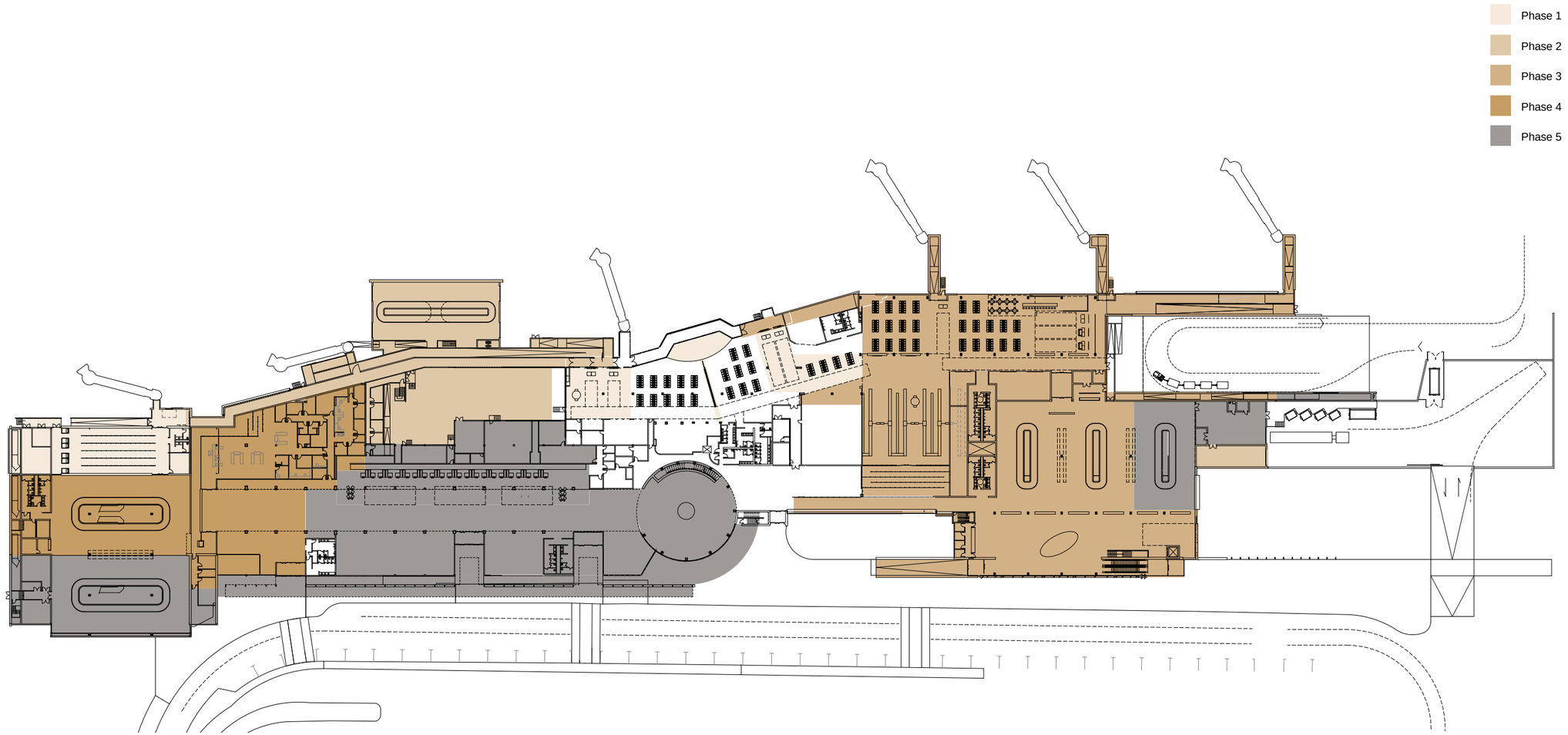
Phase 4 – International Arrivals Facilities
(tentative delivery 2015)

Once the domestic arrivals facility is complete and domestic passengers are no longer using the north bag claim area, it is possible to build a new international baggage claim hall, expanded CBSA secondary and dedicated meeter greeter facility.

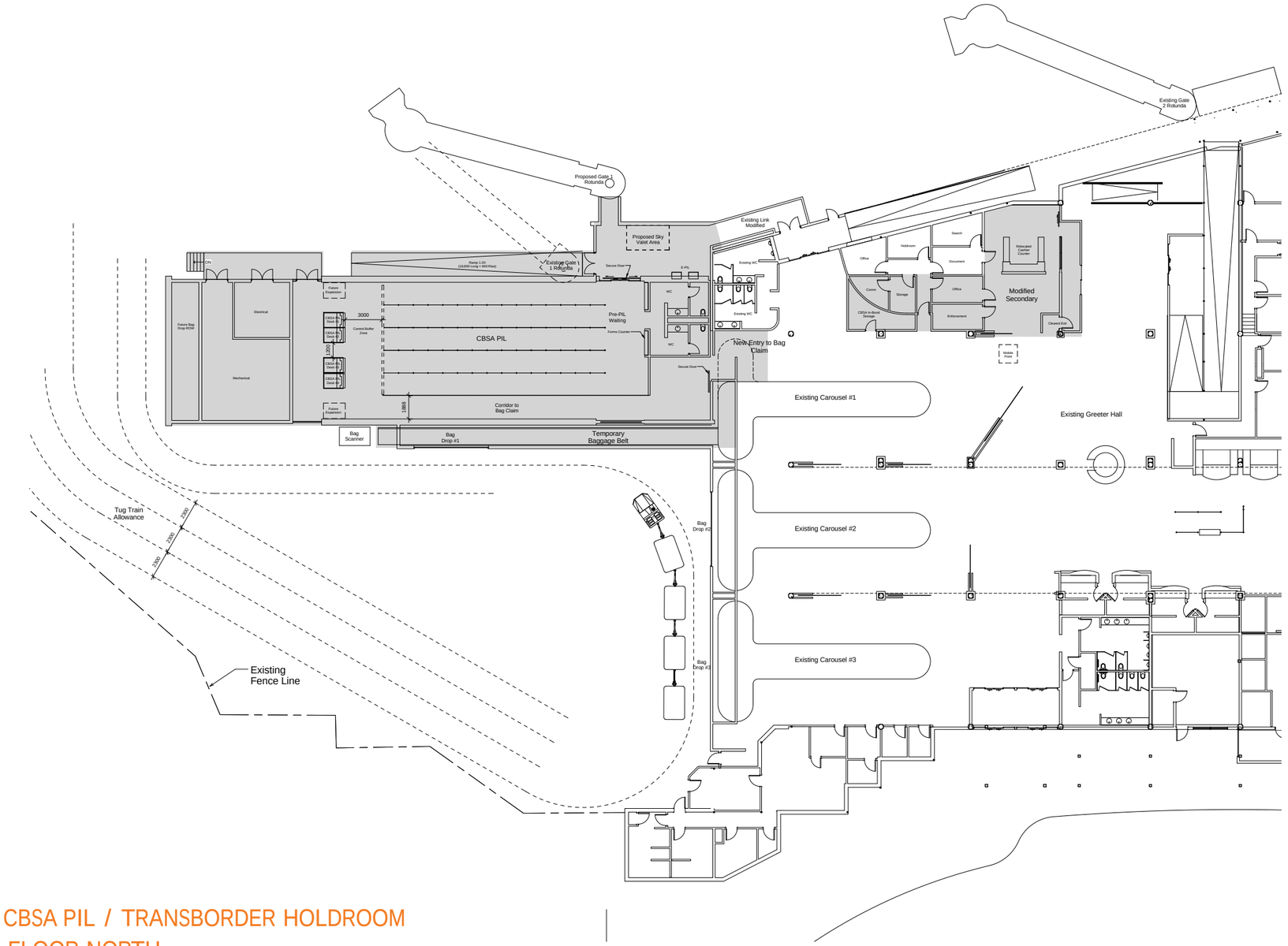
Phase 5 - Check In Hall / International Meeter Greeter Retrofits / Claim Hall Expansions
(delivery to be determined by demand)

Long term plans look to expanding the Check in Hall by moving the existing washrooms and providing more check in counter space. Desks will be moved to align with the existing West Jet counters. Retail will be expanded to the west and into the rotunda with retrofits to level the floor in the rotunda and revising the stair to the observation deck. Both International and Domestic baggage claim halls are expanded to receive one more carousel each.

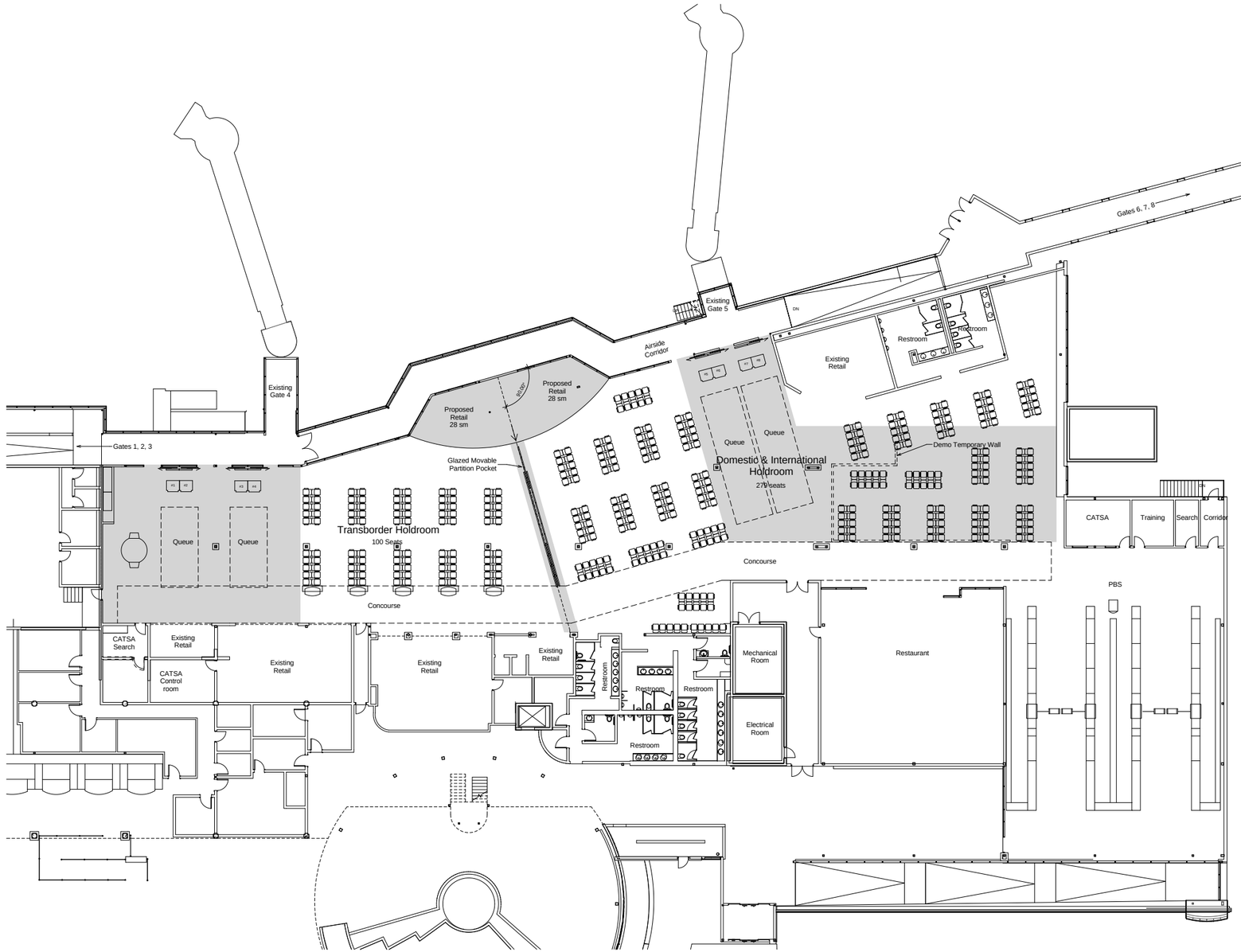
During the Design Development Phase the consultant team and the airport and airline operations teams will review and prepare detailed phasing plans for each of these five planned phases to ensure seamless continuing operations. These plans will take into account seasonal airline travel peaks; access to critical areas and constructor access.



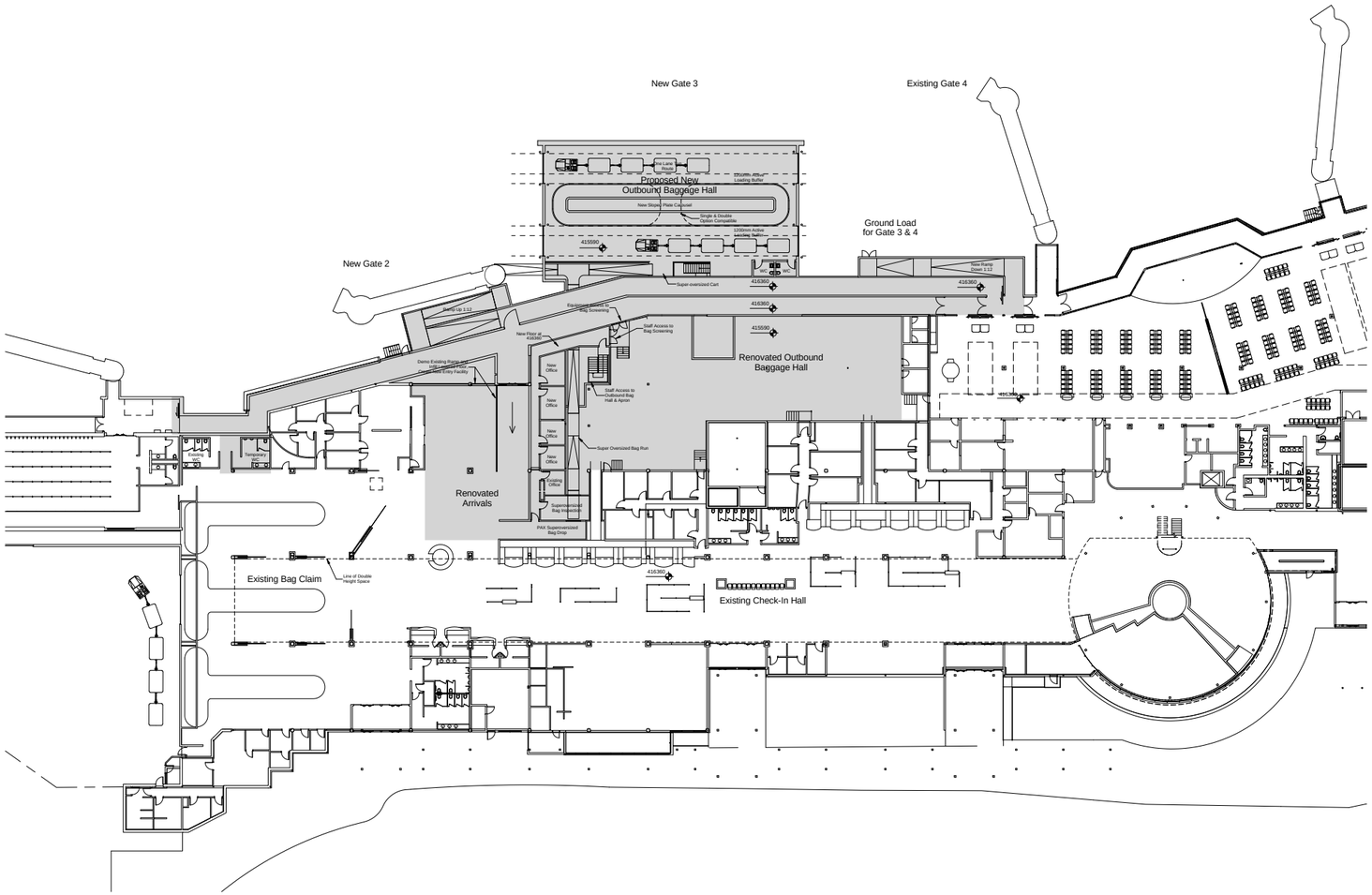
PHASING DIAGRAMME



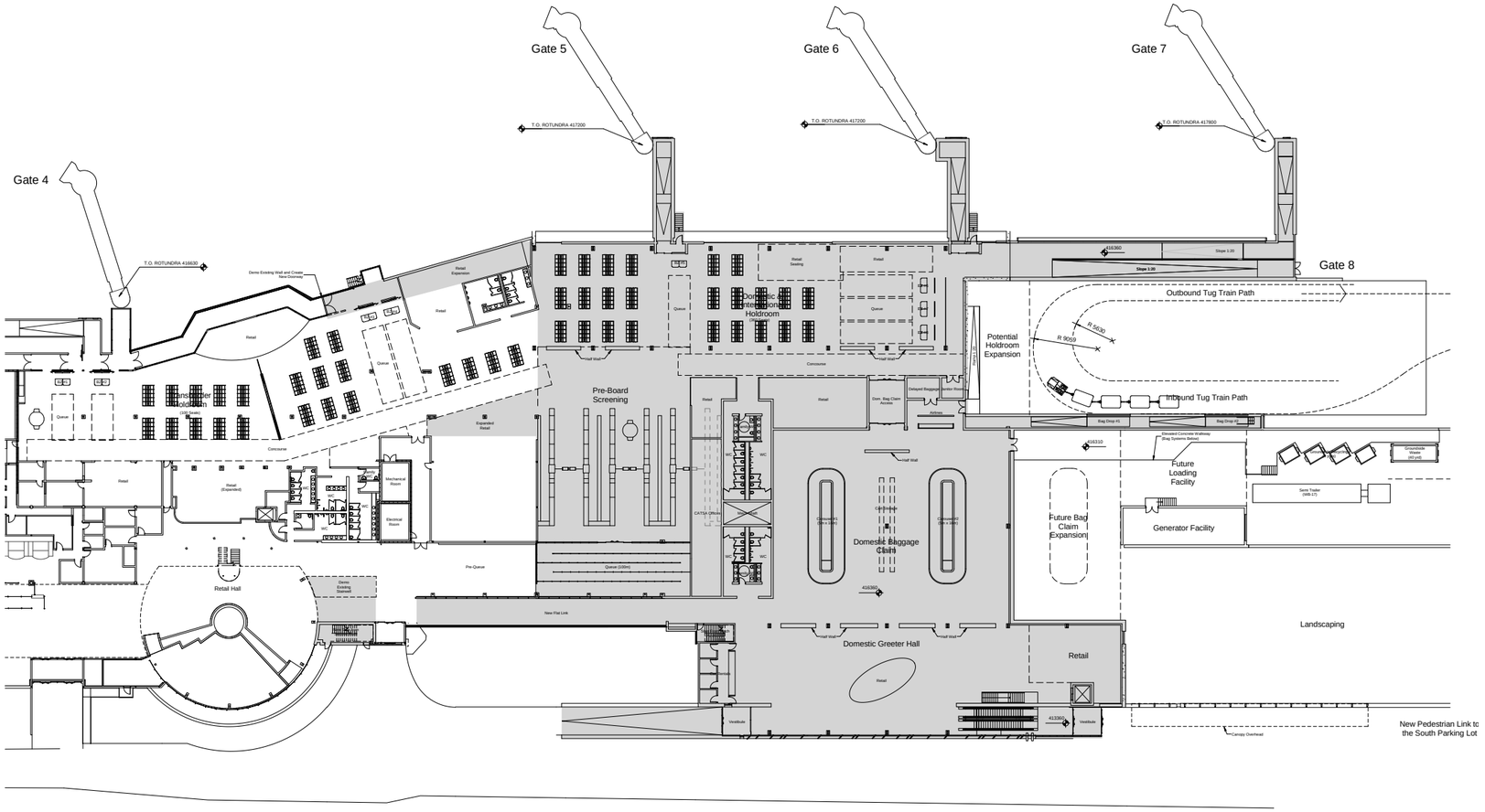
PHASE 1 CBSA PIL / TRANSBORDER HOLDROOM GROUND FLOOR NORTH



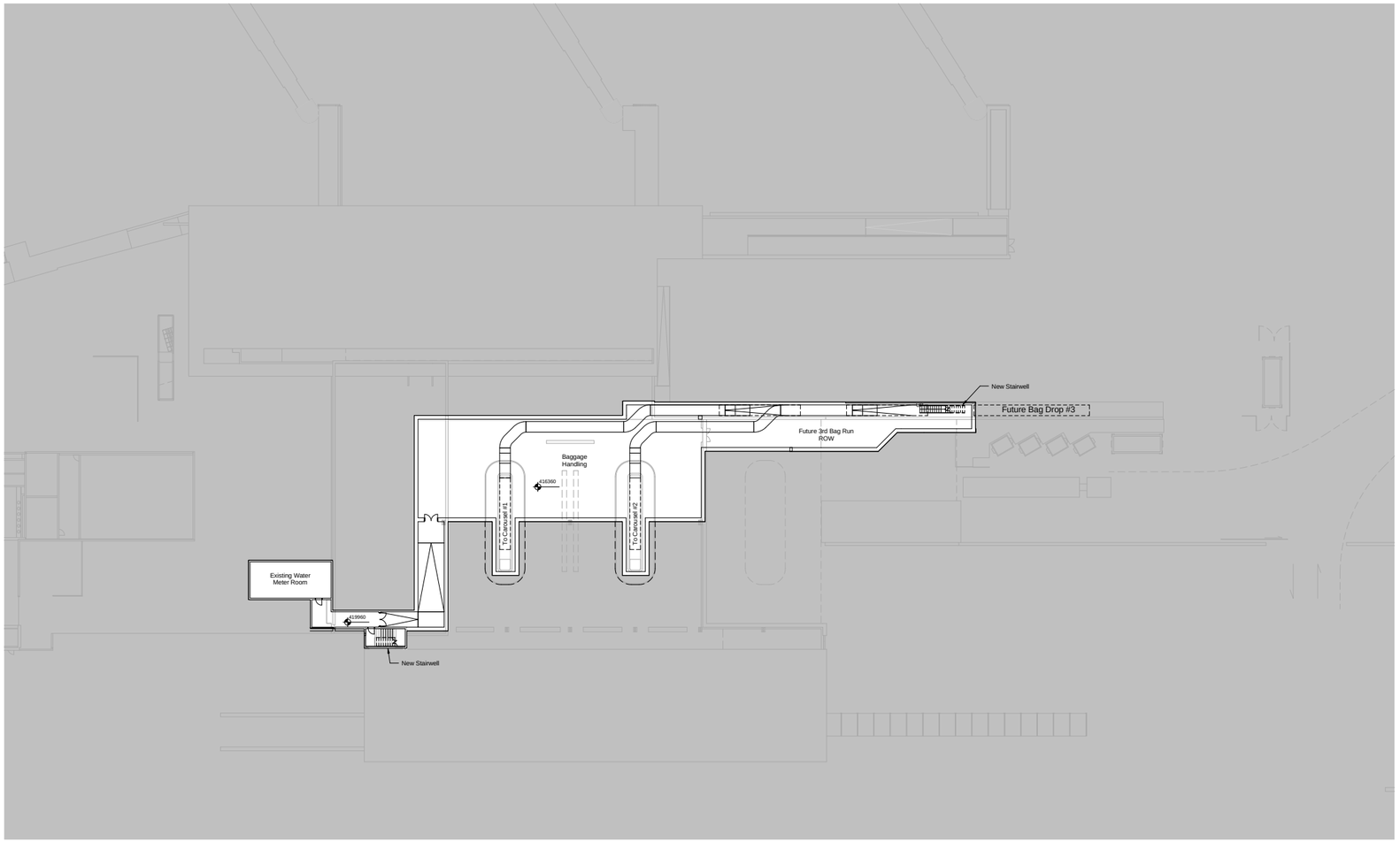
PHASE 1 CBSA PIL / TRANSBORDER HOLDROOM
GROUND FLOOR SOUTH



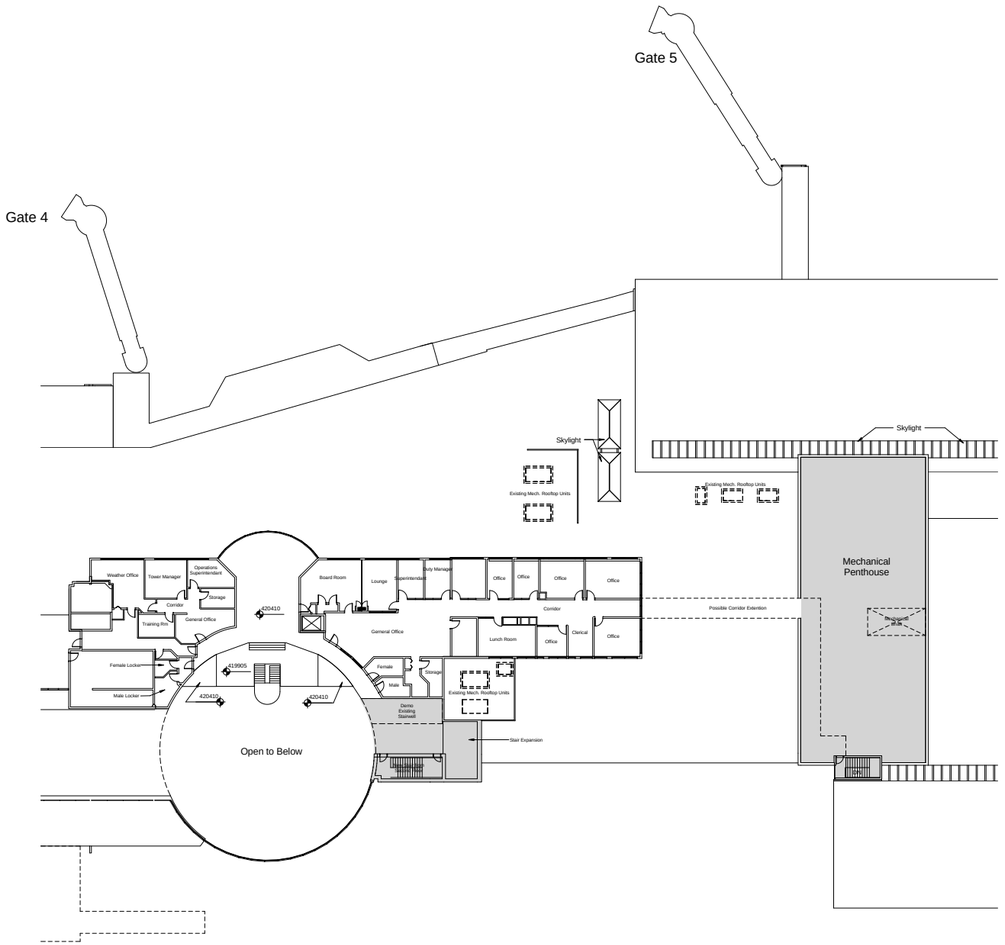
PHASE 2 OUTBOUND BAGGAGE MAKE UP HALL / AIRSIDE CORRIDOR
GROUND FLOOR



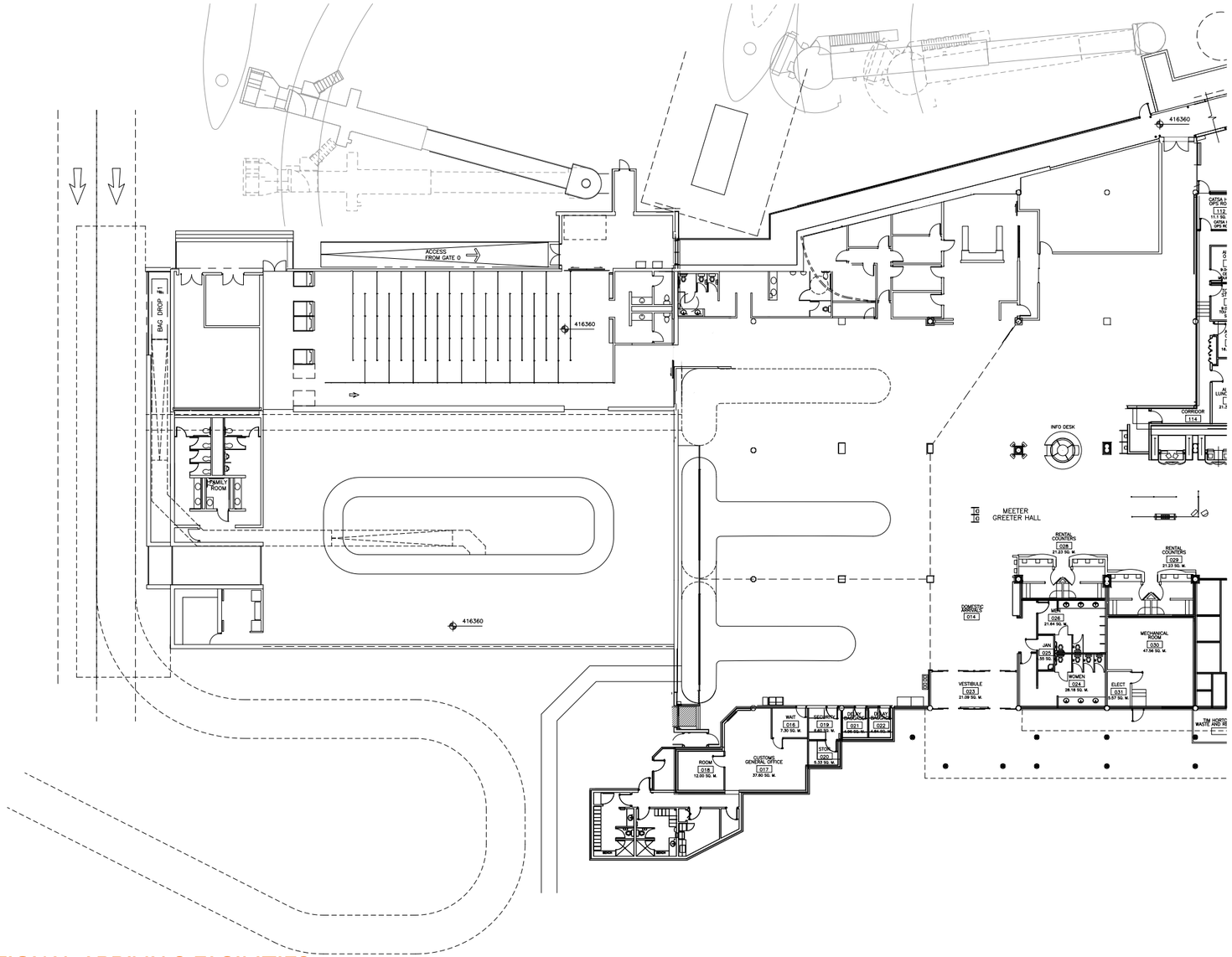
PHASE 3 DOMESTIC ARRIVALS FACILITIES
GROUND FLOOR



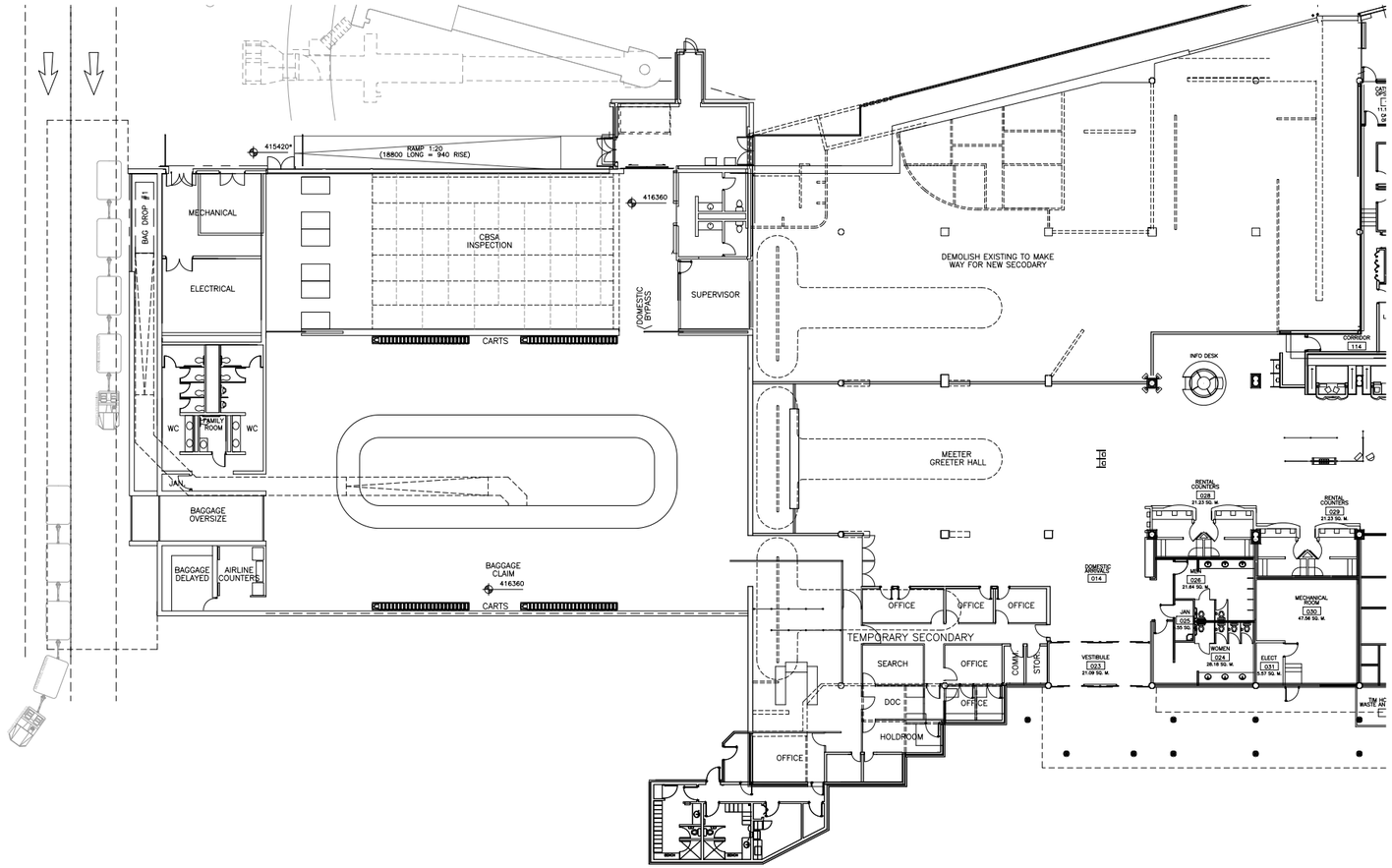
PHASE 3 DOMESTIC ARRIVALS FACILITIES
BASEMENT



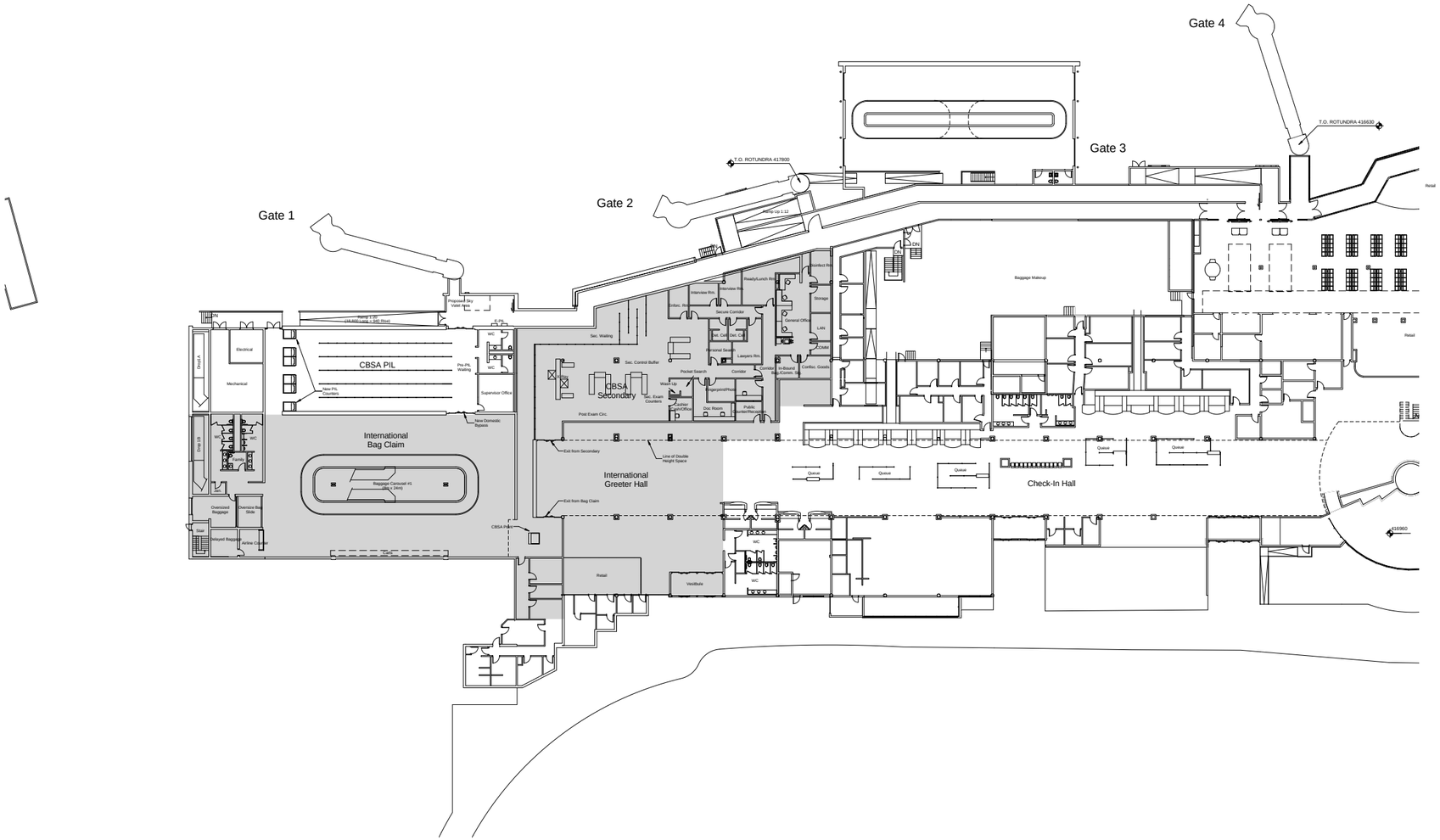
PHASE 3 DOMESTIC ARRIVALS FACILITIES
SECOND FLOOR



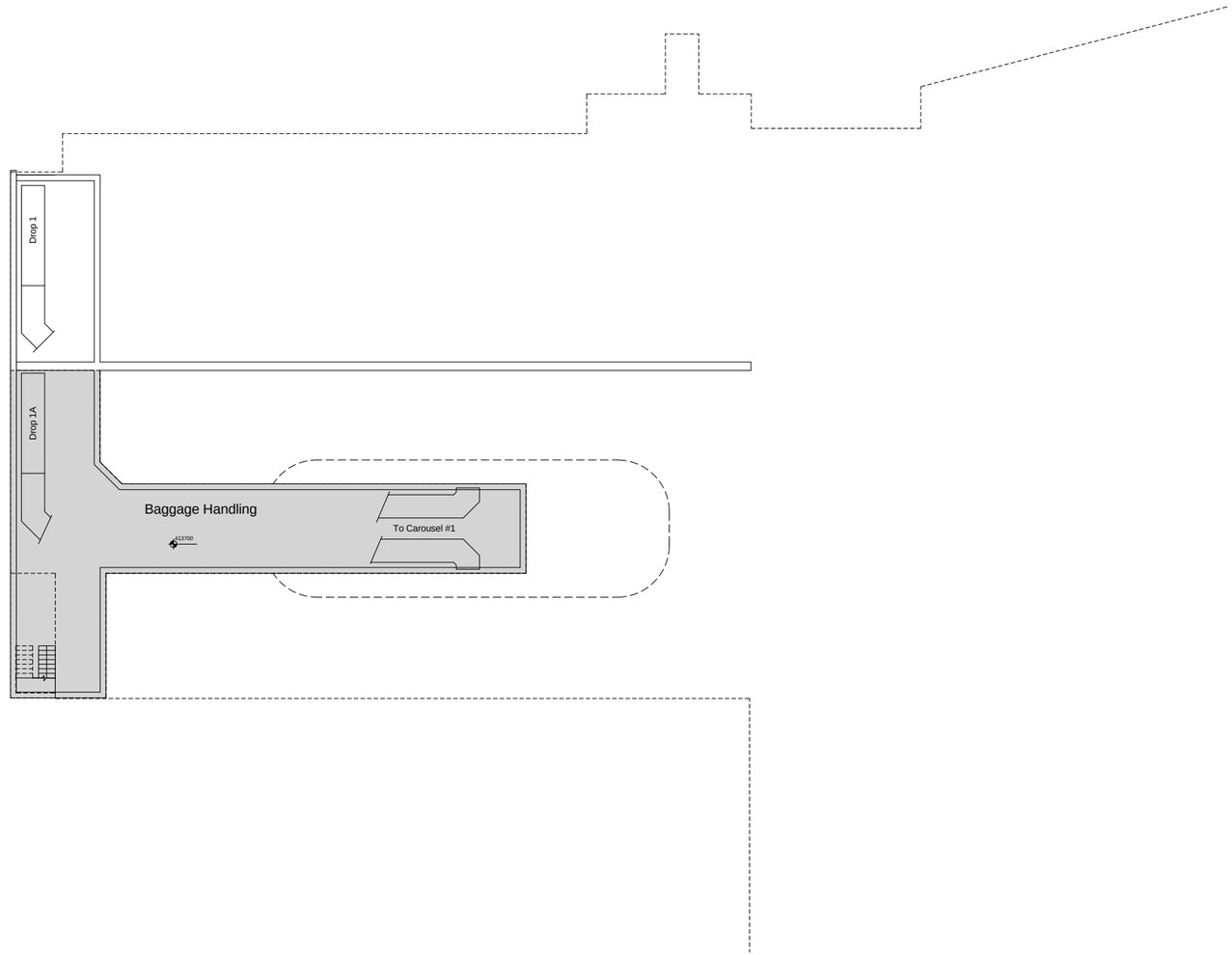
PHASE 4 INTERNATIONAL ARRIVALS FACILITIES
GROUND FLOOR – STEP 1



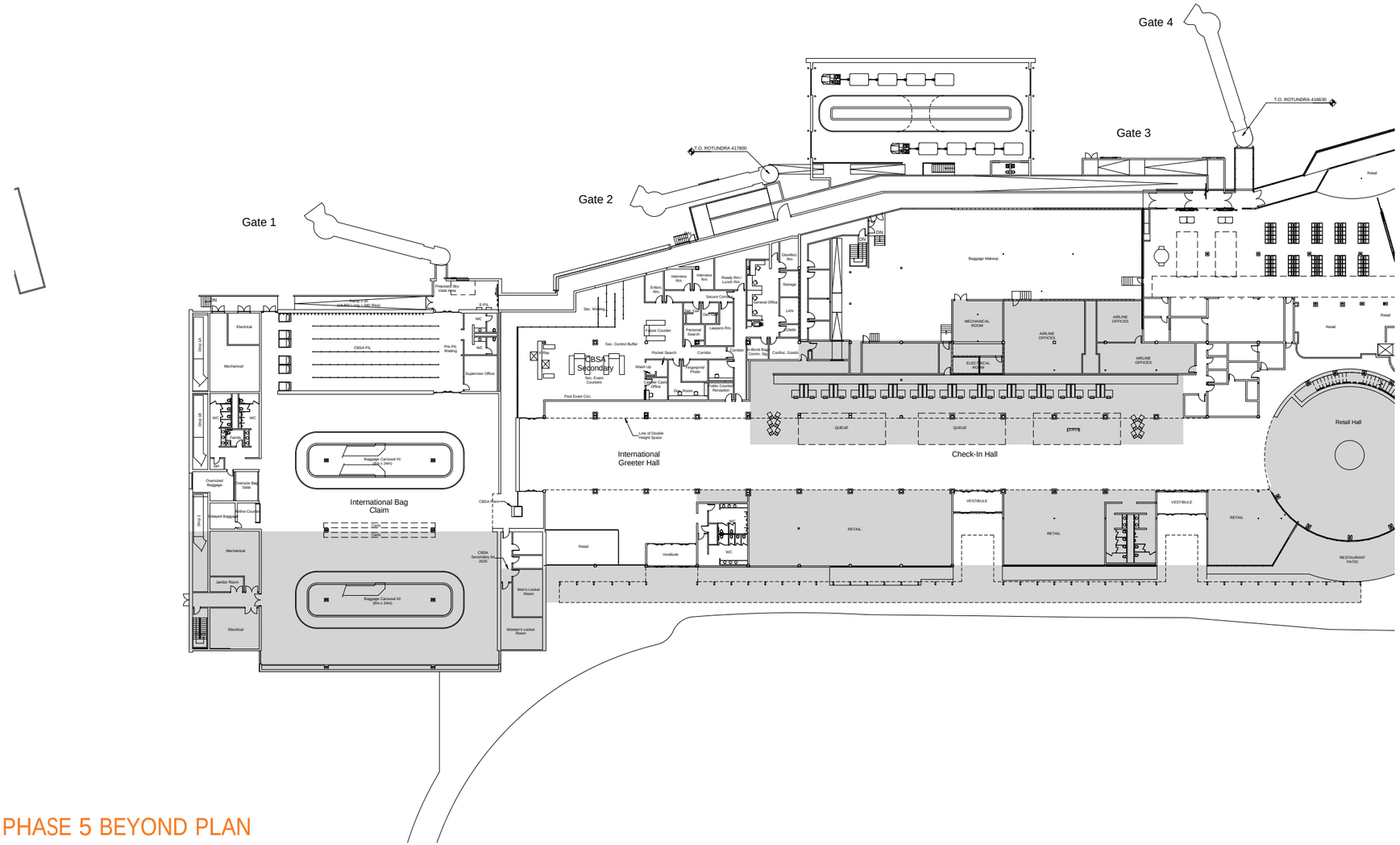
PHASE 4 INTERNATIONAL ARRIVALS FACILITIES
GROUND FLOOR – STEP 2



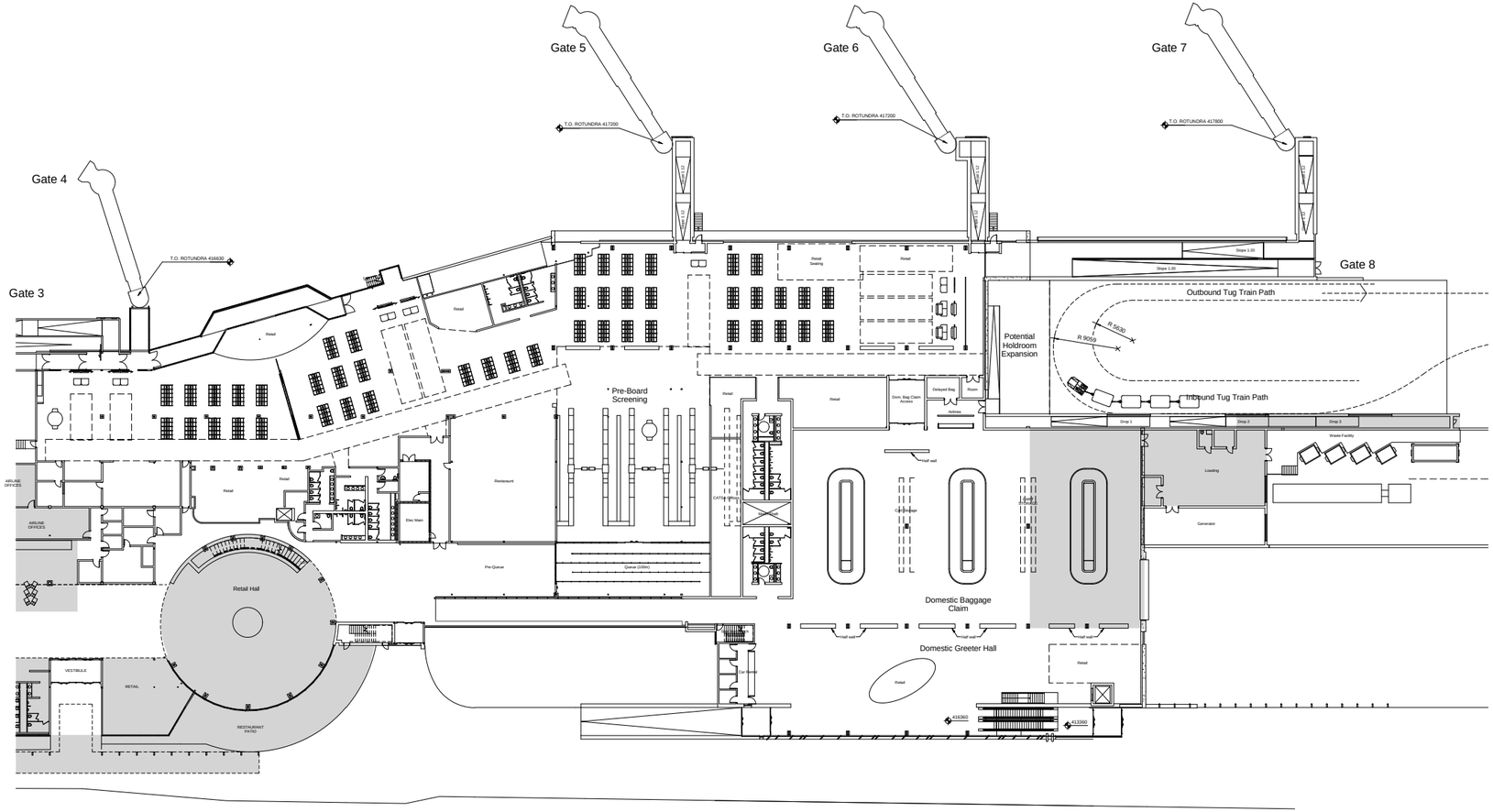
PHASE 4 INTERNATIONAL ARRIVALS FACILITIES
GROUND FLOOR – STEP 3



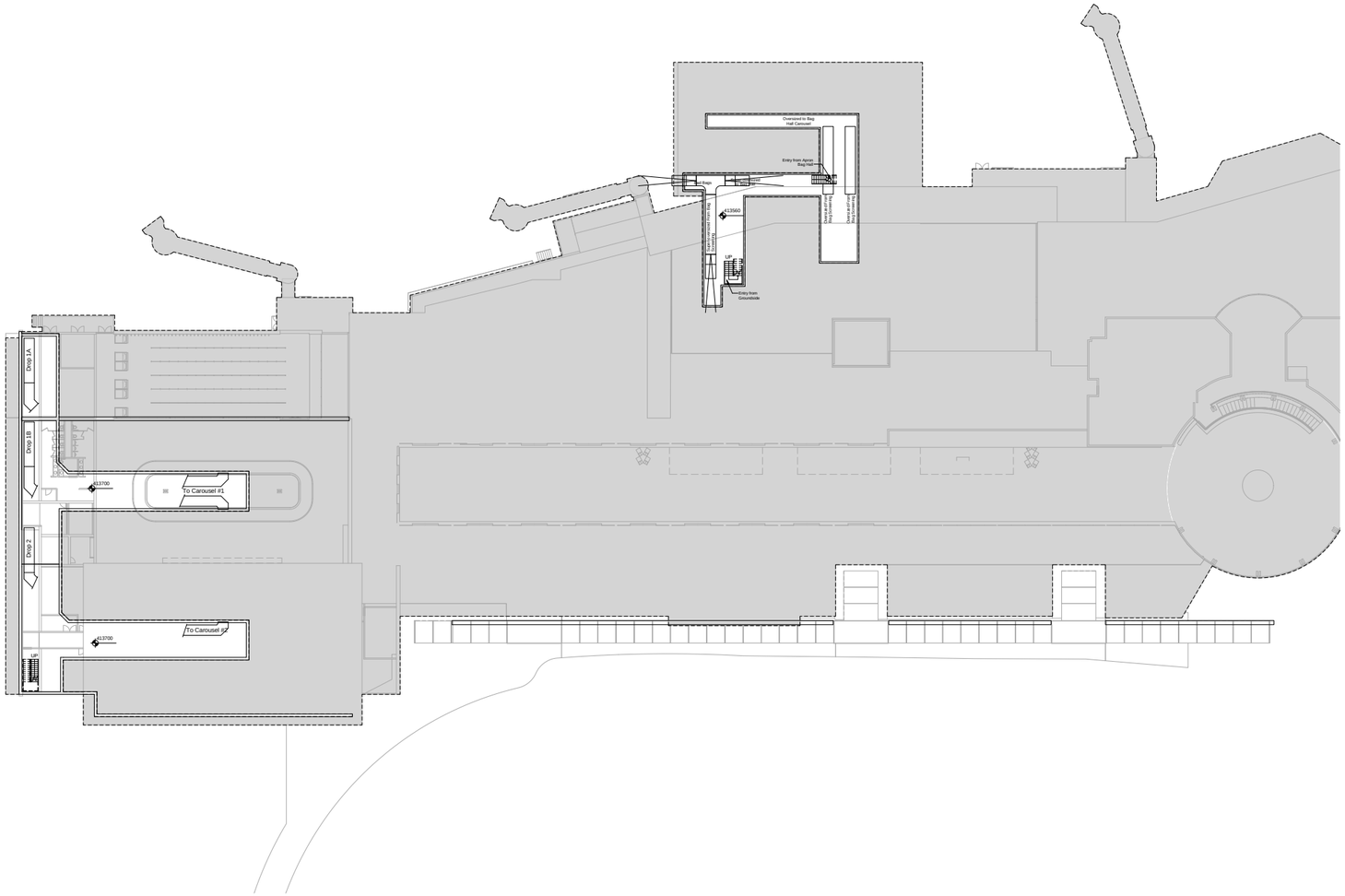
PHASE 4 INTERNATIONAL ARRIVALS FACILITIES
BASEMENT



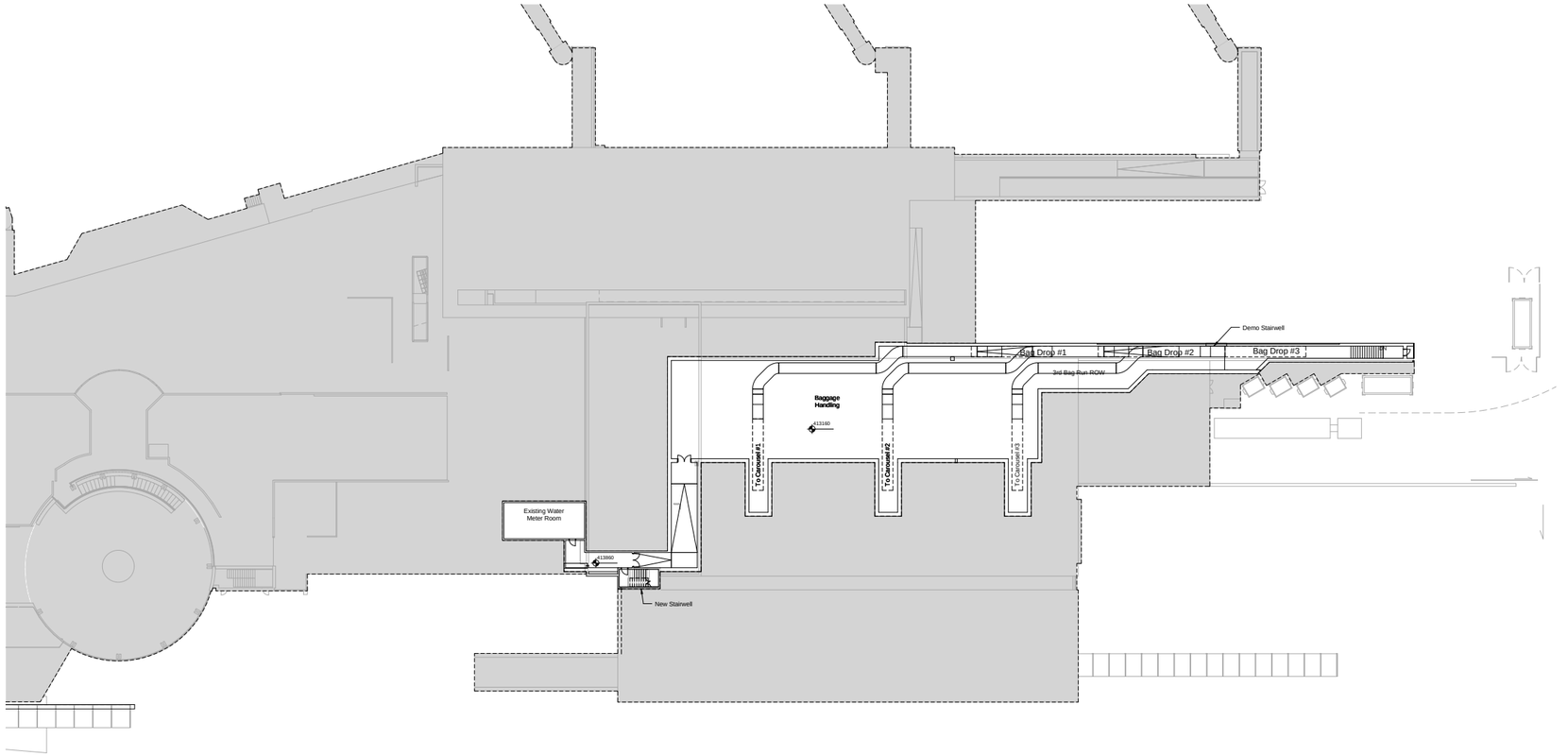
PHASE 5 BEYOND PLAN
GROUND FLOOR NORTH



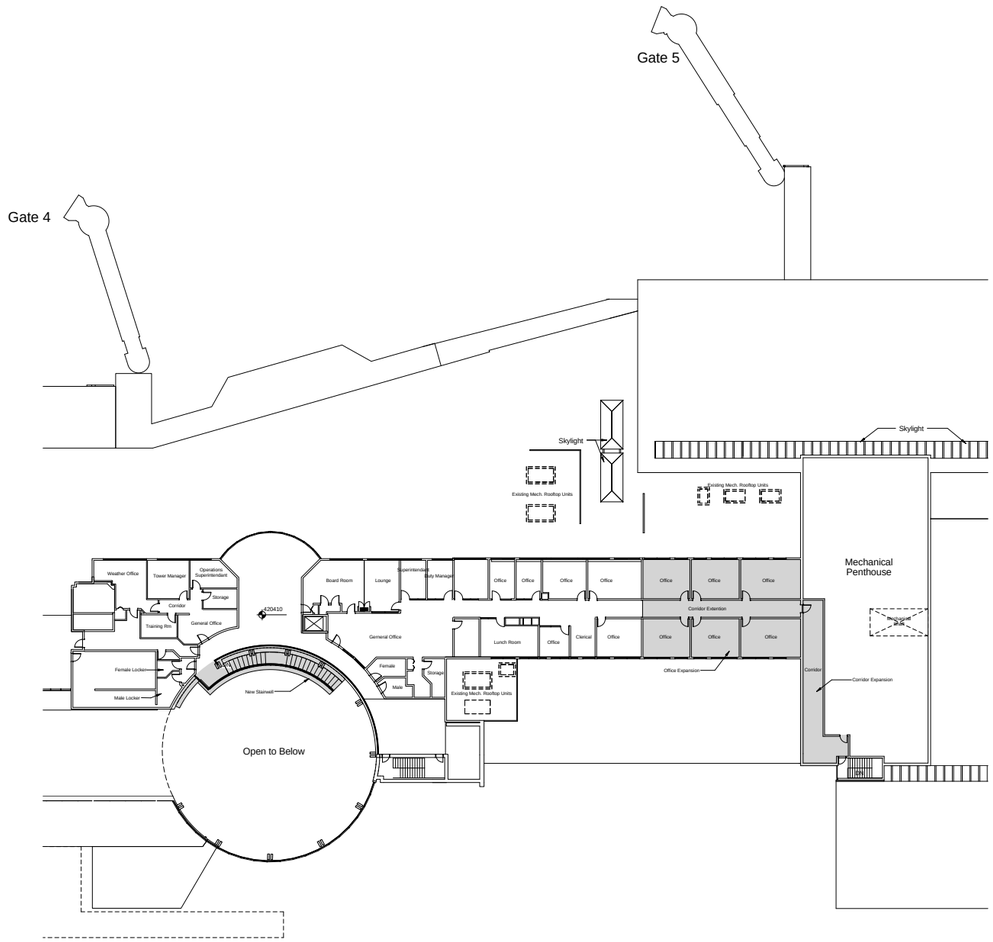
PHASE 5 BEYOND PLAN
GROUND FLOOR SOUTH



PHASE 5 BEYOND PLAN
BASEMENT NORTH



PHASE 5 BEYOND PLAN
BASEMENT SOUTH



PHASE 5 BEYOND PLAN
SECOND FLOOR

8.0 MECHANICAL SYSTEMS

GENERAL OVERVIEW

Introduction

This report defines the proposed HVAC, controls and BMS, plumbing, fire protection and life safety systems for the YLW Kelowna Airport Expansion. Mechanical systems have been selected to address the service needs generated by airport passenger traffic projections and realignment of international and domestic gates.

Estimates of mechanical system capacities have been based on preliminary cooling and heating load calculations and preliminary architectural layouts. System capacities will be finalized with detailed heating and cooling load calculations through the design development phase and in conjunction with the details of the building envelope construction to be developed by the architectural team.

General Mechanical Design Criteria are as follows;

- Cost Effective Design for the Mechanical Systems. This is particularly important to obtain the best mechanical value in terms of life cycle while meeting the budget constraints.
- High ventilation effectiveness for increased indoor air quality. The general mechanical HVAC design concept of Airport Facilities is to provide sufficient ventilation to support high occupant loads that vary depending on flight schedules, security processing, holding, and baggage claim requirements. It is undesirable, however, to continue to supply high outdoor air rates to unoccupied areas. At the Kelowna Airport, there may be long time periods with minimal occupancy in some areas.
- Utilize hydronic based systems wherever possible to save fan energy utilized by continuously operated fan systems.
- Limit water use in the new facility while maintaining important characteristics such as maintainability and performance for plumbing fixtures.
- Reduce energy usage wherever possible to provide long term sustainable performance from the facility.
- Flexibility in servicing common spaces to allow for future renovations.
- Elegance and simplicity of design to allow ease of operation of the mechanical systems.
- Reduction of the Carbon footprint for the existing and new airport expansion to levels below the existing condition today, even with a substantial increase in floor area.

Design Criteria

Design Criteria for the typical room types has followed BC Building Code and ASHRAE Guidelines as follows:

- Heating and Cooling capacities will be based on the following criteria for peak winter design conditions, and defined in the BC Building Code.
  - » Outdoor design temperature: -20°C 1% winter design condition, 33°C DB/20°C WB 2.5% summer design conditions as prescribed in the BC Building Code. The percentages indicate for example that 99% of the time the temperature will be above -20°C and 97.5% of the time the temperature will be below 33°C.
  - » In addition, ASHRAE weather data will be used to determine dehumidification conditions for the space. Therefore, the 1% dehumidification condition for Kelowna is 14.6°C dewpoint at 20.7°C dry bulb, which is the most humid outdoor condition.
  - » Indoor space temperature: 21°C winter, 24°C summer.
  - » Indoor space relative humidity to be maintained at a maximum of 60% in summer and will not be controlled in the winter. The intent is not to provide humidification for the air handling units.
  - » Elevation = 350 m, Rainfall = 10 mm in 15 minutes
  - » Seismic Data Sa(0.2)=0.28, Sa(0.5)=0.17, Sa(1.0)=0.094, Sa(2.0)=0.056, PGA=0.14

- Load calculations have been carried out to determine the building envelope heat loss. Overall thermal resistance values in walls, roof and glazing have been calculated using catalogued data and methods in ASHRAE. This work has been closely coordinated with the rest of the design team and represents recommended values from the Energy Analysis.
- Overall "R" values for the building envelope exceed those prescribed in the National Energy Code. The assumed R values for the walls are RSI 4.07 (R23.1), roofs are RSI 5.42 (R30.8), and the windows are high performance with an USI 0.99 (R5.75) with a Solar Heat Gain Coefficient SHGC = 0.30 (shading coefficient of 0.26). The windows are currently selected as triple glazed, this is to be confirmed during value analysis. This may drop the window performance, which will have to be compensated by the mechanical heating and cooling systems.
- High thermal massing has been assumed utilizing the concrete floor as the primary mass element (Note: without carpet), as well as utilizing rammed earth walls strategically placed in the space, and block walls that would typically be provided for some rooms. The added thermal mass tends to lower the peak heating and cooling loads and even out the heating and cooling loads in the space over the day.

Code and Code-Referenced Standards

The mechanical system design will be in accordance with all applicable codes and regulations of the local inspection authorities having jurisdiction, and City of Kelowna requirements.

- BC Building Code 2006
- BC Fire Code 2006
- BC Building Code – Plumbing Services Part 7 2006
- National Plumbing Code of Canada current edition
- ASHRAE 55 – Thermal Environmental Conditions for Human Occupancy
- ASHRAE 62.1 – Ventilation for Acceptable Indoor Air Quality
- CSA B51 Boiler, Pressure Vessel and Pressure Piping Code.
- CSA B52 Mechanical Refrigeration Code.
- CSA B64.10 Manual for the Maintenance and Field Testing of Backflow Prevention Devices
- CSA B149.1 Natural Gas Installation Code
- National Fire Protection Association (NFPA) Standards:
  - NFPA 10: Portable Fire Extinguishers
  - NFPA 13: Installation of Sprinkler Systems
  - NFPA 14: Installation of Standpipe and Hose Systems
  - NFPA 90A: Installation of Air Conditioning and Ventilation Systems
  - NFPA 96: Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations
- SMACNA Standards for Ductwork and IAQ During Construction

Standards and Guidelines

The Mechanical Systems will be designed to meet the following Standards and Guidelines:

- Model National Energy Code of Canada current edition
- ASHRAE 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings
- LEED NC 1.0 – New Construction

Ventilation Calculations

Ventilation rates to the spaces have been calculated based on ASHRAE 62.1, assumed occupancy rates, and space type. The intent of the mechanical system design is to de-couple ventilation requirements from cooling loads, therefore the assumed ventilation rates determine air handling unit sizes.

The International CBSA and Bag Claim will be all new and will require a dedicated air handling unit to provide ventilation to all of the new spaces. The Domestic expansion is a mixture of new areas and renovation to existing areas. Therefore, some of the areas are partly served by existing equipment such as existing Screening Areas noted in bold.

NORTH SIDE	ZONE INFO						
	ASHRAE 62.1 AIR FLOW RATES						
	Area(sq ft)	People	cfm/ person	cfm/ft²	Max cfm	Min	Exhaust
CBSA	3,500	250	7.5	0.06	2,085	210	
CBSA Washroom	330			2.00			660
Bag. Claim North Int 1	6,600	200	7.5	0.06	1,896	396	
Bag. Claim North Int 2	8,400	200	7.5	0.06	2,004	504	
W2	688			2			1,376
Bag Delayed 1	363	2	5.0	0	32	22	
Mech Elec 1							
Mech Elec 2							
Total:	19,881				6,017 cfm	1,132 cfm	2,036 cfm

SOUTH SIDE	ZONE INFO						
	ASHRAE 62.1 AIR FLOW RATES						
	Area(sq ft)	People	cfm/ person	cfm/ft²	Max cfm	Min	Exhaust
Hallway7	2,860	0		0.06	172	172	
hold room east (new)	10,691	416	7.5	0.06	3,761	641	
Bag./Jen	244	0		0.06	15	15	
Office Area 12	388	2	5.0	0.06	33	23	
Entrance 1	419	0		0.06	25	25	
Retail 6	1,073	35	7.5	0.06	327	64	
W7	1,107			2.00			2,214
Retail 11	387	13	7.5	0.06	121	23	
Office Area 11	1,254	6	5.0	0.06	105	75	
W8	815			2.00			1,630
Office Area 10	438	2	5.0	0.06	36	26	
bag claim domestic	25,697	874	7.5	0.06	8,097	1,542	
Bag Drop 2	1,262	0	7.5	0.06	76	76	
Screening Old	5,062	600	7.5	0.06	4,804	304	
Scrennning (new)	919	24	7.5	0.06	235	55	
Loading Dock	2,898	0		0.06	174	174	
Total:					17,981 cfm	3,216 cfm	3,844 cfm

PLUMBING SYSTEMS

Storm Drainage

Storm drainage will consist of internally mounted rainwater leaders connected to storm water piping below grade. The roof drains will either provide storm water retention on the roof or will be a full flow design, depending on the final site servicing plan to meet City of Kelowna storm water management guidelines. This will be determined by the Civil consultant.

Storm drainage will consist of cast iron piping with MJ fittings above ground and PVC piping below ground. There will be new storm connections required on the north end expansion and the south end expansion.

Sanitary Drainage

Sanitary drainage will be provided for new washrooms located in the International Bag Claim expansion. A new main washroom group will be provided in Phase 4 for International Bag Claim, therefore a new main sanitary line will be provided to support this washroom group and will be sized to support additional washroom groups added in the future. The new 150 mm sanitary line will be connected to the street connection in the front of the airport.

Sanitary drainage will be provided for new large washrooms located in Phase 3 expansion. A new main sanitary line will be provided to support this washroom group and will be sized to support additional washroom groups added in the future. The new 150 mm sanitary line will be connected to the street connection in the front of the airport.

Miscellaneous sanitary connections will be required to support retail areas, mechanical rooms, and janitor/support rooms. The main sanitary lines will be coordinated with radiant slab piping to ensure sanitary is accessible and expandable to future loads.

Trap primers will be provided for all floor drain traps to ensure a positive seal is maintained on the trap, primer lines in concrete slabs will be plastic.

Sanitary drainage will consist of cast iron piping with MJ fittings above ground and PVC piping below ground (except for mechanical room areas).

Domestic Water Supply

Domestic water will be supplied from the City of Kelowna piped utility distribution system. Domestic water quality will be evaluated during Design Development to determine if the existing micro-filtration system is necessary for the proposed expansions.

Domestic water for the PIL and International Bag Claim washrooms will be extended from existing domestic water mains. Existing domestic water mains will be evaluated for sizing and upgraded as required.

Domestic water for the Domestic Bag Claim washrooms will be connected to the existing water meter room. The main water supply line from the City supply in the street will be upgraded if required to supply the existing airport and the new Phase 3 expansion. This will eliminate repetition of water meters and backflow prevention. Determination of existing DCW tie-in points to the street is to be verified by the Civil consultant.

Double-check valves will be provided for premises isolation between the Airport and City of Kelowna utility services.

Domestic water piping will consist of Type L copper minimum with Type K copper on domestic hot water recirculation lines. Two 150 mm domestic water supply lines will be provided to the building to serve domestic water and fire protection. A 50 mm takeoff for irrigation supply will be provided where required to serve landscaped areas.

Domestic Hot Water

Domestic hot water will be supplied to serve plumbing fixtures such as lavatories and sinks. The hot water system must typically be maintained at 60°C minimum, which is mandated by CSA codes, to prevent the growth of Legionella bacteria. New domestic hot water heaters will be provided in the North mechanical room and South Penthouse to support the new washroom groups. Individual plumbing fixtures will typically tempered to a single supply temperature at the fixture through a below counter mixing valve.

Domestic hot water will be distributed to the washroom groups through the mechanical room. Domestic hot water recirculation piping will be provided to each washroom group. Automatic balancing valves will be provided on each individual vertical riser to ensure flow is balanced between risers and excessive velocities don't occur. A domestic hot water recirculation pump will be located back in the mechanical room.

Domestic hot water piping will consist of Type L copper minimum with Type K copper on domestic hot water recirculation lines.

Plumbing Fixtures

Plumbing fixtures will be selected based on the following criteria:

- Provision of high performance fixtures capable of performing the required service at lower water flows. Therefore, all water closets must have a Maximum Performance Test (MAP) rating of 1000 to ensure high performance. This testing is undertaken to verify manufacturer claims of high performance using test media.
- Provision of hands free infra-red plumbing fixtures throughout all public washrooms. Theses fixtures will provide low water consumption and reliable operation is an important characteristic for the high loading of these washrooms.
- Provide wall hung toilets and a substantial service chase for the toilets to allow ease of servicing. The toilets can utilize an exposed infrared flushometer as shown or a completely concealed flushometer located flush with the wall, depending on Owner preferences.

Examples of typical plumbing fixtures proposed are as follows:

HEATING, VENTILATION AND AIR CONDITIONING (HVAC)

Heating

Introduction

The primary methodology for providing energy efficiency for the heating system is to provide a combination of ground-source geothermal heat pumps and condensing boilers.

Ground source geothermal heat pumps utilize the relatively constant ground temperature to provide heat in the winter and reject heat in the summer. Ground source geothermal heat pumps are one of the most effective methodologies for reduction of green-house gases such as carbon dioxide, particularly in hydro-electric dominated areas. The intent is to provide a closed loop heat pump system to vertical bore fields located in fixed areas of the airport site. Vertical bore fields typically extend 60-90 m below the ground and utilize a non-freeze solution to extract and reject heat to the ground. Ground bore field piping is typically installed in a 100 mm well and sealed with a thermally conductive grout, then routed to a header for connection to the main pumps. It is intended that the headers be located in remote concrete header boxes to allow the use of main supply and return pipes from the Airport.

Ground source heat pumps can provide a Coefficient of Performance (COP) in heating mode of 4.1 – 4.9, which is much more efficient than even condensing boilers when ground temperatures are favorable. The determining factor in sizing the external geothermal field is the difference between electric and natural gas energy rates, and source energy carbon content.

Condensing boilers recover up to 15% of the energy contained in the flue gases that is normally lost up the chimney, and is one of the most efficient energy savings methodologies in a heating dominated climate. It is recommended that all new boiler installations utilize condensing boilers to provide this additional efficiency.

The mechanical terminal systems must be designed to force the boilers to condense, which requires low temperature return back to the boilers. Therefore, all mechanical distribution systems will be designed to lower the return water temperature as low as possible.

Primary Source

The primary heating source for the new PIL expansions and International Bag Claim will be two (2) 116 kW wall mount condensing boilers and one (1) 30 ton heat pump. This hybrid system utilizes primary heat pump operation to provide a minimum of 20-25% of the peak heating load, which will form a substantial portion of the annual heating load. The condensing boilers will be utilized on extreme peak days or when the geothermal heat pump is not operable. The condensing boilers will utilize low temperature return water to condense flue gases.

The primary heating source for the new Domestic Bag Claim will be two (2) 234 kW floor mount condensing boilers and two (2) 30 ton heat pumps. This hybrid system utilizes primary heat pump operation to provide a minimum of 20-25% of the peak heating load, which will a substantial portion of the annual heating load. The condensing boilers will be utilized on extreme peak days or when the geothermal heat pump is not operable. The condensing boilers will utilize low temperature return water to condense flue gases.

The condensing boilers and geothermal heat pumps will require a small constant speed boiler pump to maintain constant flow. These pumps will only operate when the associated equipment is required to operate.

Building Distribution

The building distribution system will be structured to provide heating to perimeter heating loads first to serve radiation and cabinet unit heaters. Hot water will be the primary heating medium for the perimeter heating system. The intent is to provide a maximum of 71.1°C supply water temperature to the radiation and hot water terminal units. The return water from the radiation will be 60°C or less, which will then be used for slab heating and air handling unit heating coils.

The slab heating and air handling unit heating coils will further drop the return water temperature down to as low as 43°C prior to returning the water to the boilers. This will create condensing in the boilers and increase boiler efficiency to approximately 92%. The control system will automatically reset the maximum supply water temperature based on outdoor air temperature to obtain even better boiler efficiency at partial load, up to 95% at 32.2°C. The design hot water temperatures will be optimized to provide the lowest possible hot water temperature at all times.

Propylene Glycol at a concentration of 40% will be provided in air handling unit heating coils to prevent freeze-up concerns, particularly in 100% outdoor air units. Variable speed drives will be provided for the glycol pre-heat pumps serving 2-way control valves on the pre-heat coils.

Heating Terminal Units

Radiation will be provided below perimeter windows and clerestory windows. Radiant floor heating will be utilized in large open spaces in conjunction with radiant floor cooling. The floor slabs close to the perimeter will be switchable between heating and cooling. Unit heaters will be provided for support spaces such as baggage hall and baggage loading areas.

The design intent is to minimize the required hot water temperature by providing a more insulated and sealed building envelope, reducing heating requirements. This can be accomplished by increasing the wall and glazing RSI values and providing high performance glazing and frames. The radiation maximum hot water temperature will be limited to 71.1°C instead of a typical design temperature of 93.3°C.

Force flow units, cabinet unit heaters, and unit heaters will be provided in support spaces, entrances, stairways, and unoccupied areas to provide heating.

Cooling

Introduction

Cooling for the new expansion will be provided by a combination of ground source geothermal heat pumps and centrifugal chillers. Approximately 20-25% of the cooling load will be supplied by geothermal heat pumps with the remainder provided by the centrifugal chillers. This will provide the best balance between external borehole field size, energy consumption, and initial capital cost.

Primary Source

The primary cooling source for the new PIL and International Bag Claim will be a single 105 kW (30 ton) geothermal heat pump with R-410A refrigerant. The geothermal heat pump will provide a cooling coefficient of performance (COP) of 5.2-5.4 by utilizing the ground for heat rejection. The future phases will include a new 421 kW (120 ton) centrifugal chiller and closed circuit fluid cooler to provide cooling to the new expansion and a portion of the existing building.

The primary cooling source for the new Domestic Bag Claim will be two 105 kW (30 ton) geothermal heat pumps with R-410A refrigerant. The geothermal heat pumps will provide a cooling coefficient of performance (COP) of 5.2-5.4 by utilizing the ground for heat rejection. The future phases will include a new 738 kW (210 ton) centrifugal chiller and two closed circuit fluid coolers to provide cooling to the new expansion and a portion of the existing building. The intent is to replace the existing centrifugal chiller and reroute the chilled water to the new penthouse. This will open up much needed electrical room space on the main floor.

The centrifugal chiller will be selected for maximum efficiency and in compliance with energy code requirements. New centrifugal chillers with sophisticated controls, variable speed drives, and increased surface area can provide a COP of 5.5 and Integrated Part Load Value of 5.9 which can exceed the performance of geothermal heat pumps. This performance requires a water cooled centrifugal chiller with an associated cooling tower.

Closed circuit fluid coolers will be provided to allow the use of glycol through the cooling tower circuit and to allow cross connection with the geothermal heat pumps. The closed circuit fluid coolers will utilize evaporative sprays during peak conditions to provide heat rejection.

Building Distribution

The building cooling distribution will consist of variable speed primary chilled water pumps supplying a 2-way control valves on the cooling coils. The primary distribution medium will be chilled water for the fan coils, chilled slabs, and chilled beams.

Various sensible cooling solutions can be adapted to use in high load spaces to augment the cooing provided by displacement. Fan coils are a poor solution for most spaces as are chilled beams because they disrupt floor to ceiling temperature stratification necessary for acceptable displacement performance. Radiant cooling technology can provide additional cooling and is compatible with displacement. Radiant ceiling, floor or panel systems are all compatible systems for displacement. Radiant floor system capacity varies based on type but typical capacity is shown below.

- Radiant Ceiling Panels 90W/m2
- Radiant Concrete Ceiling 75W/m2
- Radiant Concrete Floor (without carpet) 75W/m2
  (note: 100 W/m2 in sunlit areas)

Radiant cooling and the accompanying higher comfort levels for occupants rely on good view factors to the cooling surfaces. Studies completed by the Centre for Built Environment in Berkeley indicated that overhead radiant panels/slabs are as effective as floor radiant systems in providing proper comfort in low ceiling areas. High ceiling areas (over 5 meters) perform better with floor based systems. Sedentary occupant foot temperature must be limited (when applying radiant floor) with a warmer surface temperatures than overhead system explaining the higher ceiling cooling capacities for overhead. The cooling limits to ceiling system capacities are controlling surface temperatures above room dewpoint to avoid sweating. Cooling mode for radiant floors in direct sunlight can be 2.5 to 3 times the capacity listed above due to the floor acting as a solar sponge also making it highly effective in daylit atria spaces. Typical radiant floor as installed in a similar application, the University of Calgary EEEL project is shown below:

Radiant slab systems can provide heating duty but in spaces with highly variable loads, radiant heated slabs can be slow to respond. Radiant panels both in cooling and heating mode can provide quick response to space load changes. Radiant slab systems provide a self regulating capacity, idling at low load and absorbing loads as required up to their design loads as the loads "appear" in the space.

Radiant slabs can be developed into a concept known as a Thermally Active Building Systems (TABS). Developing the building with high thermal mass, radiant slabs can be "charged" at night using more favourable cool night conditions, this enables the space conditioning systems to be downsized and also take advantage of charged thermal slabs to allow the spaces to flywheel through the next day's loads with reduced energy use. Kelowna's high diurnal temperature swings and the building's primary daytime use patterns are ideal for implementing this concept. Self learning night time purge algorithms will be necessary to fine tune this concept during the first year of occupancy. A balance of slab charging and stopping short of overcooling the space for early morning conditions is the largest challenge for effective use of the system but the technologies and control sequences are well established.

It is proposed that the base mechanical concept for the project be ventilation using a 100% outdoor air system, primarily delivered by displacement techniques, augmented with radiant cooling/heating as required. There are several types of spaces characterized by their individual load and use patterns. Based on preliminary cooling load calculations the following configurations are proposed.

Ventilation

Air Supply – General Description

Ventilation systems will provide adequate ventilation air to meet minimum air changes required by ASHRAE 62.1. The intent is to reduce airflow to unoccupied or lightly occupied spaces from the minimum ventilation volumes by utilizing carbon dioxide demand control. For example, baggage hall areas are lightly occupied most of the day and may be completely empty at night. The carbon dioxide sensors would provide variable volume between the area ventilation rate and the occupant ventilation rate. Occupancy sensors will be used in office spaces to reduce air volumes in unoccupied spaces.

An innovative solution for the large common areas is to decouple the ventilation and cooling loads by the use of Displacement Ventilation and Chilled Slabs. Displacement Ventilation provides supply airflow at a low level at a higher temperature. This provides several advantages for the Airport as follows:

- Improved ventilation effectiveness in open areas. Air is supplied at low level and contaminants are directed upwards towards return/exhaust grilles.
- Provision of higher temperature supply air, minimizing reheat and maximizing free-cooling capabilities from the air handling units. Free-cooling hours are extended by approximately 1000 hours/year.
- More effective cooling at higher supply air temperatures. The rooms can be effectively cooled with minimal cooling energy.
- Fan power relatively lower than conventional systems
- System compatible with lower grade cooling sources such as geothermal heat pumps, allowing higher chilled water supply water temperatures.

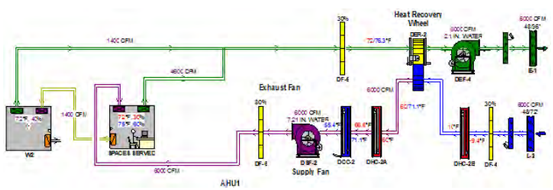
Displacement is the favoured choice to ventilate the majority of the large open spaces, which is the primary space type for the expansion. Displacement ventilation is well adapted to being coupled with a room based sensible cooing system for high load spaces. This would allow the air supply system to be 100% outdoor air and simplify the building systems by avoiding an extensive return air duct systems such as required for VAV systems. Typical displacement diffusers are shown below, but custom made solutions can also be utilized for low velocity air supply.

Air Supply Equipment

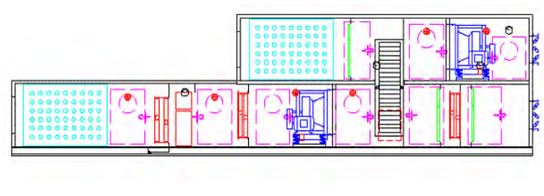
Air handling units will be indoor units supplied with glycol heating coils and chilled water cooling coils. Vertical duct shafts will facilitate ducted supply, return and exhaust air to the floors. Typical air supply units will be custom construction with 100 mm insulated walls, multiple split sections, and configurations to suite the mechanical room requirements.

- AHU-1 – PIL/International Bag Claim: The air handler for the PIL/International Bag Claim area will be a 2830 l/s, variable volume, 100% outside air complete with supply and exhaust fans, glycol cooling coil, glycol heating coils, heat recovery wheel, and with Dynamic air filtration. The air handling unit will be zoned to allow demand reduction based on carbon dioxide sensors. Low pressure ductwork will supply low wall mounted displacement diffusers or custom diffusers integrated with architectural features such as ticket booths, thermal mass walls, and baggage carousels. Return fans on the units will in fact be exhaust fans as all return air will be exhausted after heat recovery. The heat wheels will provide both sensible and latent recovery, which will save substantial heating energy and provide some humidification in the winter.

- AHU-2 – Domestic Bag Claim: The air handler for the Domestic Bag Claim area will be a 5660 l/s, variable volume, 100% outside air complete with supply and exhaust fans, glycol cooling coil, glycol heating coils, heat recovery wheel, and with Dynamic air filtration. The air handling unit will be zoned to allow demand reduction based on carbon dioxide sensors. Low pressure ductwork will supply low wall mounted displacement diffusers or custom diffusers integrated with architectural features such as ticket booths, thermal mass walls, and baggage carousels. Return fans on the units will in fact be exhaust fans as all return air will be exhausted after heat recovery. The heat wheels will provide both sensible and latent recovery, which will save substantial heating energy and provide some humidification in the winter. A typical schematic air handling layout with heat wheel for the CBSA PIL/International Bag Claim is shown below:



The air handling unit physical configuration is as shown below:



Air Distribution

Air distribution will be provided through medium pressure ductwork to VAV boxes and low pressure ductwork to displacement diffusers. Outdoor air will be distributed to the inlet of fan coils and chilled beams where utilized in retail and smaller high load spaces.

Exhaust Systems

Exhaust from individual washrooms and common spaces in the will be ducted back to central locations adjacent to the roof mounted air handlers where it will be directed through heat recovery wheels prior to discharging to the outside. Remote washrooms which will be difficult to return back to the air handling unit will be individually exhausted.