Chapter 7

Project Description

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7. Project Description

7.1 Overview

The new parallel runway will be located east of and parallel to the existing 16/34 runway and staggered in a northerly direction. Key features of the proposed Parallel Runway Project (PRP) are:

- Construction and operation of a new 4,267 m (14,000 ft) runway located 2,170 m east and parallel to the existing 16/34 runway. Included are the associated taxiways, navigational aids, and land-based access infrastructure. This construction will occur within the boundaries of Calgary International Airport (YYC), which is federal land held under long-term lease by the Calgary Airport Authority (the Authority)
- Changes to the roads and pathways leading to and from the airport to accommodate the new runway. Barlow Trail NE will be closed north of 48 Avenue NE to Airport Trail. McCall Way will also be closed north of 78 Avenue NE, and 78 Avenue NE will be closed east of Barlow Trail NE. New roads will be constructed connecting 48 Avenue NE to 36 Street NE
- Changes to the storm drainage systems to accommodate the volumes of stormwater to be collected from the new developed areas
- Navigational aids (approach lighting) to be constructed at the ends of the new runway. The navigational aids extend to a distance of 720 m from the runway threshold
- Development of changes to current airspace design to accommodate new arrival and departure procedures
- Airfield underpass for Taxiway Foxtrot and Juliet Extension

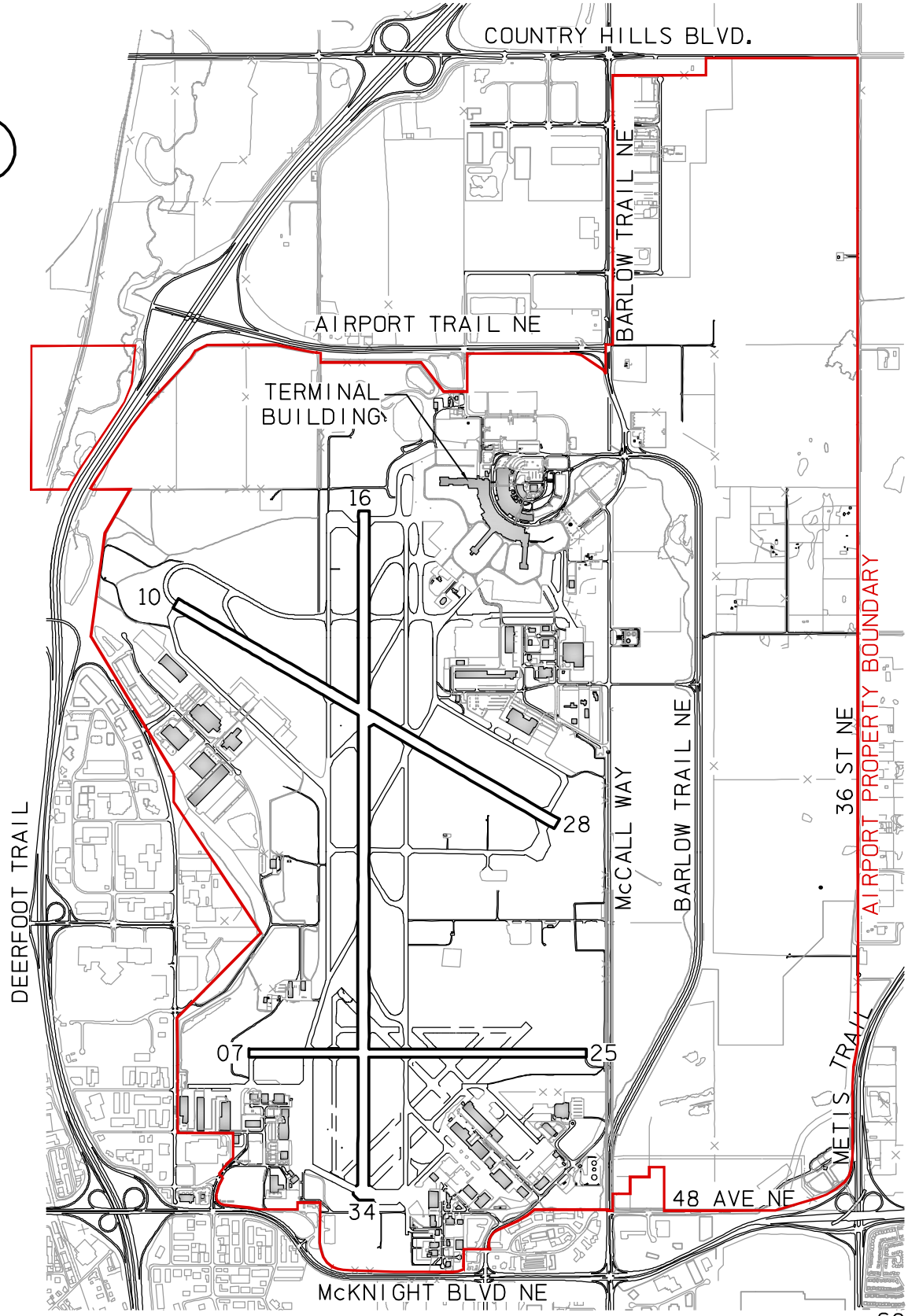
This section presents an overview of the PRP project, including its proposed layout, construction, methods and schedule, based on the preliminary design.

7.2 Existing Airport Infrastructure

Existing development of the YYC site includes both aviation-related facilities and commercial development that benefits from proximity to airport operations. Figure 7.1 contains the existing infrastructure within the airport property boundary and includes:

- 16/34 runway (main runway 3,863 m long 60 m wide)
- 10/28 runway (cross runway 2,438 m long 60 m wide)
- 07/25 runway (cross runway 1,890 m long 45 m wide)
- terminal building and apron
- general aviation area and aprons
- control tower and related facilities
- catering facilities
- cargo handling facilities
- aircraft maintenance facilities
- services and utilities
- car parking facilities
- local road network

The new runway will form part of the Authority's $3 billion investment in infrastructure that includes additional roads, aprons, and terminal expansions. These projects will interact with the runway project either through design or construction. Section 7.11 of this report describes the other significant projects that are occurring at YYC.



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The Calgary Airport Authority
Runway Development Program
Parallel Runway Project

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Existing Airport Development

Figure 7-1

7.3 Description of the New Parallel Runway

The preliminary engineering design and layout of the new runway and associated infrastructure is based on a comprehensive analysis of the physical features of the site, the requirement to deliver a runway, associated taxiways and supporting infrastructure that integrate with the existing airport operations and infrastructure, and the needs of airlines and aircraft fleets that will use the new facilities. The design of the new runway is consistent with the Calgary Airport Master Plan (2004) and meets applicable provincial, federal and recommended practices of the International Civil Aviation Organization (ICAO).

The proposed configuration of the rapid exit taxiways (RET) was rationalized during the design process in recognition of the anticipated operating modes.

Table 7-1 Summary of Permanent Works associated with the PRP

Design Element	Details
Constructing the new 16L/34R runway and associated RETs	The runway will facilitate the arrival and departure of aircraft. Taxiways will be used to enable aircraft to manoeuvre between the runway and terminal facilities.
Clearing of approximately 582 ha of cultivated land and previously disturbed lands	Vegetation will be removed from cultivated land, pasture and agricultural land.
Constructing a new dual parallel taxiway (adjacent to the 16L/34R runway between the runway and terminal)	The full-length dual parallel taxiway system has been designed for the expected demand for service. Construction of this taxiway system will be staged as the full system is not required in the short term. Its future construction will be dependent upon airport demand and future developments around the airfield.
Constructing a connecting taxiway from the 16L/34R runway to the main existing runway (Taxiway Juliet)	The construction of the 16L/34R runway will involve the construction of a major link taxiway between the existing runway, the new runway and the terminal.
Constructing a connecting taxiway from the 16L/34R runway to the main existing runway (Taxiway Foxtrot)	A link taxiway will provide an additional connection between the 16L/34R runway and existing runway. The proposed link, in addition to the Taxiway J Link, will create a “dual link” layout to provide efficient flow between the east and west sides of the airfield.
Construction of underpasses beneath Taxiways Juliet and Foxtrot	As a safety requirement to reduce conflict between aircraft movements and ground service vehicles, vehicular passage will be under the link taxiways.
Extension of Taxiway Foxtrot with a crossing of McCall Way	For the safe and efficient movement of aircraft between the two parallel runways and terminal, an extension to Taxiway Foxtrot will require a grade separated crossing of McCall Way to allow vehicular traffic to access the aviation businesses in McCall central.
Constructing new perimeter roads around the airfield	To enable regular maintenance of the airfield, security inspections, and response to emergencies, new perimeter roads will be constructed.
Installing new security fencing	To maintain safe, reliable airport operations and to define a boundary between ‘airside’ and publicly accessible ‘landside’ areas, new fencing will be installed.
Constructing new airfield drainage works	Substantial drainage infrastructure will be constructed to safely manage water from the runway and taxiways. Stormwater will be directed to drainage ponds within the airport property, and then to the City of Calgary stormwater sewer system.
Relocating power and utility services	Relocation and installation of water, electrical and telecommunication services will be required for the 16L/34R runway.
Changing the roads that provide access to airport facilities	Closure of Barlow Trail NE and McCall Way will be required for the development of the new taxiway system for the 16L/34R runway. Barlow Trail NE will be realigned to join onto McCall Way near 48 Avenue NE; McCall Way will be closed at 78 Avenue NE; 48 Avenue NE will be extended to 36 Street NE.
Establishing new navigational aids, airfield lighting (including approach lighting), and a new field electric centre (FEC)	Approach lighting is provided at each end of the runway centreline to enable use during periods of low visibility. Approach lighting for planes arriving or departing the new runway will extend approximately 720 m north and south of the runway thresholds.
Airside Maintenance Centre (AMC)	Located in the SW corner of the airfield, consisting primarily of 2 large buildings. The existing AMC occupies approximately 4.6 ha and approximately 7.5 ha will be required in total for the expanded AMC requirements to be met.

The location of the new runway components and project footprint boundary are shown on Figure 7-2.

7.4 Temporary Works

In addition to the permanent works required for the operation of the new runway, temporary infrastructure is required to enable the construction of the PRP. The majority of the temporary infrastructure relates to temporary offices, lay-down areas, temporary access roads, stockpiles and batch plant(s).

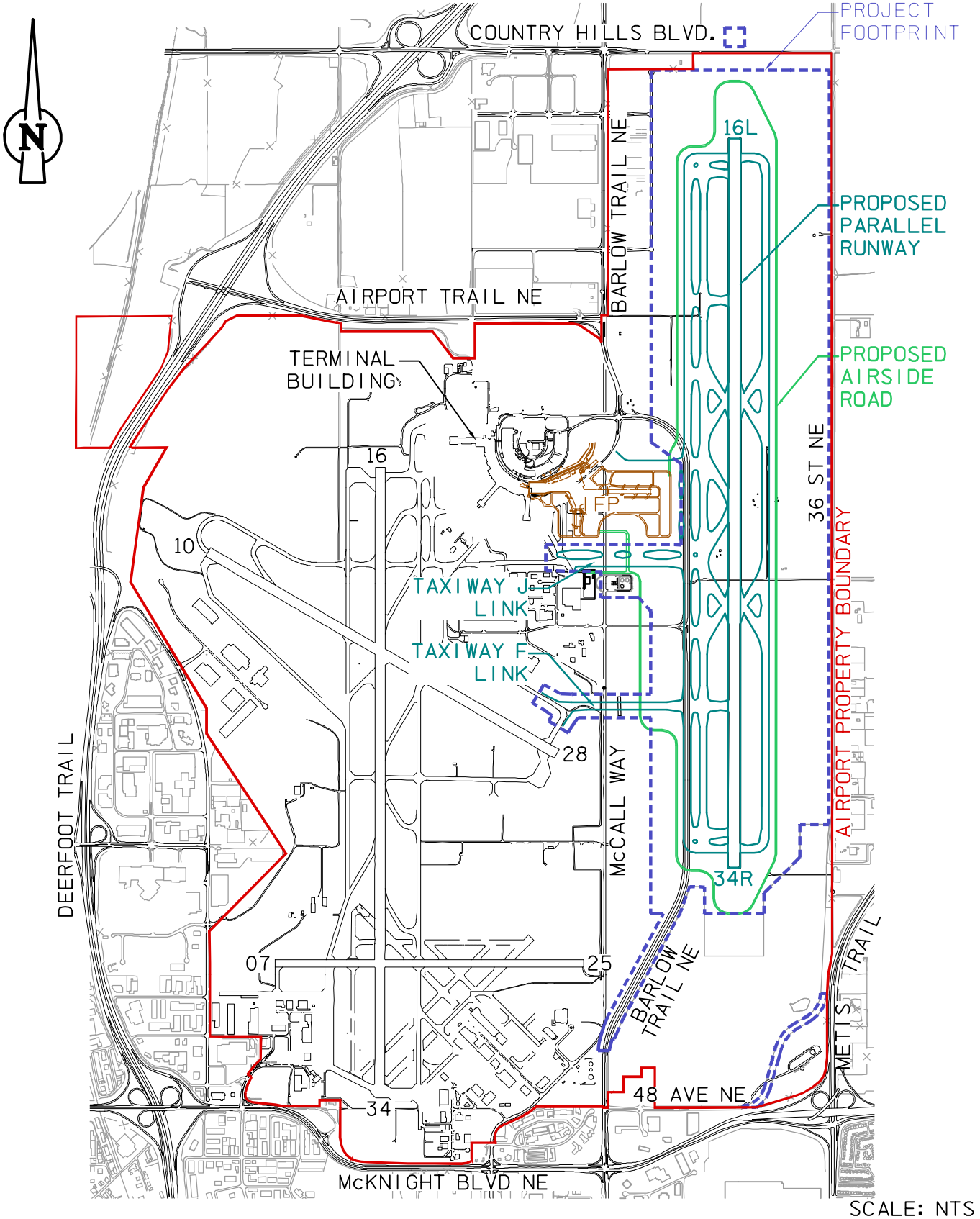
7.5 Project Design

National standards and recommended practices applicable to civil airports in Canada are governed by Transport Canada (TC) and are formalized in the document TP312E – Aerodrome Standards and Recommended Practices (4th Edition). This TC document generally follows international standards and recommended practices defined in Annex 14 of the Convention on International Civil Aviation and adopted by the ICAO. The Government of Canada is a signatory to the ICAO standards.

Recent discussions with TC have indicated that a new version of TP312E is currently under development and will likely come into effect prior to the commissioning of the new parallel runway. TC has advised the Authority that TP312E 4th Edition supplemented by ICAO Annex 14 should be used for the purposes of design and that TC will provide direction on issues with respect to compliance with the proposed TP312E 5th Edition on a case-by-case basis.

The 2004 Master Plan confirmed the separation distance of 2,170 m from the existing runway 16/34, a design length of 4,267 m (14,000 ft), and used an ICAO Code F standard for planning and dimensional clearances. The ICAO Code F aircraft design criteria provides adequate clearances and geometry to safely accommodate all aircraft types up to and including new large aircraft such as the Airbus A380.

Design of the Instrument Landing System (ILS) and Visual Navigational Aids for the new runway and taxiway system is based on precision approach runway Category II/III (CAT II/III) as defined in TP312E. CAT II limits are intended for runway operations down to a 30 m (100 ft) decision height (vertical visibility of runway surface) and a Runway Visual Range (RVR) of 1,400 ft (horizontal visibility). CAT III installations have no decision height applicable (runway surface visible) and an RVR (horizontal visibility) of 600 ft. These types of electronic and visual aids are required by aircraft operators to ensure accessibility to an airport in all weather conditions and to avoid diversions to other airports.



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Proposed Parallel Runway

Figure 7-2

In addition to TP-312E and ICAO Annex 14, the following codes, standards, manuals and guidelines are applicable to the airfield design:

- ICAO Aerodrome Design Manuals
  - Part 2 – Taxiways, Aprons and Holding Bays (3rd Edition)
  - Part 3 – Pavements (2nd Edition)
  - Part 4 – Visual Aids (4th Edition)
  - Part 5 – Electrical Systems (1st Edition)
- AK-64-11-500 – Transport Canada – Airport Lighting
- AK-70-16 – Transport Canada – Airport Drainage Manual
- AK-77-64-009 – Transport Canada – Static Ground Practices
- ASG-19 - Public Works Canada Manual of Pavement Structural Design
- Federal Aviation Administration (FAA) Advisory Circular AC 150/5320-6E – Airport Pavement Design and Evaluation (2009)
- FAA Layered Elastic Airport Pavement Design (LEDFAA) (v 1.4, June 2004)
- FAA Rigid and Flexible Iterative Elastic Layered Design (FAARFIELD) v 1.302 (2009)

7.5.1 Obstacle Limitation Surfaces

The horizontal alignment of Runway 16L/34R has been fixed from the aeronautical zoning point of view for over 30 years. The locations and minimum elevations of Runway 16L-34R thresholds are also, meaning that the threshold elevations cannot be lowered without contravening aeronautical zoning regulations. The aeronautical zoning defines the vertical obstacle limitation surface. This surface was integrated into the Airport Vicinity Protection Area (AVPA) and the Noise Exposure Forecast (NEF) contours which have been used as the basis of external land use planning around the YYC since 1979 (updated 2009).

Figure 7-3 Obstacle Limitation Surface

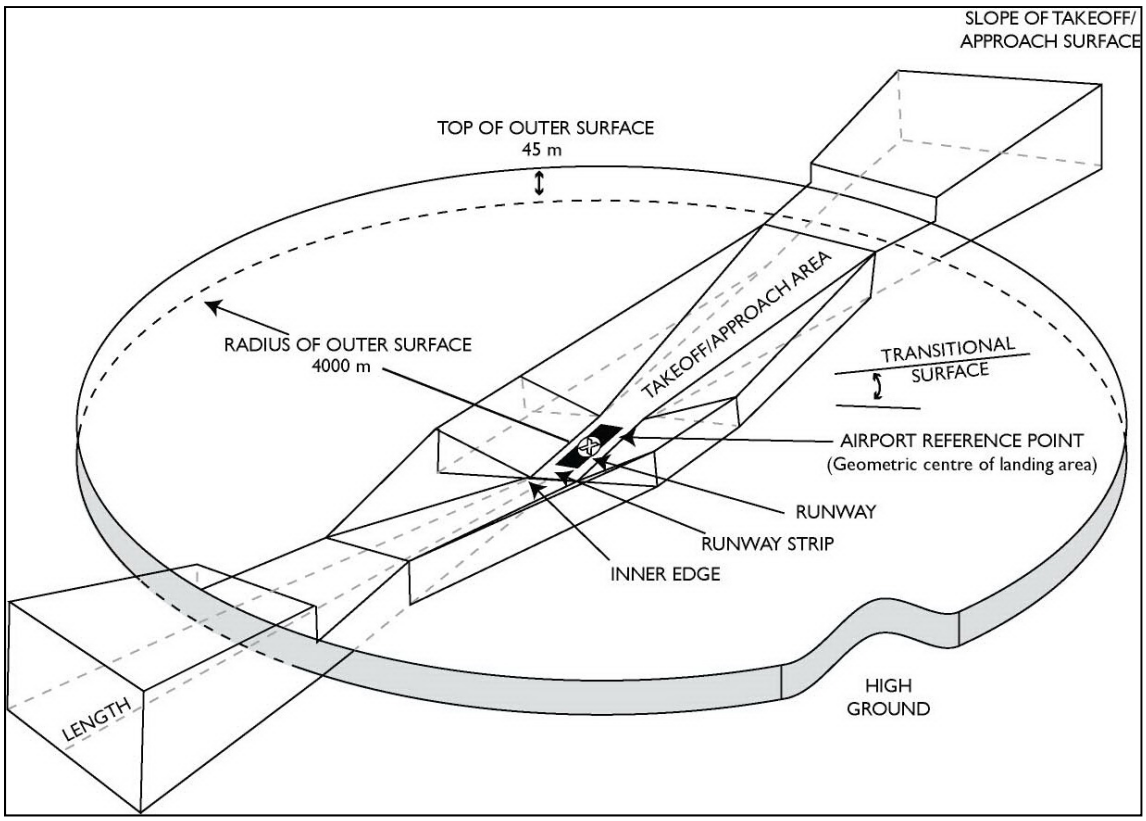
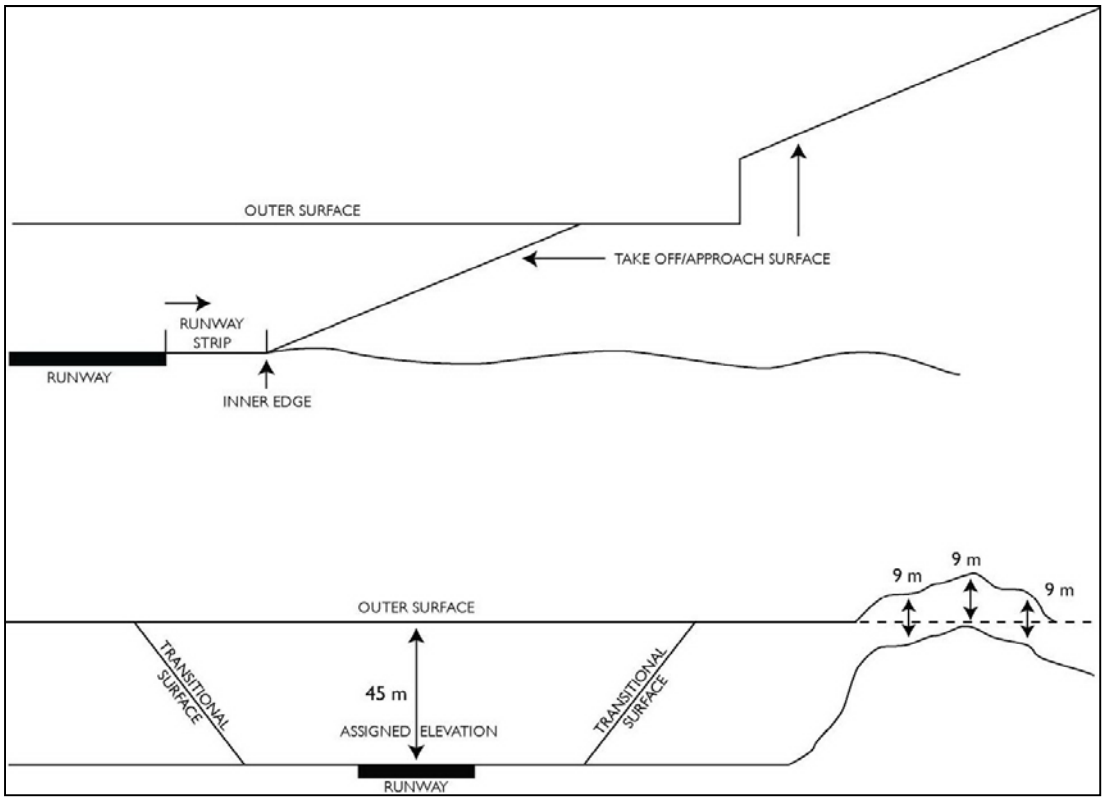


Figure 7-4 Obstacle Limitation Surface (Side View)



7.6 Project Components

7.6.1 Runway and Taxiways

The key features of the PRP are detailed in Section 7.1 of this report.

The parallel alignment and separation distance between the two parallel runways allows them to be operated independently and will maximise capacity while minimizing operational constraints. This alignment also provides maximum flexibility in the design of future airport development between the runways.

The new 16L/34R runway and taxiway system consists of the following geometric components:

- Runway (ICAO Code 4F): 4,267 m (14,000 ft) long by 60 m wide (196 ft).
- Runway shoulder (ICAO Code 4F): 7.5 m wide.
- Runway strip width (ICAO Code 4F): 150 m on each side of the runway (total width of 300 m). This area is essentially devoid of any obstacles that are higher than the runway centreline (except electronic and visual aids).
- Runway graded area (ICAO Code 4F): 90 m on each side of the runway centreline. This is an area within the runway strip that is properly shaped and compacted to limit aircraft damage if an aircraft leaves the paved surface and shoulders.
- Parallel taxiways: Ultimately there will be two full-length (4,267 m) parallel taxiways on the west side (terminal side) of the new runway that provide simultaneous access to arriving and departing aircraft to the new runway. In the initial phase only portions of the western parallel taxiway will be

constructed. In addition, there is a second full-length taxiway planned on the east side of the new runway that will service commercial and other non-terminal processing developments that also require direct access to the runway system. This taxiway will be built in stages as development warrants.

- Cross field taxiways: Two additional taxiways running perpendicular to the new and existing runways will accommodate two-way cross-field aircraft traffic between the two parallel runways. This will ease congestion in the vicinity of the terminal complex and will facilitate circular movement of aircraft traffic on the airfield. The cross field taxiways are planned as extensions of existing Taxiways F and J.
- Taxiway width: All taxiways are planned to be a nominal 25 m wide (ICAO Code F) with a nominal shoulder width on each side of 9.5 m (initially Code E). The actual location of shoulder pavement will be primarily on taxiway turns and other areas with higher jet blast that will be prone to more significant erosion. Shoulders can be retro-fitted as required over time.
- RETs: There are three rapid exits on the runway in each direction. These exits are set at 30 degrees to the runway with a minimum radius of 550 m. Their purpose is to allow aircraft to leave the runway quickly with an exit speed of approximately 95 km/hr under wet conditions for larger aircraft and 65 km/hr for smaller aircraft. This reduces runway occupancy time (ROT), 50 seconds or less for any landing, and increases the operating efficiency of runway/taxiway system. In turn, fuel consumption is reduced both in the air and on the ground, ultimately reducing greenhouse gas emissions. The nominal width of these taxiways is also 25 m, but their shape results in wider entrance throats at the runway taxiway intersection.
- Taxiway strips and graded areas: The taxiway strip and graded areas are 30 m wide on each side of the taxiway centreline.
- Other taxiways: In addition to the six RETs, there are 20 other taxiway links at a nominal 90-degree configuration connecting to the runway, between the parallel taxiways and to the existing taxiways and terminal apron system. The exact configuration of these will be refined during detailed design and added as demand warrants on the east side of the runway.
- Potential aircraft viewing area.

The parallel runway general layout is shown on Figure 7-5. The ultimate runway and taxiway layout planned for YYC Stage 1 is shown in Figure 7-6. The additional taxiway components will be constructed as required over time to suit growth in aircraft traffic.

7.6.2 Earthworks and Grading

The earthworks and grading activities are associated with the clearing of cultivated and disturbed lands where the construction of the new runway and other facilities are to be located. The total footprint of land where clearing, excavation and filling will occur is estimated to be approximately 580 ha.

The proposed runway development will interface directly along the west and south perimeter of the International Facilities Project (IFP) terminal building expansion and apron that are currently underway. This crucial apron/taxiway interface has had a significant effect on the development of both the PRP and IFP airside design. The spatial relationship between the proposed IFP East Concourse footprint and the proposed parallel runway alignment, coupled with the approximate 9.7 m elevation difference between the existing terminal apron and the proposed parallel runway centerline, are critical design challenges for the PRP.

A balanced earthworks model has been developed to incorporate all excavated materials generated from both the IFP and PRP construction into the PRP design. The IFP project is currently underway and portions of the construction period are anticipated to overlap with the construction schedule of the PRP.

This balanced earthwork concept is based on the premise of rough grading for the ultimate build-out of the runway/taxiway system including the full length of all taxiways in the initial phase of construction while the pavement areas will be constructed in phases over time to suit demand and operational requirements. The key objectives of the balanced earthworks design are to minimize earth movements and to reduce the amount of surplus soil to be disposed of off-site.

Approximately 1.5 million m^3 of excavated material will be generated by the IFP apron construction and approximately 3.5 million m^3 of excavated material will be generated by the runway/taxiway construction. All of the suitable excavated material will be placed as engineered fill to construct the runway and taxiway structures, and the remaining materials will be placed in graded areas between the runways and taxiways and along embankment slopes. An additional 700,000 m^3 of topsoil and organic materials will be stripped, stockpiled and re-used in soft graded areas within the PRP site. The excavation activities will also require the removal of bedrock, particularly in the more northern sections. A geotechnical investigation has identified rippable weathered bedrock over denser bedrock layers (the rock will be ripped as much as possible using a tooth mounted on a D10 or equivalent bulldozer). If required a hydraulic breaker will be used to remove harder, denser formations. Blasting will likely not be required to remove the rock. After the rock material has been ripped or broken, it will be loaded into articulating trucks and hauled to the southern portions of the site where it will be used as fill. The amount of rock to be ripped, excavated and re-used as fill has been estimated to be 400,000 m^3.

The main design factor in establishing an earthwork balance is that it has been necessary to raise the runway threshold elevations above the elevations defined in the Calgary International Airport Zoning Regulations (C.R.C., c. 77). The concept of raising the runway threshold elevations has been reviewed by TC and it has been confirmed that this strategy will not contravene the airport zoning regulations. Higher thresholds provide a greater distance over surrounding obstacles as identified in the zoning regulations and could result in increased elevation of aircraft over surrounding communities during take-off and landing.

Areas of cut and fill are illustrated in Figure 7-7 and expected areas of disturbance are illustrated in Figure 7-8. The importance of conserving topsoil and soil containing organic material has been recognized.

7.6.3 Pavement

Pavement design for the airfield pavements is based on a combination of geotechnical site investigations and TC's historical pavement-bearing values from existing airside pavements at YYC. In addition, aircraft fleet mix; expected frequency of aircraft traffic; aircraft wheel loads, tire pressures and landing gear configurations; and local climatic conditions are taken into consideration.

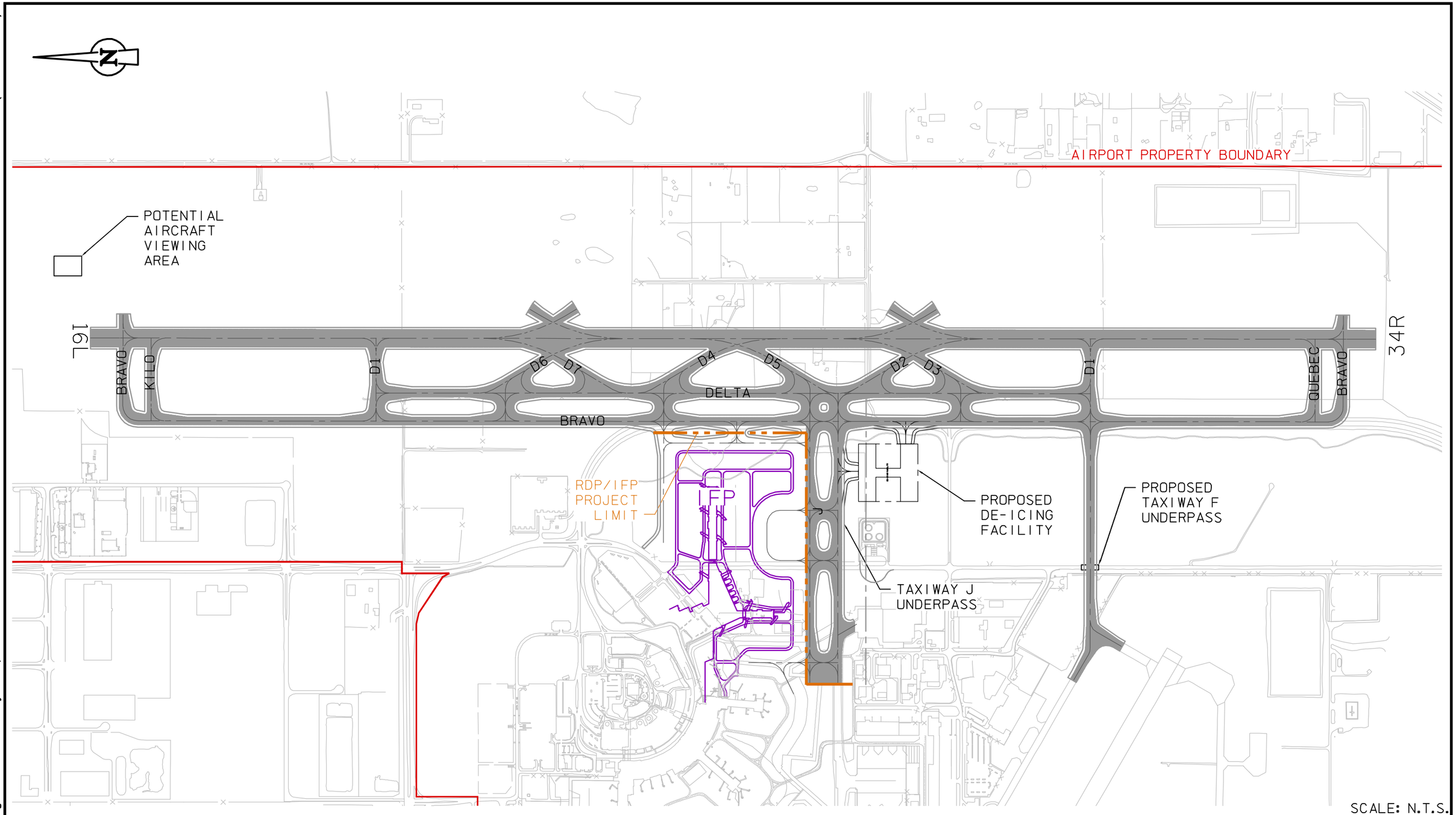
In terms of conventional rigid and flexible pavement designs, three methods have been considered:

- Public Works Canada (PWC) Manual of Pavement Structural Design ASG-19 (TC AK-68-12)
- FAA Layered Elastic Airport Pavement Design (LEDFAA) (v 1.4, June 2004)
- FAA FAARFIELD v 1.302 (2009), which incorporates the LEDFAA 1.4 for flexible pavement design and a 3D finite element analysis that is only applicable to rigid pavements. This program is issued by FAA under Advisory Circular AC 150/5320-6E and is the current FAA airfield pavement design standard.

Rigid pavement will be used for the runway and other heavy load areas and that there will be a mix of concrete and asphalt elsewhere depending on the use.

The general pavement structure for the main aircraft load bearing sections is proposed to be 1135 mm thick, comprising:

- 435 mm Portland Cement Concrete (PCC)
- 200 mm Cement Treated Base Course (CTB)
- 150 mm Crushed Granular Base Course (CGB)
- 350mm Sub Base.



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The Calgary Airport Authority
Runway Development Program
Parallel Runway Project

Site Plan Stage 1 Development

Figure 7-5

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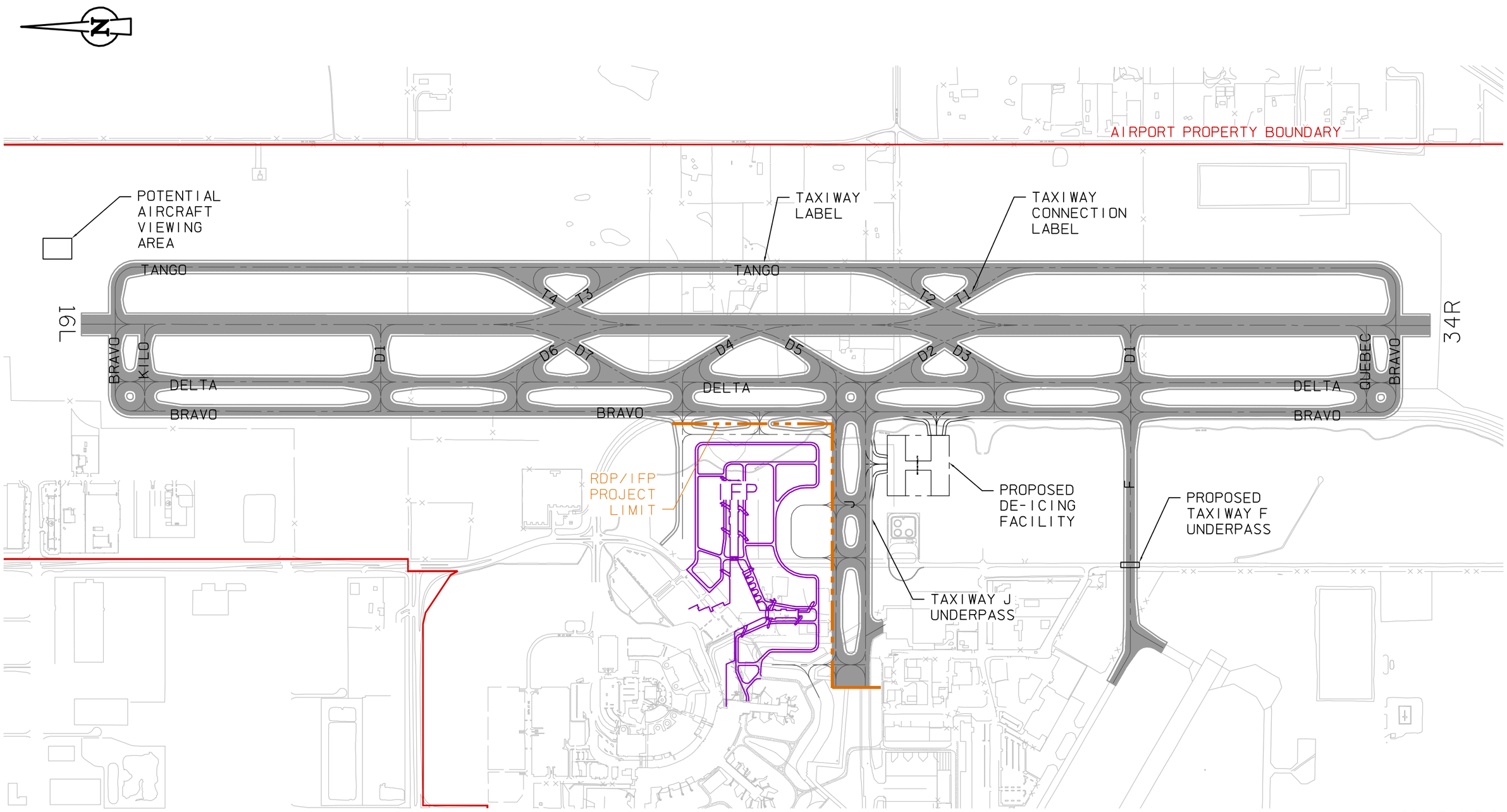

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Parallel Runway Project

Site Plan Ultimate Development

Figure 7-6

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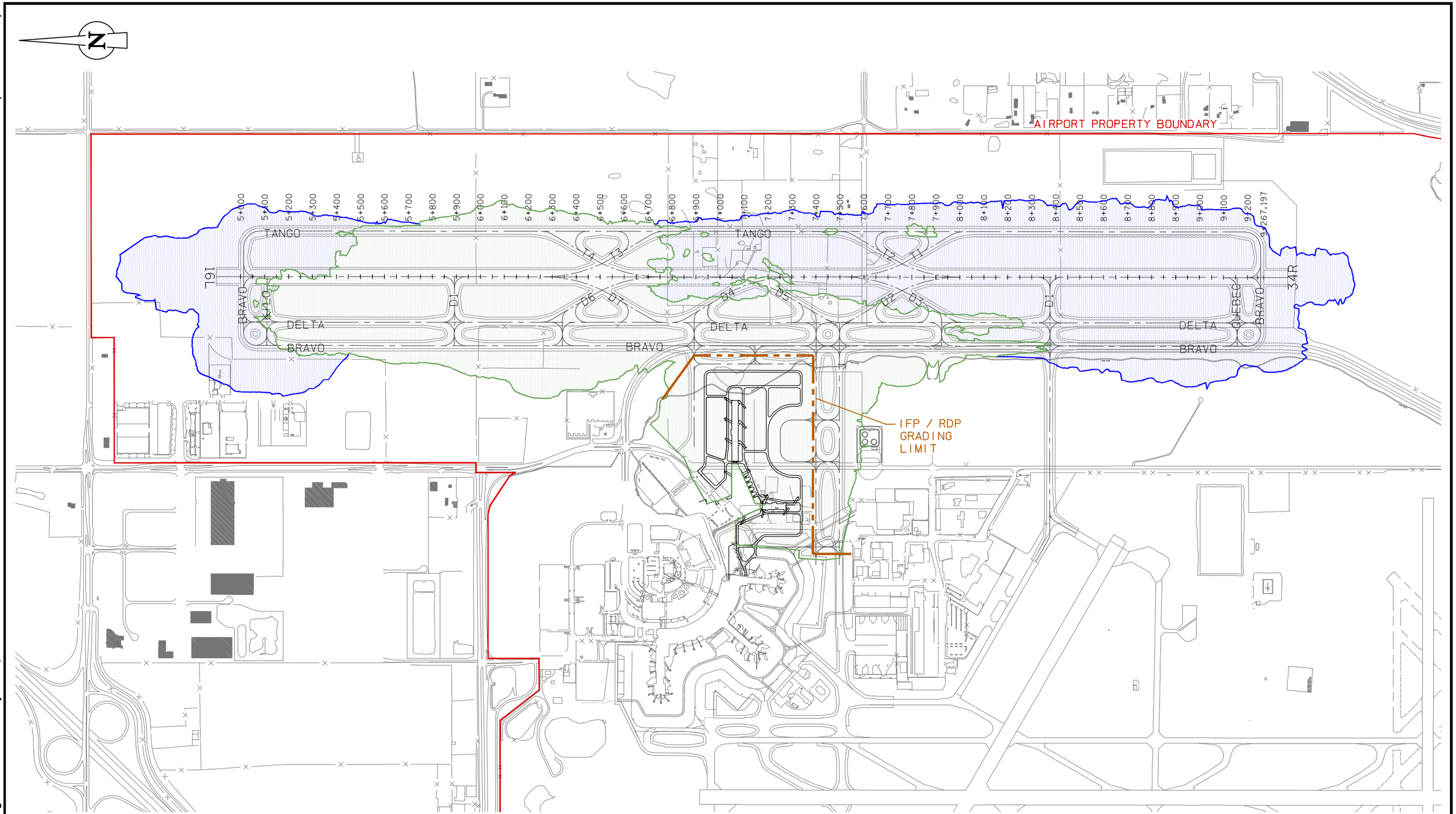

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LEGEND

EARTHWORKS CUT AREA

EARTHWORKS FILL AREA

200 0 200 400 600 METRES

SCALE: 1:15,000

The Calgary Airport Authority
Runway Development Program
Parallel Runway Project

Cut and Fill Areas

Figure 7-7

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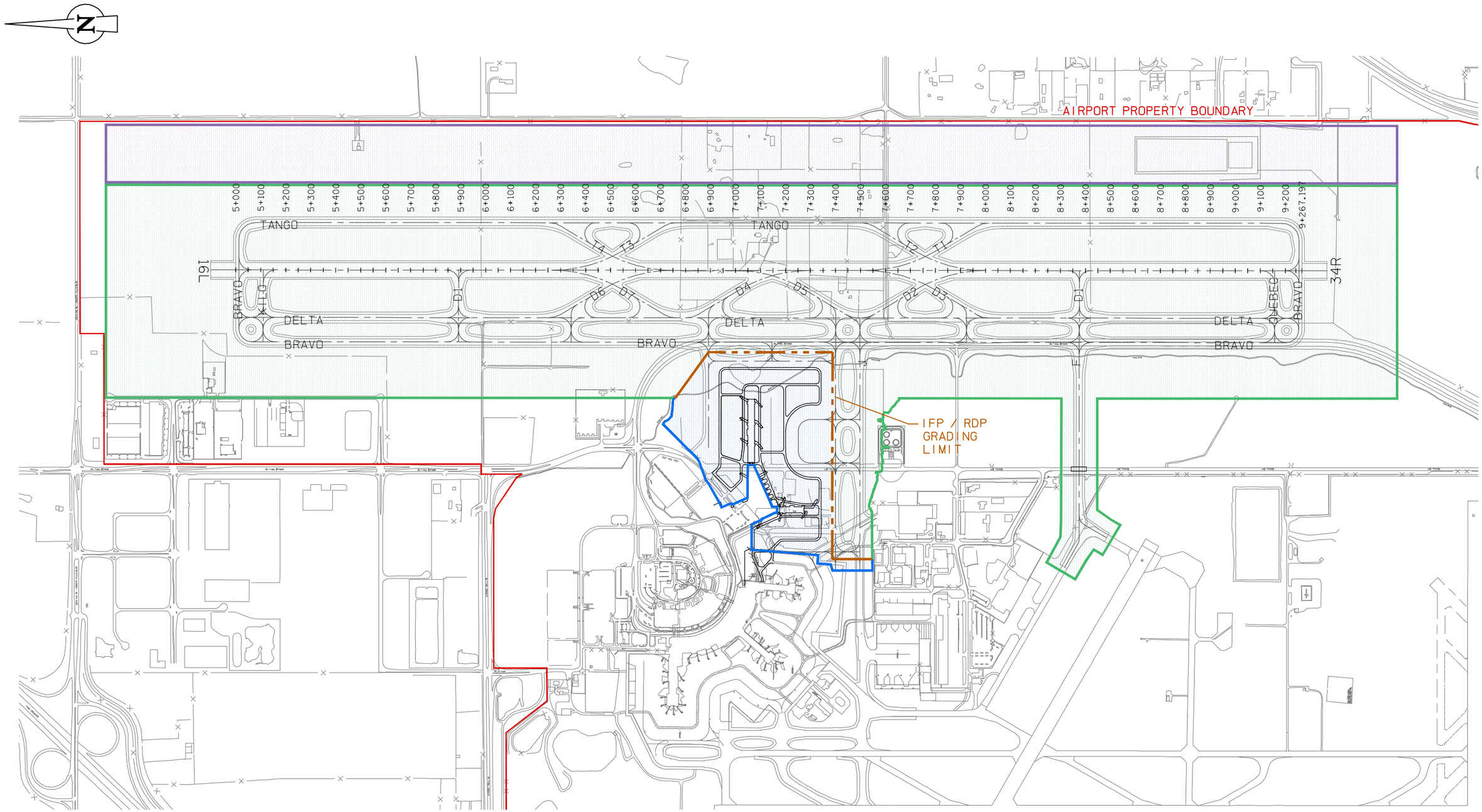

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LEGEND:

- IFP CONSTRUCTION
- TEMPORARY WORKS & UTILITIES CONSTRUCTION
- RDP GENERAL EARTHWORKS & AIRFIELD CONSTRUCTION

200 0 200 400 600 METRES

SCALE: 1:15,000

The Calgary Airport Authority
Runway Development Program
Parallel Runway Project

Estimated Area of Disturbance

Figure 7-8

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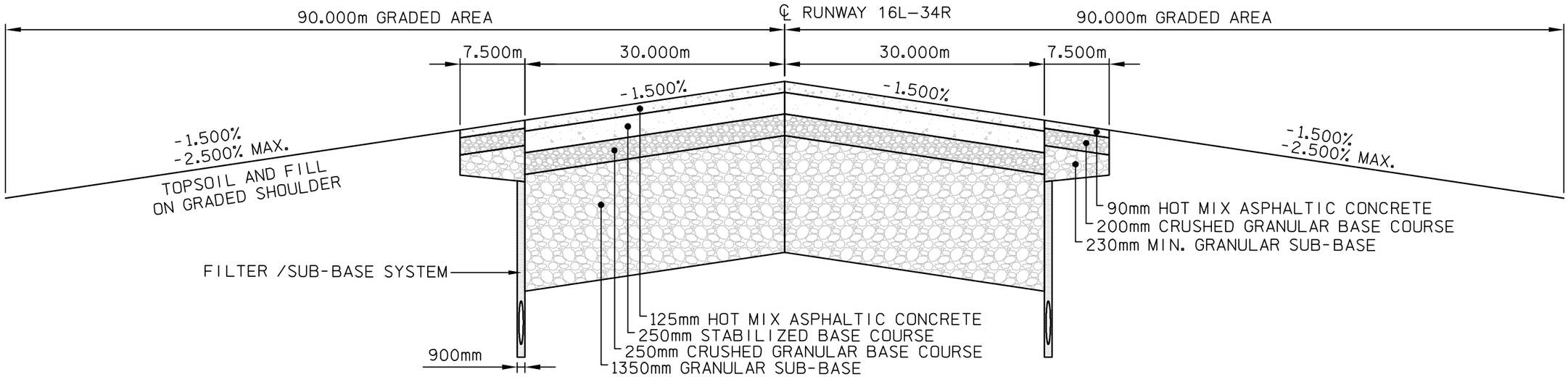

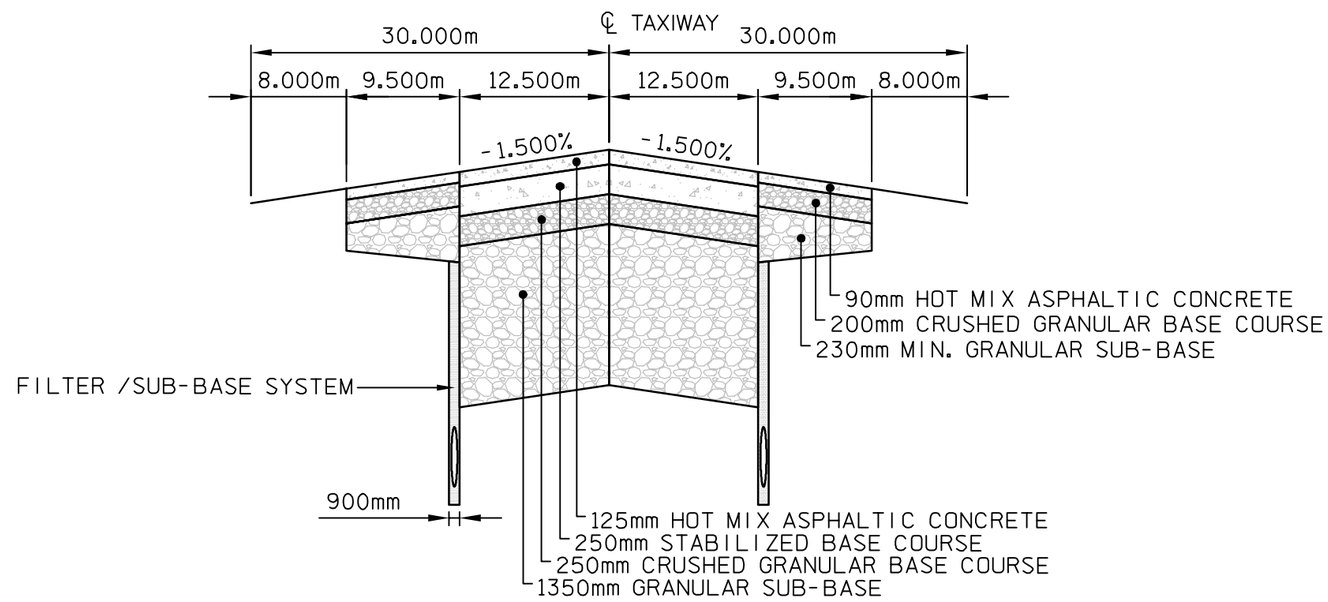

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HORIZONTAL SCALE
0 10 20 30

VERTICAL SCALE
0.25 0.75
0 0.50 1.00

The Calgary Airport Authority
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Parallel Runway Project

Typical Flexible Pavement Details

Figure 7-9

B SIZE 17" x 11" (431.8mm x 279.4mm)
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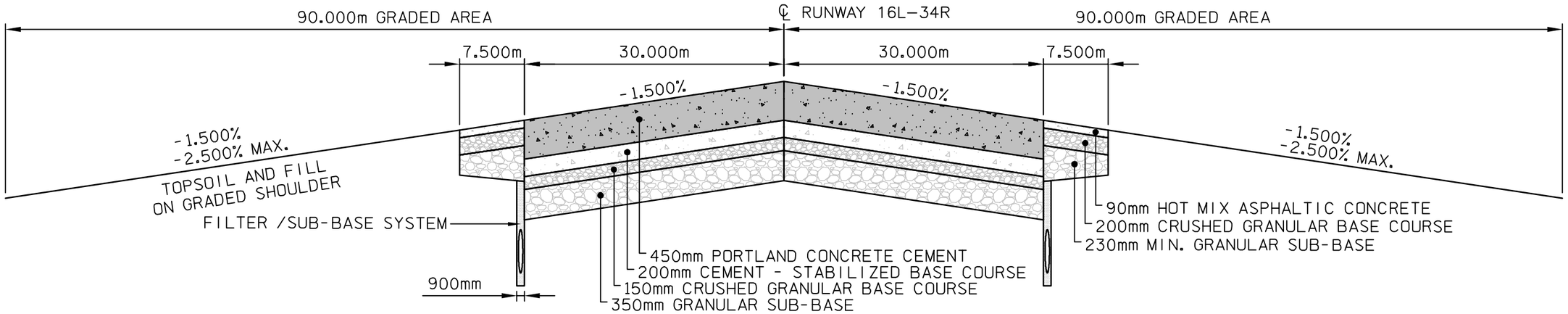

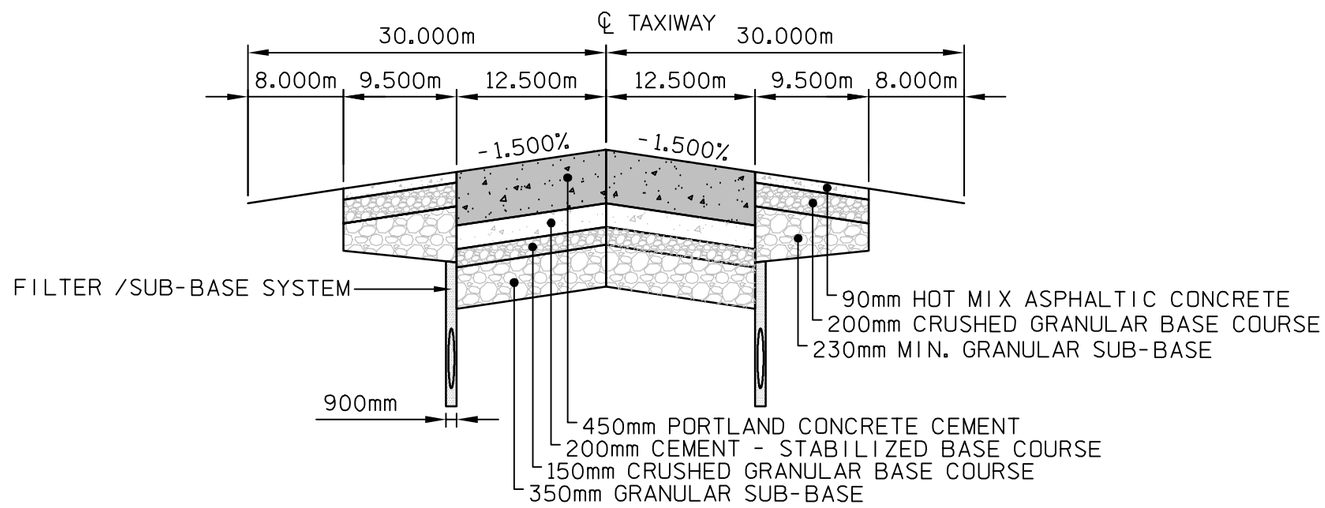

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AECOM

HORIZONTAL SCALE
0 10 20 30

VERTICAL SCALE
0.25 0.75
0 0.50 1.00

The Calgary Airport Authority
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Parallel Runway Project

Typical Rigid Pavement Details **Figure 7-10**

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7.6.4 Utilities

The existing utilities within the PRP footprint are detailed below. An extensive investigation to identify all of the affected utilities has been completed, and conflicts with the new PRP facilities have been identified. Section 7.8.1.1 discusses the relocations or terminations required to accommodate construction of the expanded airfield. The major utilities that are affected are shown on Figure 7-11.

7.6.4.1 Water

Investigation has revealed that there are no conflicts between the PRP and any existing water lines servicing YYC. However, a conflict exists between the PRP and a proposed water line re-route required to service the IFP development.

The proposed water line re-route is required due to construction of the IFP as well as future construction of a parking garage and extension of the arrival/departure roadways. The re-route will involve installing a new 400 mm PVC pipeline east from the existing terminal area to the eastern edge of the new IFP apron, south to approximately 78 Avenue and finally west along 78 Avenue connecting back into the existing 400 mm pipeline.

The conflict arising from this re-route will be mitigated by installing the water line under the grassed areas between paved surfaces as much as possible. The water main will also be encased in steel under the paved surfaces to facilitate future repairs and services.

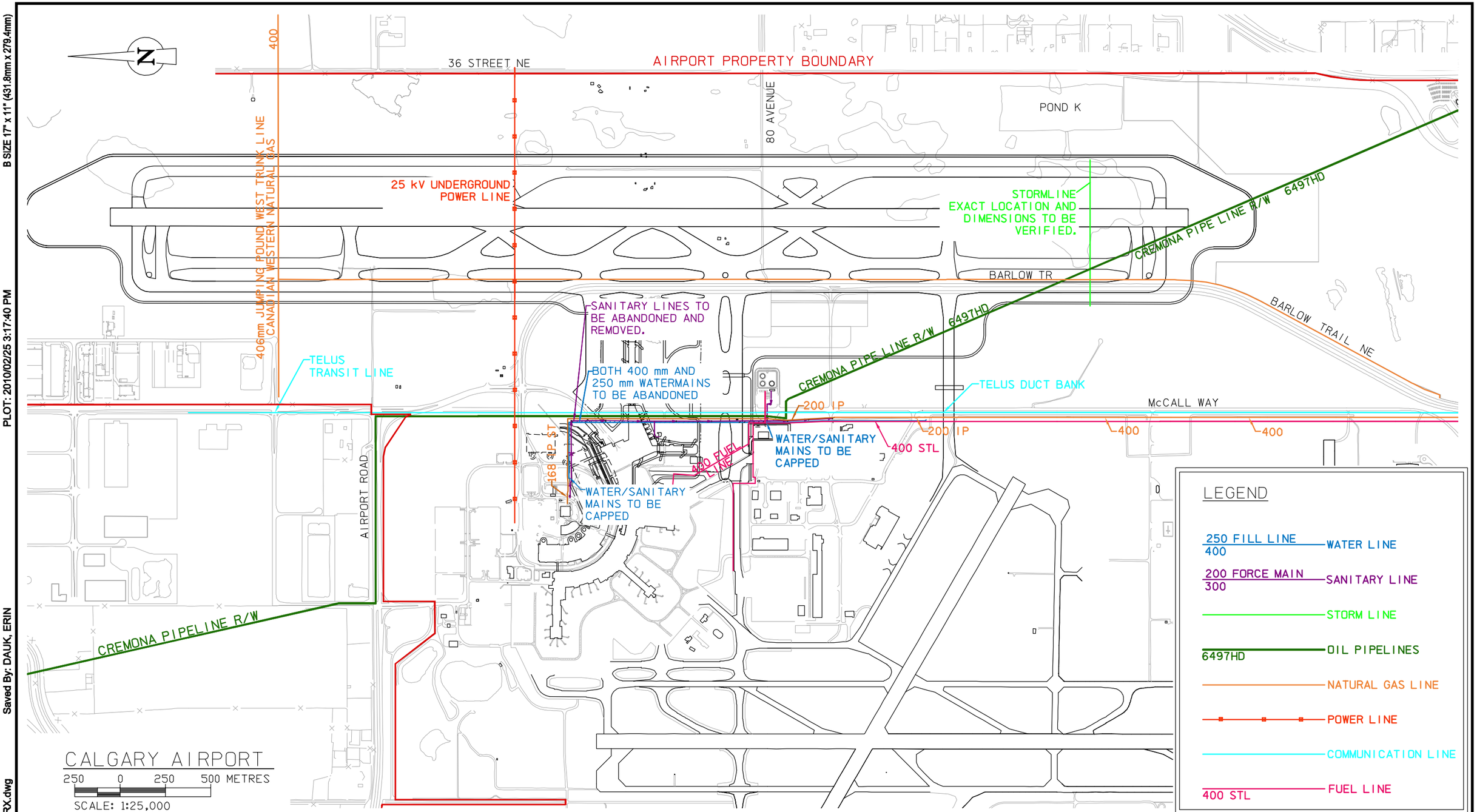
7.6.4.2 Sanitary Sewer

Investigation has revealed that there are no conflicts between the PRP and any existing sanitary lines servicing YYC. Additionally, proposed sanitary re-routes servicing the IFP development will not be in conflict with the PRP.

7.6.4.3 Stormwater Sewers

An existing open drainage system is in place to drain Barlow Trail. This system will have to be removed in its entirety, as construction of the PRP necessitates the closure and removal of Barlow Trail and all related utility services.

Additionally, the southern end of the planned runway will cross an existing stormwater pipe. The existing storm sewer can remain in place without significant modifications to accommodate the PRP construction.



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Major Existing Utilities Figure 7-11

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7.6.4.4 Communications Lines

A main communications trunk owned by TELUS runs parallel with McCall Way and will require relocation to accommodate construction of Taxiway J. The communications cables are categorized into three groups:

- YYC services
- Other TELUS customers on YYC property
- Main TELUS transit cables

Relocation solutions are detailed in Section 7.8.1.3 of this report.

7.6.4.5 Electrical Power Lines

ENMAX is the owner and operator of power distribution lines within the PRP footprint.

Relocation solutions are discussed in Section 7.8.1.4 of this report

7.6.4.6 Resource Pipelines

There are two high pressure gas transmission lines that will be affected by the PRP: (1) the Jumping Pound West Trunkline, a 406.4 mm steel line that crosses the east airfield approximately 1,000 m south of the Runway 16L threshold, and (2) the line serving TransCanada Turbines, a 219.1 mm steel line running parallel to, and approximately 30 m east of, the Taxiway B centreline.

The gas pipelines are owned and operated by ATCO Pipelines (high-pressure transmission lines) and ATCO Gas (low-to-intermediate pressure lines for commercial and residential distribution). High-pressure transmission lines are typically buried to a depth of 1.4 m to 1.5 m. The low-to-intermediate pressure lines are typically buried to a depth of 1.0 m and are considered to be shallow utilities.

There are several low and intermediate-pressure pipelines that directly conflict with the PRP.

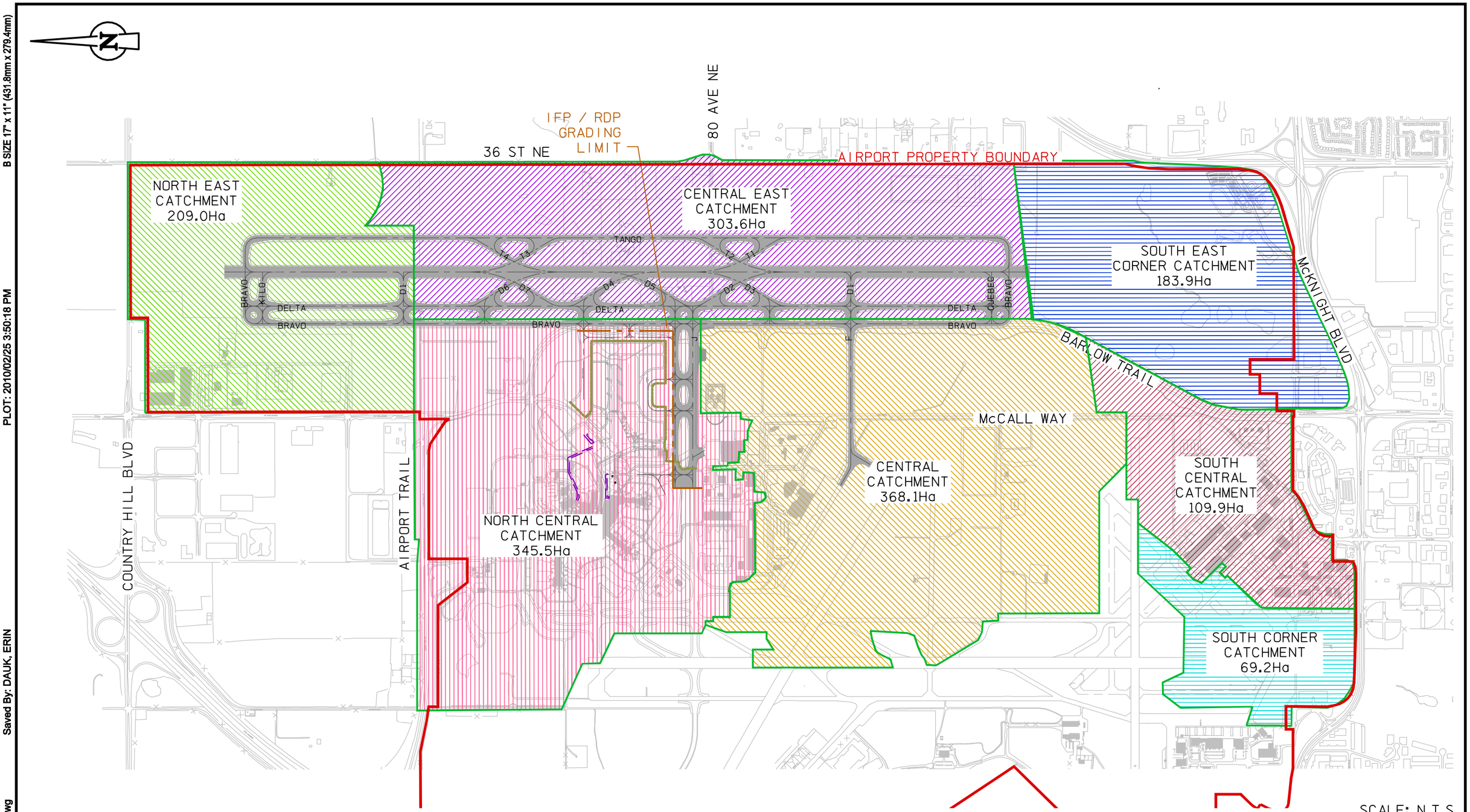
There are two oil pipelines that conflict with the construction of the PRP; they have been out of service for several decades and are abandoned. The oil pipelines can be removed.

Relocation solutions are discussed in Section 7.8.1.6 of this report

7.6.5 Stormwater Management

7.6.5.1 Existing Drainage System

The 2000 and 2003 Stormwater Management Plans for YYC divide the airport lands into 7 distinct catchment areas for analysis and design purposes. The proposed Runway 16L/34R will be situated in both the North East and Central East drainage catchments as shown in Figure 7-12. The South East Corner drainage catchment is located south of the proposed parallel runway. The North Central and Central drainage catchments are located west of the proposed parallel runway. The proposed Taxiway J connecting the air terminal building (ATB) aprons to Runway 16L/34R will be situated in the North Central drainage catchment.



LEGEND:

CATCHMENT BOUNDARY

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Stormwater Management Catchment Boundaries

Figure 7-12

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The Barlow North Tradepark development was constructed within the North East catchment east of Barlow Trail between Airport Trail and Country Hills Boulevard. The first basin of a two-basin stormwater management facility was constructed within the Barlow North Tradepark to handle the stormwater runoff from the development area. The facility releases stormwater into a 900 mm storm sewer along 100 Avenue NE. This 900 mm storm sewer runs west along 100 Avenue NE and then south along 19 Street NE. The sewer discharges into the 96 Avenue NE storm trunk before discharging to Nose Creek.

The remainder of the North East catchment is undeveloped and is used for agricultural purposes. Near the centre of the catchment, the land reaches a high elevation of approximately 1,098 m. The land slopes down from this high ground to all boundaries of the catchment. Low-lying areas near the intersection of Country Hills Boulevard and 36 Street NE have elevations of approximately 1,090 m. Near the intersection of Barlow Trail and Airport Trail, the land is near 1,086 m.

The Central East catchment is largely undeveloped and is used for agricultural purposes. The north half of the catchment slopes to the south from an elevation of roughly 1,093 m to roughly 1,087 m. The majority of stormwater runoff from this half of the catchment collects in an intermittently wet depression located near the eastern boundary of the catchment, south of 80 Avenue NE. The south half of the Central East catchment has ground elevations ranging from roughly 1,087 m to 1,083 m. Overall, the Central East catchment lands are poorly drained and it is expected that little runoff exits the catchment.

The North Central catchment includes the ATB, passenger aprons, the Airport Corporate Centre, and adjacent staff and public parking areas. The area between the ATB and the existing Barlow Trail is largely undeveloped. Stormwater runoff from the North Central catchment drains to Pond A, located northwest of the ATB as shown on Figure 7-13. Two main storm trunks convey stormwater to Pond A. Pond A was recently re-designed into a 3-basin system. Two groundside retention basins (one wet and one dry) collect “clean” stormwater (i.e., non-glycol-contaminated runoff) from the North Central catchment. Glycol-contaminated runoff collected by vacuum trucks is disposed at a pump station that discharges through a force main to the City of Calgary wastewater treatment plant (Bonnybrook). An airside retention basin collects the remaining glycol contaminated runoff. This basin uses an aeration system and dissolved oxygen to biologically degrade the glycol in the runoff. Discharge from the basins combine and flow through a 1,500 mm storm trunk along 96 Avenue NE to Nose Creek.

7.6.5.2 Stormwater Management Philosophy and Design Criteria

The proposed Runway 16L/34R and the ultimate groundside development will add large impervious areas and yield higher volumes of runoff as compared to pre-development conditions. As the land is covered by man-made structures, the natural surface available for water storage and infiltration will also decrease dramatically.

To manage the impacts from the large impervious areas, drainage systems are required that typically include storm sewer pipes (minor systems), overland flow paths (major systems) and storage facilities. Generally, storage facilities are a combination of parking lot storage, rooftop storage and dry or wet detention ponds. These storage facilities are designed to retain the surface runoff and to control the release rate from the new developments in order to protect downstream areas.

The 2003 Stormwater Management Master Plan Update establishes the stormwater management philosophy and design criteria for the PRP. The Plan states the following:

- The dual-drainage concept (i.e., minor/major systems) will be used as the design basis for the drainage system at YYC.
- The drainage systems within future developments (i.e., systems upstream of any large-scale stormwater management facilities) will be sized based on unit area interception rates ranging from 50 to 150 l/s/ha.
- Within the future developments, excess runoff that is not intercepted by catch basins and storm sewers will be accommodated by an overland conveyance system or by on-site storage facilities.
- Surcharging of storm sewers is allowed, provided impacts on buildings and weeping tile systems are identified.
- A combination of best management practices (BMPs) is envisioned to be implemented for the PRP. Most of the end-of-pipe facilities will be dry ponds because of air traffic safety concerns. Other types of BMPs such as source-control BMPs and oil-grit separators will be considered since dry ponds have only limited water quality. enhancement capabilities. Grassed swales may also be considered where they would not constitute a hazard.
- Alberta Environment requires an 85% reduction in Total Suspended Solids (TSS) in stormwater runoff.
- The unit area release rate to Nose Creek is 2.6 l/s/ha for the 1:100 year event. Several large-scale stormwater management facilities are required to comply with this rate.
- Adequate on-site storage will be provided in the developments east of 36 Street NE so that there will not be any upstream lands contributing flows into YYC lands up to the 1:100 year event. Interim conditions may need to be considered until the area east of 36 Street NE is fully developed.
- TC has specific criteria for the duration of temporary ponding on airport lands. These criteria are safety-driven in that excessive ponding in the vicinity of runways or taxiways is undesirable.

7.6.5.3 Proposed Stormwater Management System

Within the North East catchment, the second storage basin of Pond J will be required to handle the additional stormwater runoff from the proposed parallel runway and taxiways as shown in Figure 7-13. Within the Central East catchment, a large-scale stormwater management facility referred to as Pond K is required. The first portion of Pond K has already been constructed and a gravity storm sewer outlet draining to the west has already been installed, as shown on Figure 7-13. The existing Pond K will require enlargement to accommodate the storage requirements of the PRP.

To handle the additional stormwater runoff ultimately expected within the North Central catchment, a fourth storage basin will be required at Pond A.

Along the proposed parallel runway and taxiways, stormwater runoff from paved areas will drain toward grassed ditches as shown on Figure 7-14. Catchbasins located within the ditches will transfer the stormwater into the storm sewers as shown on Figure 7-15. The catchbasins and storm sewers are designed to handle the runoff from the 1:5 year event.

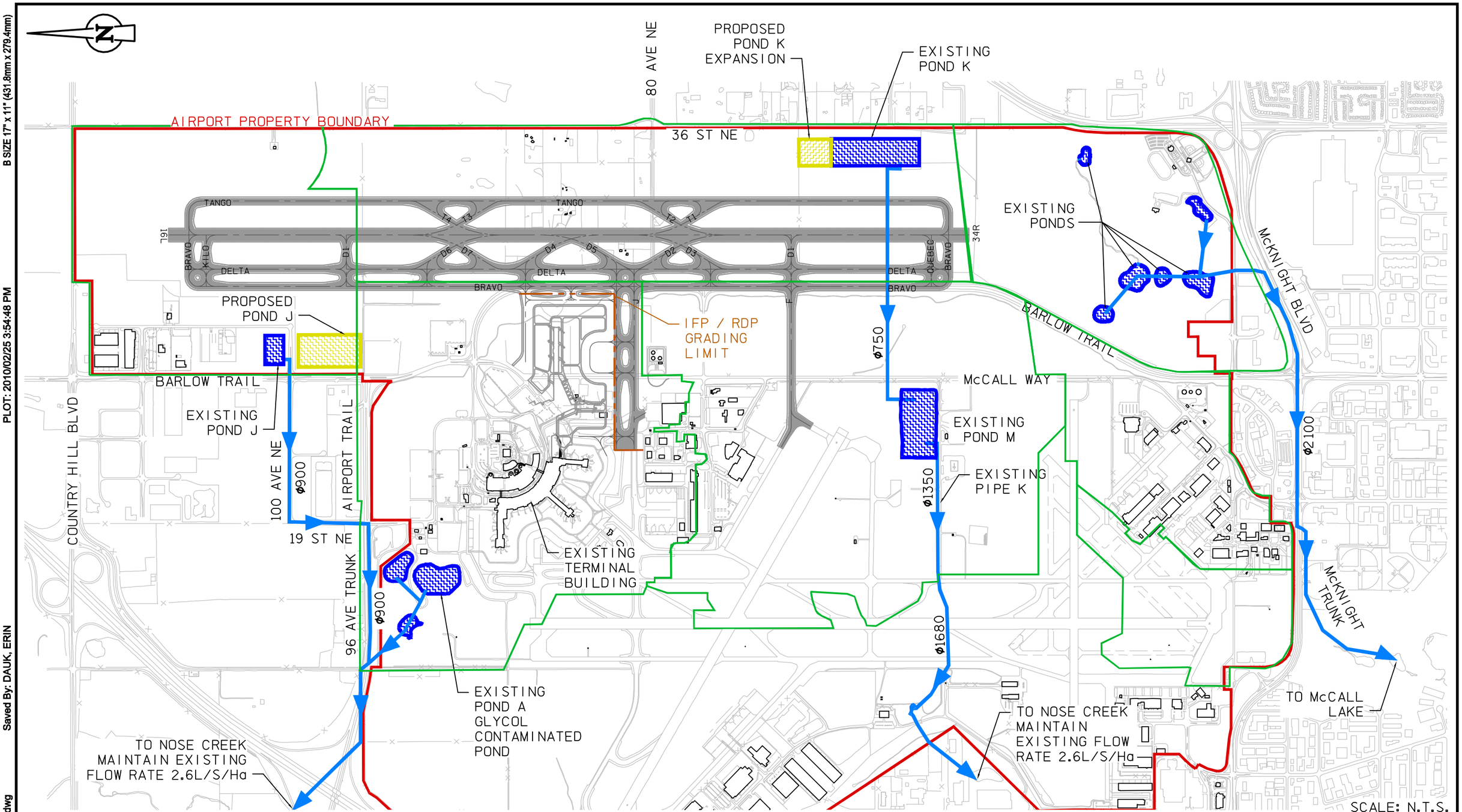
The ditches between the proposed parallel runway and Taxiways D and T will be graded to form a continuous overland flow route so that any flows not intercepted by the storm sewers will flow away from the parallel runway via culverts under the taxiways. Hence, no ponding is planned within the parallel runway ditches up to the 1:100 year event. All other ditches (i.e., between Taxiways D and B, to the west of Taxiway B and to the east of Taxiway T) will be graded to allow short-term ponding of less than 4 hours during a 1:100 year event.

Separate storm sewers will run along the east boundaries of the North East and Central East catchments. The front of the leased lots along 36 Street NE will discharge stormwater into these storm sewers. Stormwater runoff for up to the 1:100 year event will have to be stored on-site and then released into the storm sewers.

Runoff from the proposed Taxiway J and IFP development in the North Central catchment will be redirected to flow south through a new trunk storm sewer to existing Pond M. Pond M has been constructed with sufficient capacity to accommodate the storm water storage requirements of the immediate North Central development.

Geotechnical investigations have indicated relatively shallow bedrock and groundwater levels exist along the alignment of the proposed parallel runway and taxiways. It is expected that excavations for some of the storm sewers and ditches, as well as Pond K, will be in bedrock and below the groundwater level.

One of the objectives of the stormwater drainage design will be to continue to comply with the terms of the Nose Creek Watershed Water Management Plan (NCWWMP) on discharge to Nose Creek.



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AECOM

LEGEND:

- CATCHMENT BOUNDARY
- EXISTING STORM TRUNK
- EXISTING POND
- PROPOSED POND

The Calgary Airport Authority
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Parallel Runway Project

Stormwater Management
Storm Trunks

Figure 7-13

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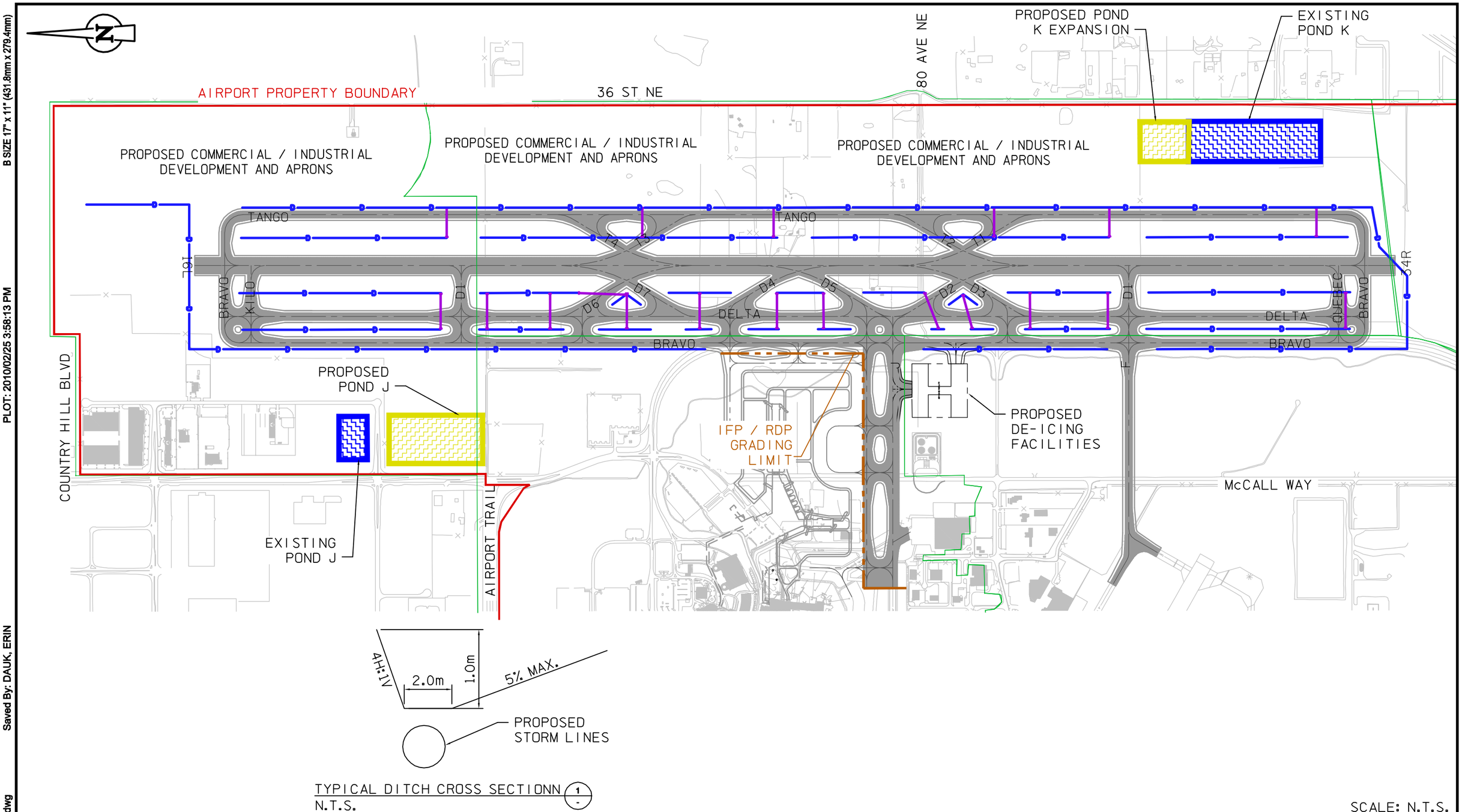

LEGEND:

- CATCHMENT BOUNDARY
- PROPOSED CULVERTS
- PROPOSED DITCH

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Stormwater Management Ditch / Culvert Systems

Figure 7-14

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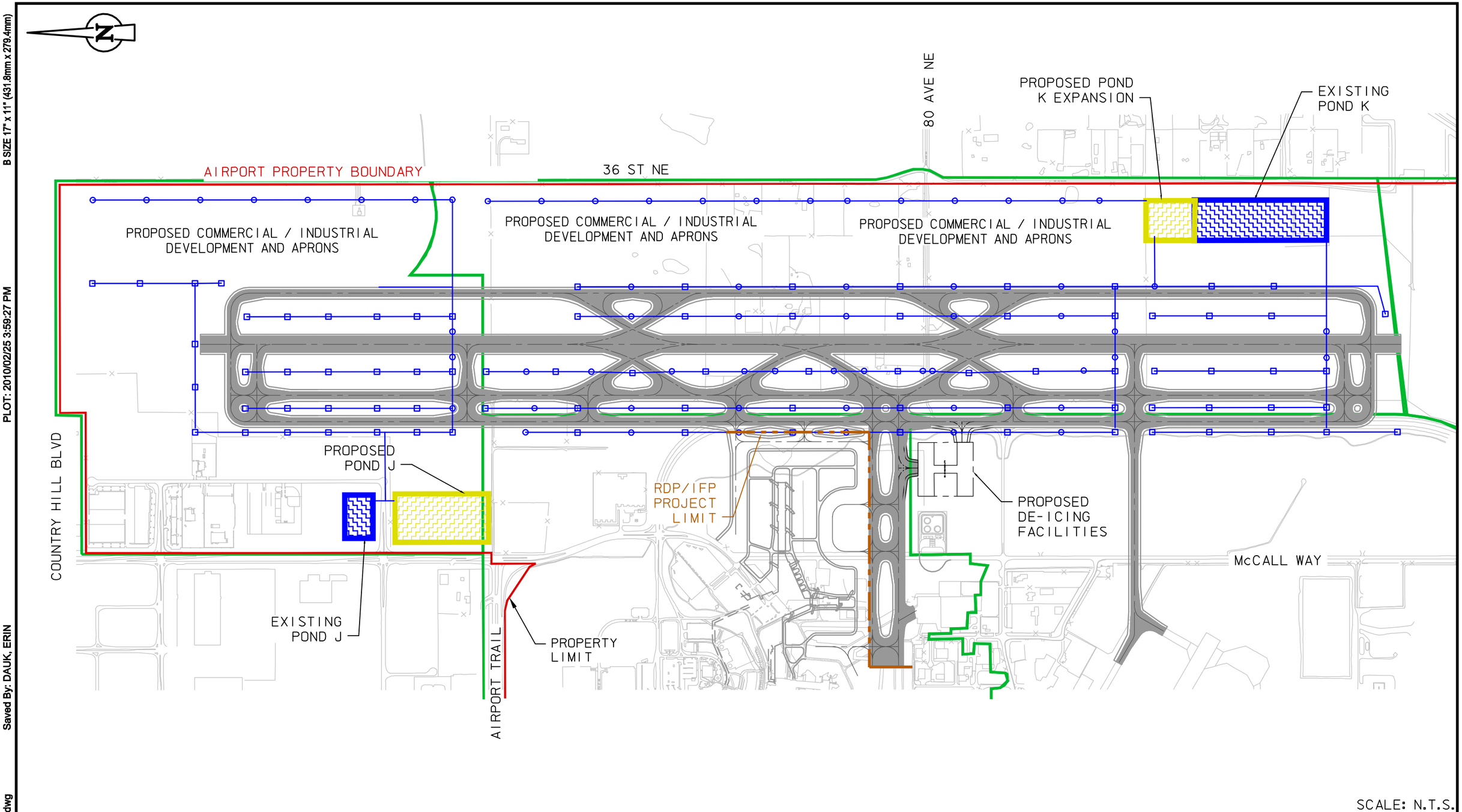

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AECOM

LEGEND:

- CATCHMENT BOUNDARY
- PROPOSED STORM LINE
- PROPOSED CATCH BASIN
- PROPOSED MANHOLE

The Calgary Airport Authority
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Parallel Runway Project

Stormwater Collection System **Figure 7-15**

B SIZE 17" x 11" (431.8mm x 279.4mm)
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7.6.6 Taxiway J Underpass

The 2004 Master Plan recommended the construction of an airside road tunnel, referred to as the aviation support precinct tunnel (Taxiway J Underpass) to provide a direct north/south link between the air cargo terminals and the passenger terminal apron. A conceptual design for the Taxiway J Underpass was developed in the 2007 Feasibility Study. The general layout and plan views illustrating the concept for the Taxiway J Underpass are shown in Figures 7-16 and 7-17. The underpass will consist of a reinforced concrete structure approximately 200 m long, 5.5 m deep and 14.2 m wide. The underpass will accommodate one lane of traffic flow in each direction along with paved shoulders and concrete sidewalks.

The Taxiway J Underpass is planned as an airside road link intended to allow free movement of aviation-related support equipment and materials within the restricted area of the airfield and is not intended for public use.

The structural engineering design for the Taxiway J Underpass takes into account existing geotechnical information, including the presence of claystone bedrock approximately 8 m below existing grade and the presence of groundwater at approximately 2 m to 4 m below existing grade. The proximity to the proposed IFP apron pavement and ramp slopes to apron/taxiway grade were also considered. A cut and cover construction method is proposed.

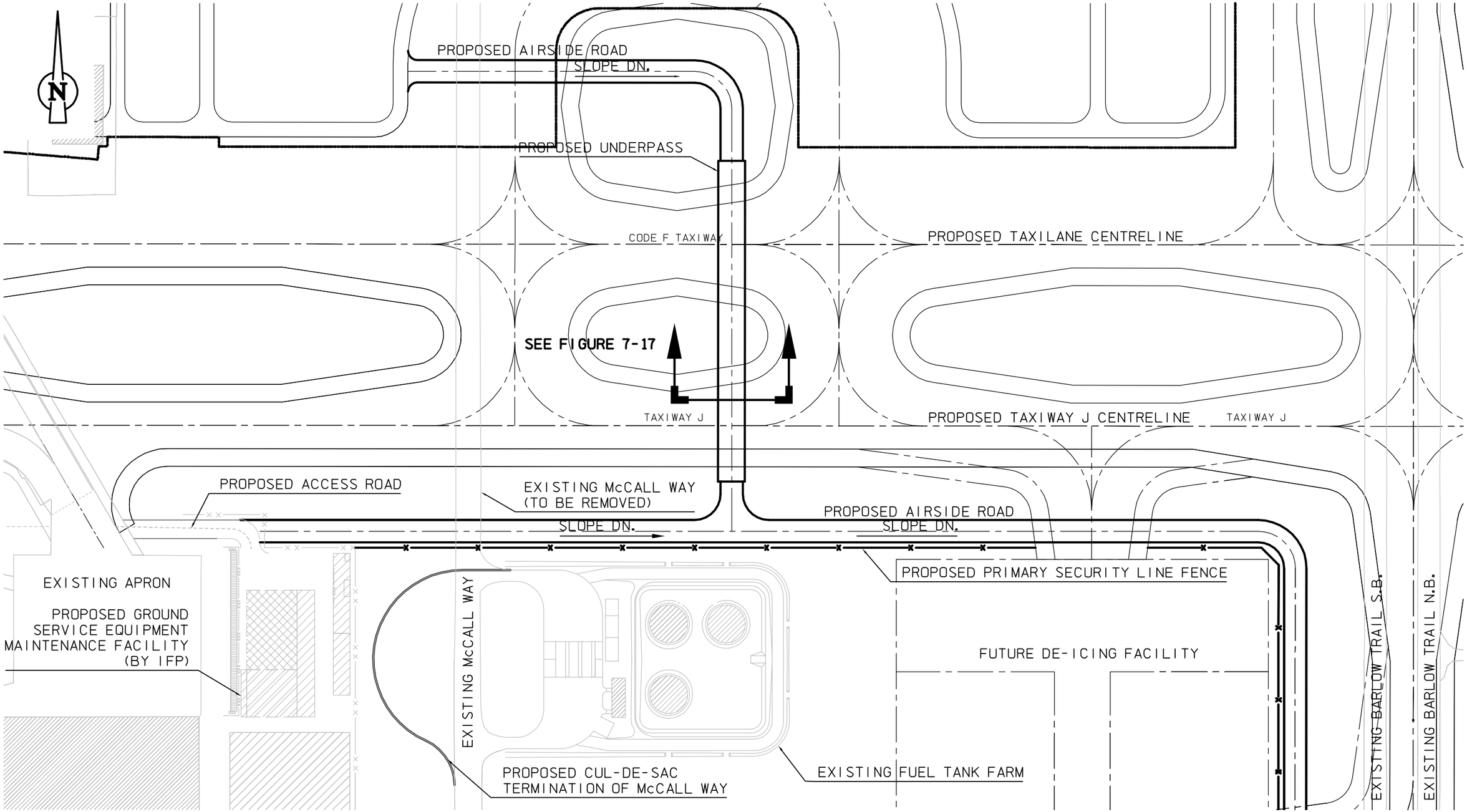
7.6.7 Taxiway F Extension and Underpass

7.6.7.1 Background

Preliminary airfield modeling analysis has revealed that a second cross-field taxiway is required in addition to Taxiway J in order to ease congestion in the vicinity of the terminal complex. It would create an alternate taxi route in order to eliminate head-to-head conflicts as aircraft move between the eastern and western sides of YYC. A second cross-field taxiway was identified in the 2004 Calgary International Airport Master Plan as Taxiway R, running parallel with and in close proximity to Taxiway J.

Due to the presence of existing airfield infrastructure including the Air Canada hangar, the aviation fuel tank facility, and various cargo and aviation support facilities, construction of Taxiway R is not possible without a major re-development of the area. Although this infield redevelopment forms part of the long-term planning for the airport, construction of Taxiway R is not feasible in time to support the PRP.

In order to address the potential air traffic congestion problem, an extension of the existing Taxiway F to the east is proposed to connect the existing airfield to the new parallel runway system. The extension of Taxiway F will require the construction of a roadway underpass to allow continued public access to the McCall North Trade Park area via McCall Way. The general layout and plan views illustrating the concept for the Taxiway F Extension and Underpass are shown in Figures 7-18 and 7-19. The Taxiway F Underpass will be a taxiway bridge structure approximately 60 m wide and 20 m long. Clearance between the new McCall Way road surface and the underside of the taxiway bridge will be 4.5 m.



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AECOM

SCALE: 1:2000

0 25 50 75 100 200 METRES

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General Layout of Taxiway J Underpass

Figure 7-16

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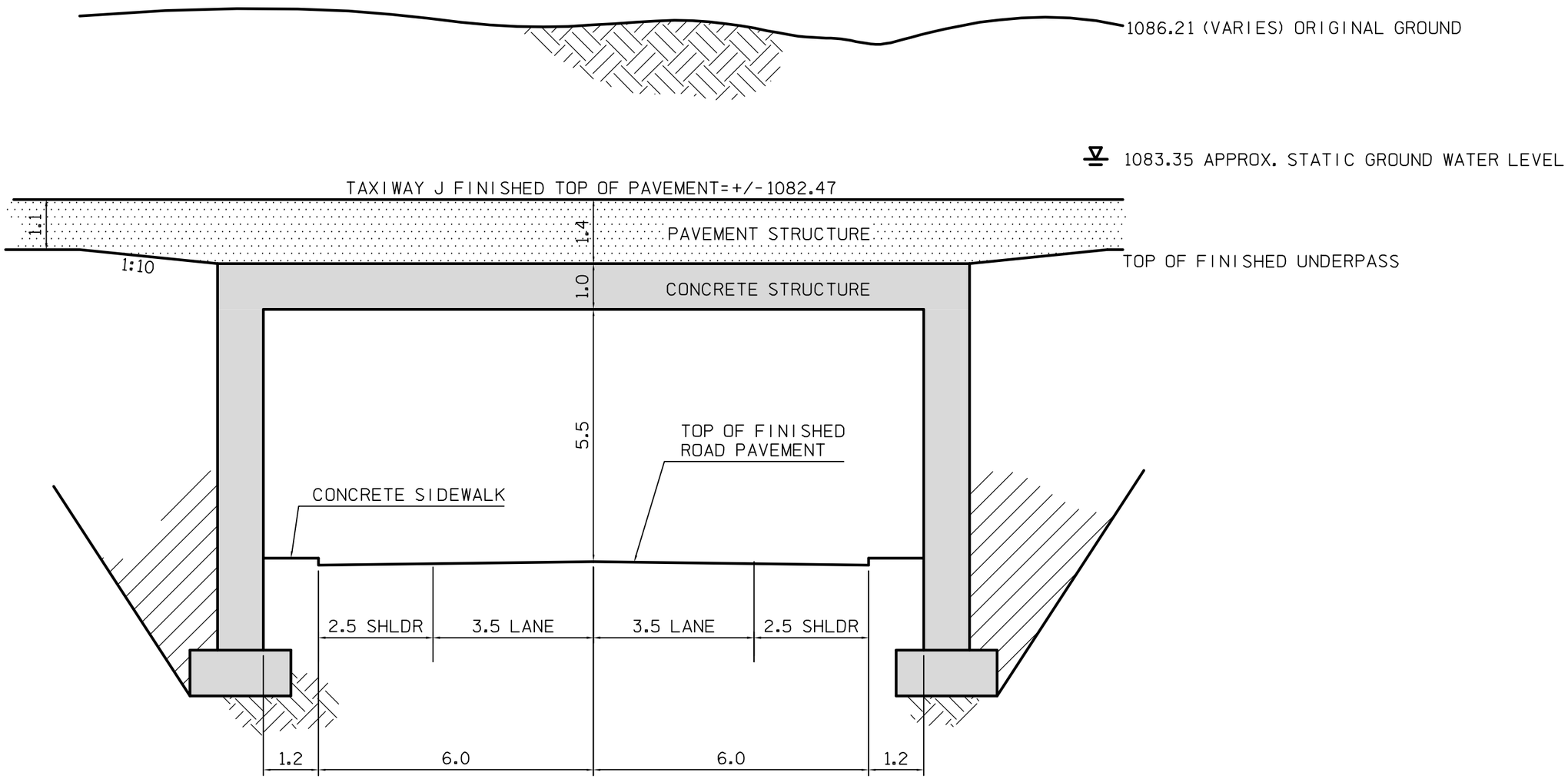

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0 20 40 60 METRES

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Typical Profile of Taxiway J & Underpass

Figure 7-17

B SIZE 17" x 11" (431.8mm x 279.4mm)
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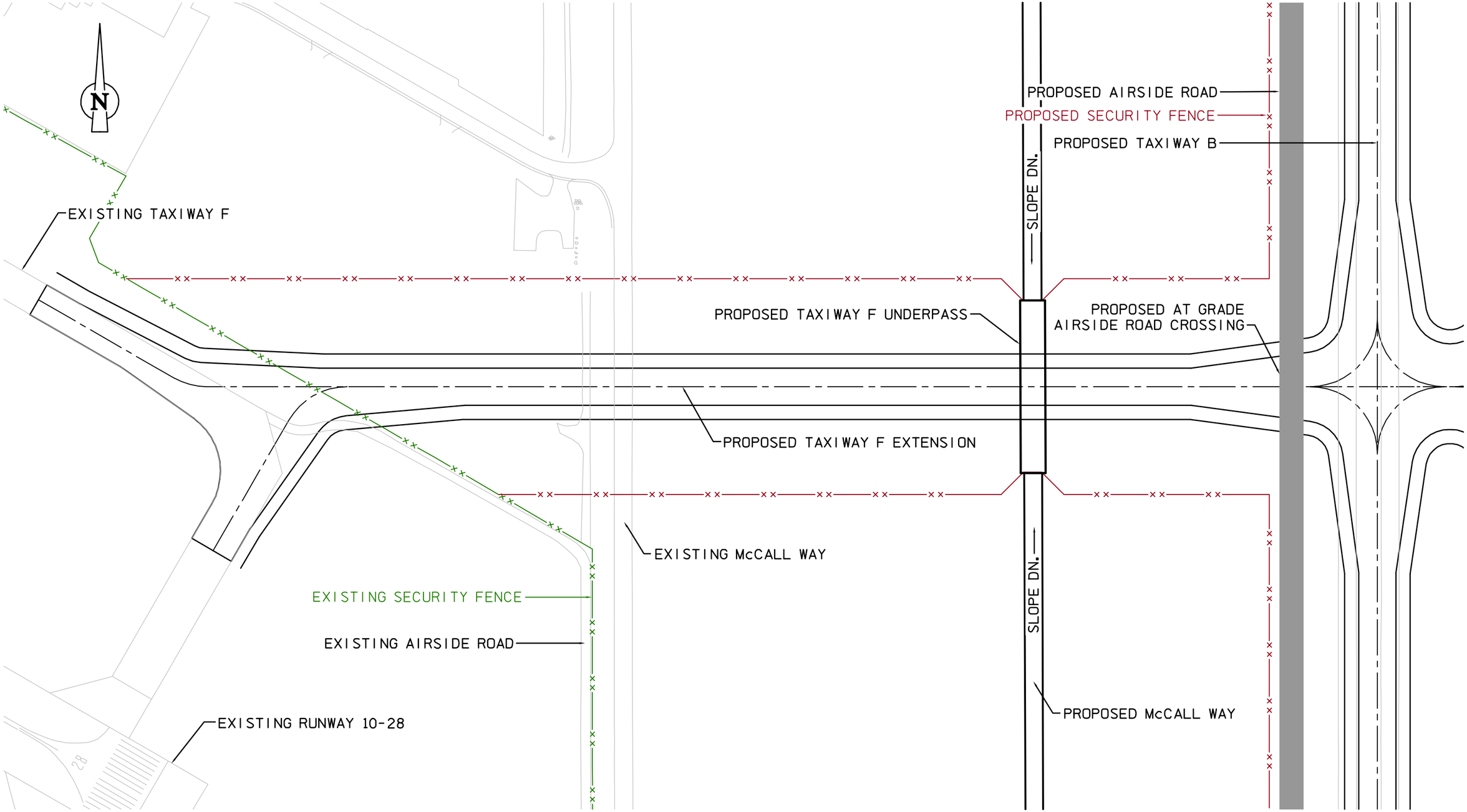

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General Layout of Taxiway F Underpass

Figure 7-18

B SIZE 17" x 11" (431.8mm x 279.4mm)
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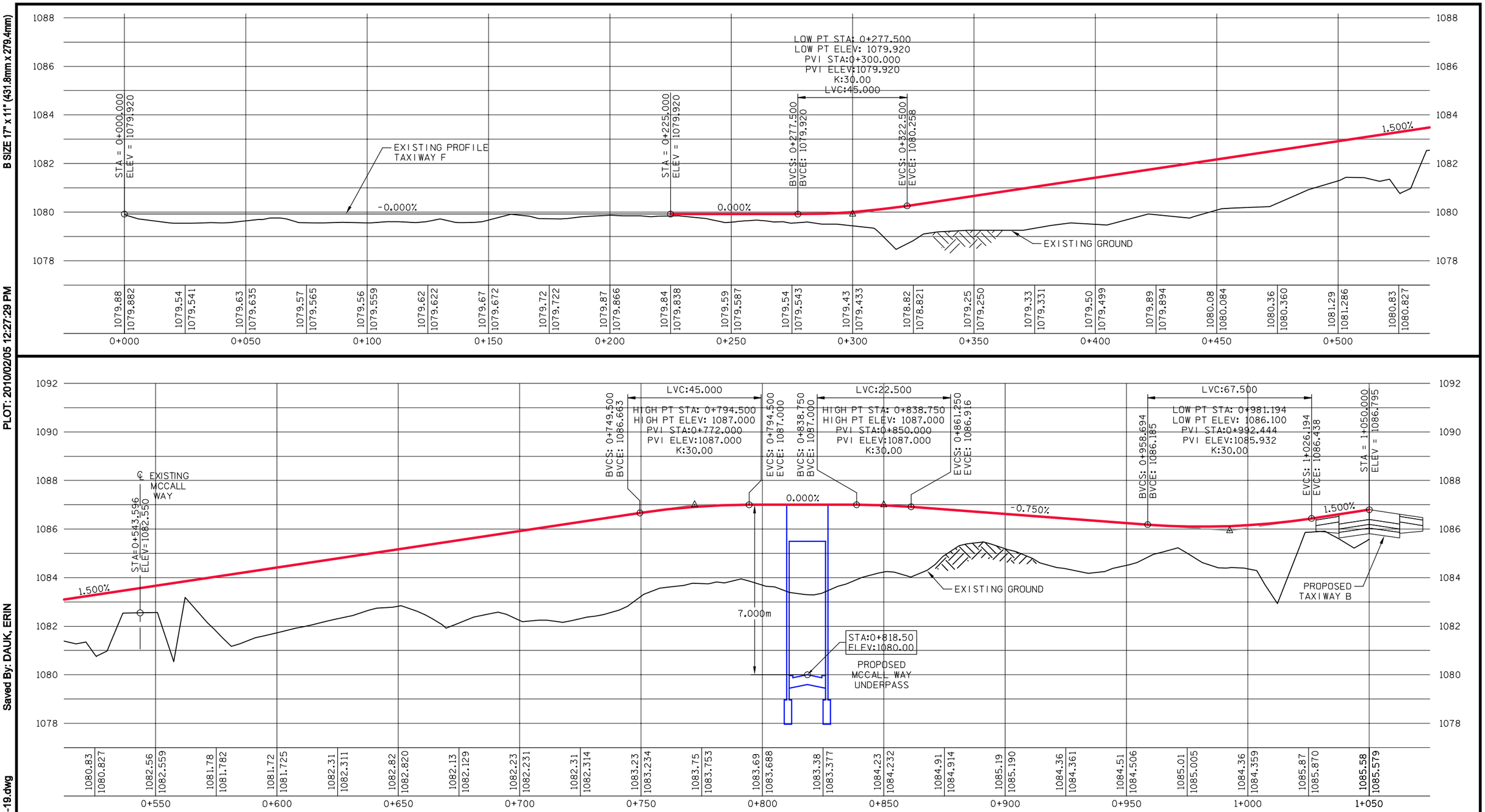

HORIZONTAL SCALE

0 25 50 75 100

VERTICAL SCALE

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Typical Profile of Taxiway F

Figure 7-19

B SIZE 17" x 11" (431.8mm x 279.4mm)
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7.6.8 Groundside Roads

The Authority's groundside roadways network will be altered as a result of the PRP airfield expansion. These alterations include the following (Figure 7-20):

- Barlow Trail will be close and removed between approximately 48 Avenue NE and Airport Trail and the remaining stub running north from McKnight Boulevard NE will be connected to McCall Way through a new roundabout
- McCall Way will be closed just north of the existing access to the Calgary Fuel Facility Consortium (CFFC) tank farm
- An underpass will be constructed at the point where the Taxiway F eastern extension crosses McCall Way
- 78 Avenue NE from McCall Way to Barlow Trail will be closed and removed
- 48 Avenue NE will be extended to the east to connect with 36 Street NE
- 80 Avenue NE will be closed west of 36 Street NE. Once the residences/structures are removed and mass earthworks commence, the road will be removed and contoured as part of the overall site grading.

7.6.8.1 Barlow Trail

The closure of Barlow Trail from north of 48 Avenue NE to Airport Trail is scheduled to occur in April 2011. The Authority is considering routing alternatives to align the southern section of Barlow Trail with McCall Way to reduce congestion from McKnight Boulevard onto McCall Way for traffic accessing businesses on George Craig Drive, Palmer Road, McCall Landing and Pegasus Road. The closed portion of Barlow Trail will be demolished, and the asphalt and concrete waste will be recycled. Granular materials beneath the paved surface will be reused in the IFP or PRP projects.

7.6.8.2 McCall Way, Taxiway F Underpass

McCall Way will be closed just north of the existing access to the CFFC tank farm at 78 Avenue. A security fence and manned Gate 306A will prevent traffic from traveling airside. The closure of McCall Way is scheduled to occur in April 2011. The extension of Taxiway F east to Taxiway D1 warrants the construction of an underpass to carry traffic to the McCall North Tradepark. The alignment of McCall Way as it approaches the Taxiway F alignment needs to be determined; moving the underpass east, somewhat central between existing Barlow and McCall Way may be necessary to achieve an acceptable grade to Taxiway B/D. Bedrock and water table elevations are known to be high in the vicinity of the underpass. Tunnel configuration will accommodate the existing asphalt two-lane configuration of McCall Way.

The closure of McCall Way is a result of both the IFP terminal/apron expansion and the extension of Taxiway J as the primary connection point from the existing terminal to the expanded airfield.

7.6.8.3 Barlow Trail – McCall Way Connection and 78 Avenue NE Closure

A new section of 2 lane road will be built connecting 48th Avenue to the existing 36 Street alignment at approximately 63 Avenue NE. This will reduce congestion for traffic currently accessing businesses on George Craig Drive, Palmer Road, McCall Landing and Pegasus Road by means of McKnight Boulevard and McCall Way. Closure of Barlow Trail and the new connection to McCall Way allow closure of 78 Avenue NE between McCall Way and Barlow Trail as there will no longer be a need for 78 Avenue to extend east of McCall Way. The closed portion of 78 Avenue will be demolished.

7.6.8.4 Extension of 48 Avenue NE to 36 Street NE

Currently, 48 Avenue NE terminates in Rotary Challenger Park and does not connect to 36 Street NE directly. The extension of 48 Avenue to 36 Street through Rotary Challenger Park is being investigated with The City of Calgary.

7.6.8.5 Closure of 80 Avenue NE

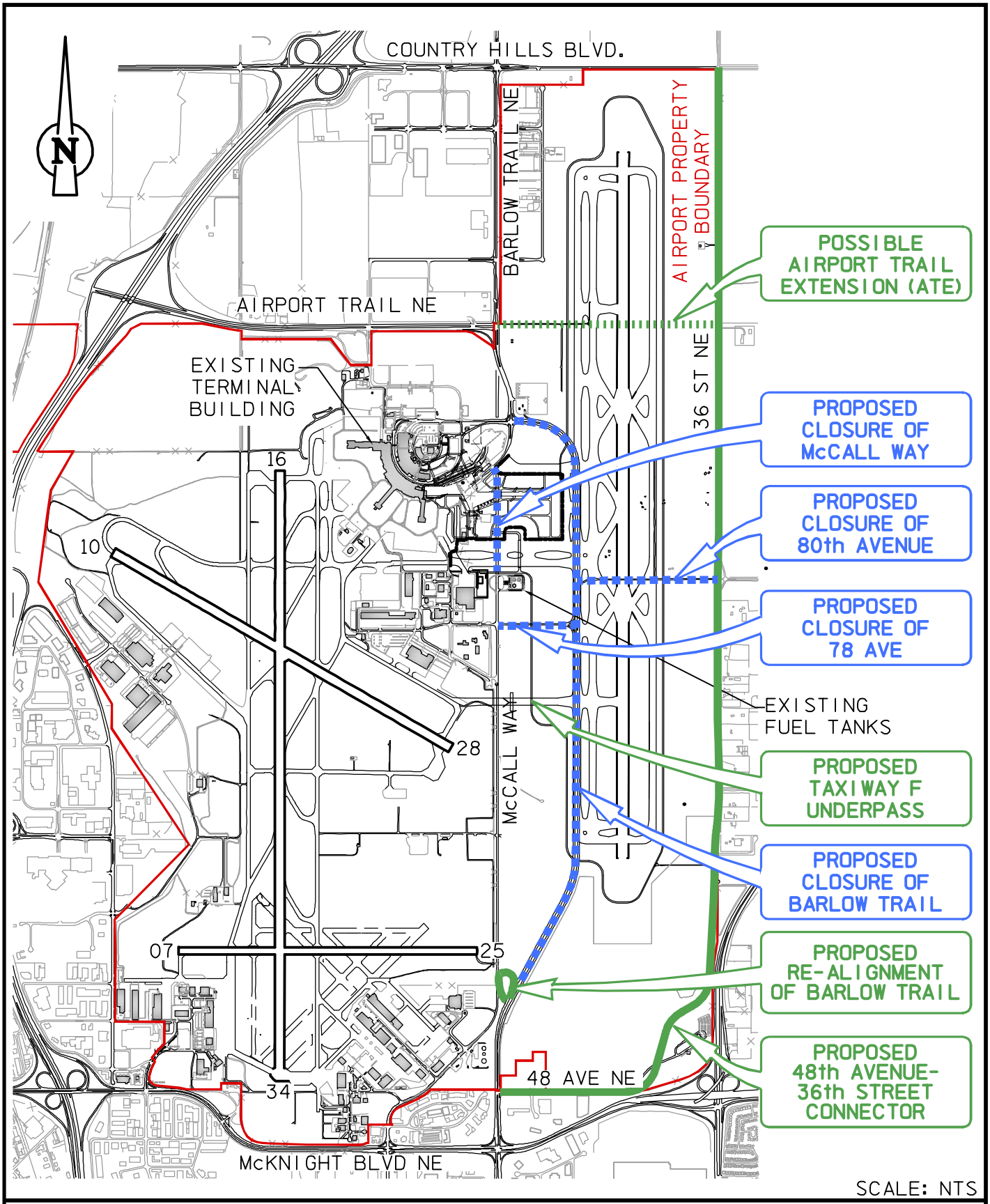
80 Avenue NE will be closed west of 36 Street NE.

7.6.8.6 Temporary Roads and Traffic Routes during Construction

During the construction phase of the PRP there will be increased truck traffic delivering materials to the PRP site and an increase in vehicular movements from PRP workers. A traffic accommodation plan will be implemented to mitigate the impact of the construction traffic on the surrounding road network, both municipal and provincial, for the duration of the construction phase. Haul routes, pre-determined with the City of Calgary and Alberta Transportation, will be utilized to haul materials to site. Construction traffic will be accommodated on site, wherever possible, with dedicated routes / roads within the PRP footprint. At peak construction, there are expected to be 400 onsite workers, bulk aggregates for the pavement structure will approach 1M cubic meters, resulting in a significant volume of truck traffic to various location on the project site, appropriate traffic accommodation is being considered including haul of material during off peak hours and during the winter. Construction activities are described further in Section 7.8, and the general pavement structure is detailed in Section 7.6.3.

7.6.8.7 City of Calgary Network

The City of Calgary Transportation Planning group and the Authority recognize that airport expansion will have an effect on traffic volumes on City roads near the airport. The City and the Authority are working together to improve the road network near the airport to accommodate additional traffic volumes from airport expansion and municipal growth. The City is considering improvements to Airport Trail, Metis Trail, 36 Street NE and Country Hills Boulevard NE. These improvements are included in the City's long term transportation plan ('Plan-It Calgary') and are briefly described in Section 7.11 of this report.



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Road Network Changes

Figure 7-20

7.6.9 Airside Maintenance Centre

The Airside Maintenance Centre (AMC) is located in the southwest corner of the airfield; it consists primarily of two large buildings of different age. The older of the two buildings was constructed in the 1960s and 1970s and houses the sand and sodium formate dry de-icing pellets, equipment parking, equipment maintenance area and wash bay, metal fabrication shop, airside supervisor's offices, locker room, lunch room, small equipment storage and stores, mechanical and electrical rooms, training room, and administrative office space. The AMC is serviced by city-supplied potable water, and the sewer connects to the City's sanitary sewer system.

The newer equipment parking building was constructed in 2001 (five bays) with an expansion in 2008 (three maintenance bays). This building stores the Vammas snow removal vehicles, loaders, sprayers, tractors, and other airfield maintenance equipment in the five-bay arrangement, with maintenance and a wash bay housed in the three-bay arrangement. A 15 ton gantry crane and high ceilings provide complete maintenance access for all equipment. The building is configured in a drive-in, drive-out arrangement with the plows for the Vammas' stored outside. The building is equipped with ventilation, fire protection, and heating built to current standards, and it incorporates room to manoeuvre equipment.

Other AMC structures include two cold storage buildings, all in good condition, and a heated storage building. Outside fenced storage areas include environmental storage, waste storage, electrical storage, recycled metals storage, and structural storage. Fuelling operations for diesel and gasoline are provided on-site, in above-ground storage tanks, and in skid-mounted dispensers. Other above-ground liquid storage tanks hold potassium acetate anti-icing chemical and waste oil from maintenance operations.

The primary function of the AMC is the storage of all airside equipment in a warm environment, ready for organized deployment for snow and ice removal. Equipment storage areas in both buildings are at capacity, and additional equipment is stored outside. Runway 16L/34R will be a priority surface such that equipment and operator requirements are expected to increase by up to 40%; however, the extent of the additional equipment for the fleet is not yet final. Each of the facilities at the existing AMC are necessary and their use will increase as a result of the PRP.

The existing AMC occupies a site of approximately 4.6 ha; approximately 7.5 ha will be required in total for the expanded AMC requirements to be met. Two options being considered by the Authority to meet the expanded need are:

- Expansion of the AMC in its current location
- Relocation of the AMC to a centralized location on the airfield (two alternatives are under consideration)

The decision on whether the AMC will be expanded or relocated will be determined as part of detailed design in 2010. For the purpose of the EA, it will be assumed that the expanded AMC will be relocated to a centralized location as this is the alternative which is deemed to have the greatest effect.

7.6.10 Airfield Electrical Distribution System and Navigational Aids

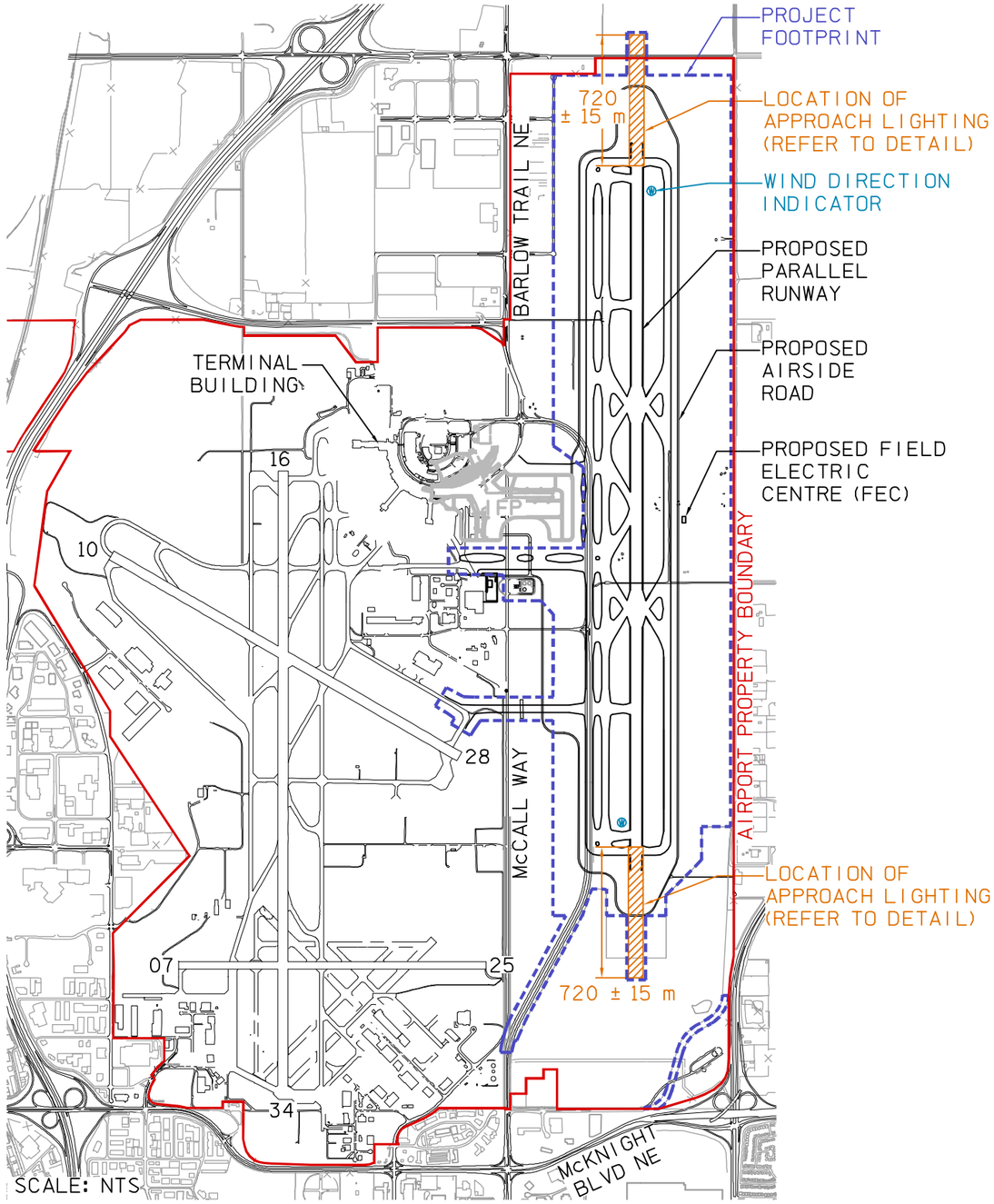
7.6.10.1 Air Navigation and NAV CANADA Interface

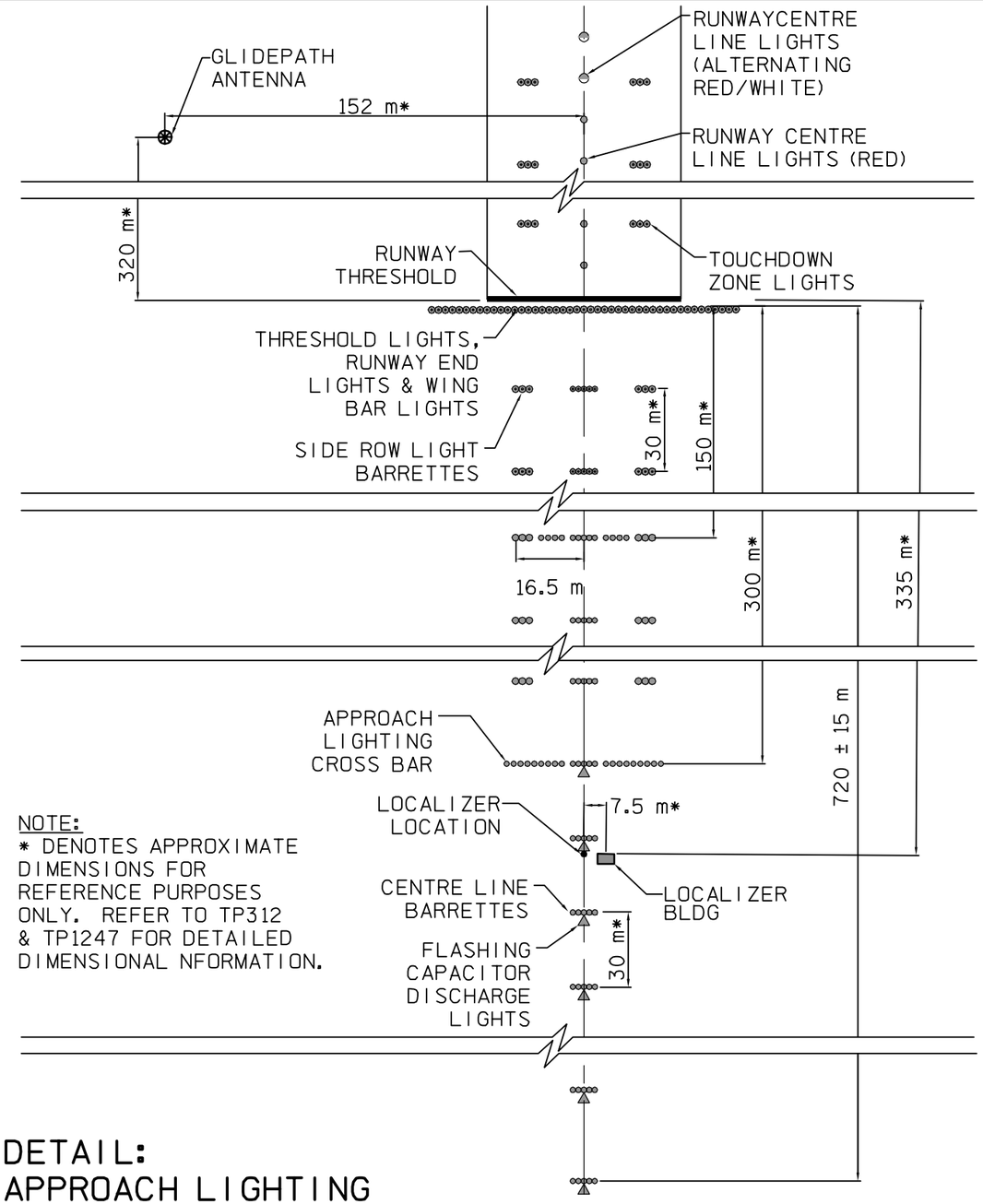
Through stakeholder consultation, the Runway Development Program preliminary design has proceeded based on a Category II/III (CAT II/III) ILS with the understanding that the final decision on the ILS category will be made during the detailed design stage.

The ILS consists of two major subsystems – electronic navigational aids and visual navigational aids.

NAV CANADA will provide the electronic ILS system components for the 16L and 34R approaches on the new runway. These electronic aids consist of a Glidepath (GP) unit co-located with Distance Measuring Equipment (DME) that provide glide slope and distance to threshold information to the pilot; and, a Localizer (LOC) unit for each runway end that provides centreline alignment information.

The visual navigational aids consist of approach lighting, which provides visual reference to pilots on approach, and ground lighting, which provides visual clarity for pilots as the aircraft moves across the airfield. Visual navigational aids include runway edge, centerline, threshold and touchdown zone lighting, taxiway centerline and edge lights, stop bars and runway guard lights, and illuminated guidance signs, as detailed on Figure 7-21.





NOTE:
* DENOTES APPROXIMATE DIMENSIONS FOR REFERENCE PURPOSES ONLY. REFER TO TP312 & TP1247 FOR DETAILED DIMENSIONAL NFORMATION.

DETAIL:
APPROACH LIGHTING

SCALE: NTS

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Navigational Aids **Figure 7-21**

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7.6.10.2 Airfield Lighting

The primary standard used in the design of light locations, quantities, alignment, and power requirements is based on TC Standard TP312E - Aerodrome Standards and Recommended Practices (4th Edition, March 1993). The following standards are also referenced:

- ICAO Annex 14 Aerodromes; Chapter 5 – Visual Aids for Navigation (4th Edition, July 2004)
- ICAO Aerodrome Design Manual; Part 5 – Electrical Systems (1st Edition, 1983).
- Canadian Electrical Code
- Alberta Electrical Safety Code

The main elements for the CAT II/III airfield lighting system include runway centreline lighting, threshold and touchdown zone lighting (inset), and high-intensity edge lighting (elevated) for the runway. The CAT II/III precision approach lighting (ALSF-2) for the runway consists of both steady burning lights and sequenced flashing lights to provide final guidance to the threshold.

On the taxiway system there are both elevated edge lights to delineate the pavement edges and in CAT III conditions, inset lights on all taxiway centrelines. In addition, there are a number of additional lighting systems that are required for low visibility conditions in order to prevent runway incursions and provide proper guidance to pilots, including static and dynamic stop bars at runway/taxiway intersections, runway guard lights (also known as wig-wags) to alert pilots that they are approaching a runway, and multiple fibre-optic guidance signs to provide direction guidance on the taxiway and runway system.

To ensure reliability of both the ILS and airfield in CAT II/III landing/takeoff conditions, this equipment must have emergency backup power available with a maximum switchover time of one second. Thus, either the emergency generator will be in operation during CAT II/III conditions or the FEC will need a second power supply from an independent substation to guarantee this switchover time.

7.6.10.3 Utility System and Corridors

Primary power for the airfield lighting and ILS system will be provided via a single 27.6 kV, 3-phase, 60Hz power supply fed along 36 Street from an existing substation located off YYC property. ENMAX has been engaged to design and construct this primary power feed. Emergency backup power will be provided either by a second 27.6kV feed from an independent substation or by a 750 kW diesel-powered generator. A final decision regarding power backup will be made during detailed design. A series of duct banks are required for distribution of power throughout the expanded airfield site.

7.6.10.4 Power Supplies

A north-south power duct bank is proposed running the entire length of Runway 16L/34R, including nine 104 mm ducts from Taxiway D1 to D8; six 104 mm ducts continue from Taxiways D1 and D8 to the south and north thresholds of Runway 34R and 16L respectively. Two duct banks of nine 104 mm ducts connect to the FEC. The proposed location for this duct bank is 115 m west of Runway 16L/34R centreline, permitting the installation of long cable runs.

7.6.10.5 Communications

A communications duct bank system for Runway 16L/34R runs parallel and adjacent to the power duct bank, located 110 m from the runway centreline; it houses communication cables routed to the ILS sites, FEC, Air Traffic Control (ATC) tower, and circuit selector switch stations. This duct bank has been sized at four 104 mm ducts, with the assumption that all cables will be fibre optic, reducing the amount of duct space required.

7.6.10.6 Field Electric Centre

A new FEC will be located near the midpoint and to the east of the proposed runway/taxiway system. The FEC is required to support the airfield lighting infrastructure and will house the constant current regulators that provide power to the airfield lighting circuits, approach lighting systems, and the emergency generator and power feeds to the ILS sites.

The FEC is typically a prefabricated structure constructed in sections with a diesel generator backup power supply. In order to reduce the building footprint the equipment selected should be of a "piggyback" style capable of stacking constant current regulators and non-regulated power cells. For CAT II/III operations, an extra section would be required for regulators and power cells.

The Runway 16L/34R layout was considered to determine the location of the FEC. Criteria used to select the FEC location include: as near as possible to the midpoint of new runway/taxiway system to minimize cable runs, direct access from the airfield, and avoidance of future terminal development area. A preliminary single-line diagram and load calculations have been developed to size the facility and a preliminary FEC floor plan has been developed.

7.6.10.7 Instrument Landing System

The Authority typically provides the necessary structures, ducts, power and cabling requirements for the ILS. Power to the ILS is anticipated to be a 50 kVA power cell with a 25 kVA pad-mounted transformer providing power to each ILS site.

7.6.10.8 Lighting Fixtures

All lighting fixtures will be located in compliance with the TP312E 4th Edition requirements. Light Emitting Diode (LED) lighting fixtures are proposed for taxiway edge and centreline lighting, and obstruction lighting. At the time of construction, other LED lighting products may be available on the market and should be utilized as much as possible to reduce electrical load and operation and maintenance costs.

7.6.10.9 Circuits

The total number of circuits required for CAT II/III is 29. Remote Circuit Selector Switch Stations (CSSS) will be located in the field area. The CSSS will reduce cable costs and cable power losses with shorter cable runs on the airfield.

Each station will be connected into the main duct bank system and will consist of circuit selector switches (four per enclosure) for taxiway edge lighting, guidance signs, taxiway centerline lighting, and taxiway stopbar lighting. One circuit each has been allowed for taxiway edge and centerline lighting, and two circuits per stopbar location.

In total, there will be over 3,200 lighting fixtures, 370 km of cabling, and over 150 illuminated guidance signs.

7.7 Airport / Airside Improvements

The objective of airport / airside improvements at YYC is to expand and improve the capacity and efficiencies of the existing airfield infrastructure. These improvements are guided by the 2004 Master Plan and the Strategic Operating Plan 2009 - 2013. The 2004 Master Plan acts as the current framework for development at YYC for a 20 year period. Stakeholders with an interest in the planning and long-term operation of YYC include:

- The Authority
- TC
- NAV CANADA
- Airline carriers and cargo operators
- Lessees, tenants and concession holders

The following types of improvements to existing airport and airside infrastructure were included in the "Runway Development Project Airfield Model" completed by AirBiz to simulate aircraft movements at future projected traffic levels for the PRP (illustrated in Figure 7- 20):

- Taxiway improvements
- Apron / holdbay improvements
- Airfield pavement restoration projects

These improvements will be in place prior to commissioning of the new runway.

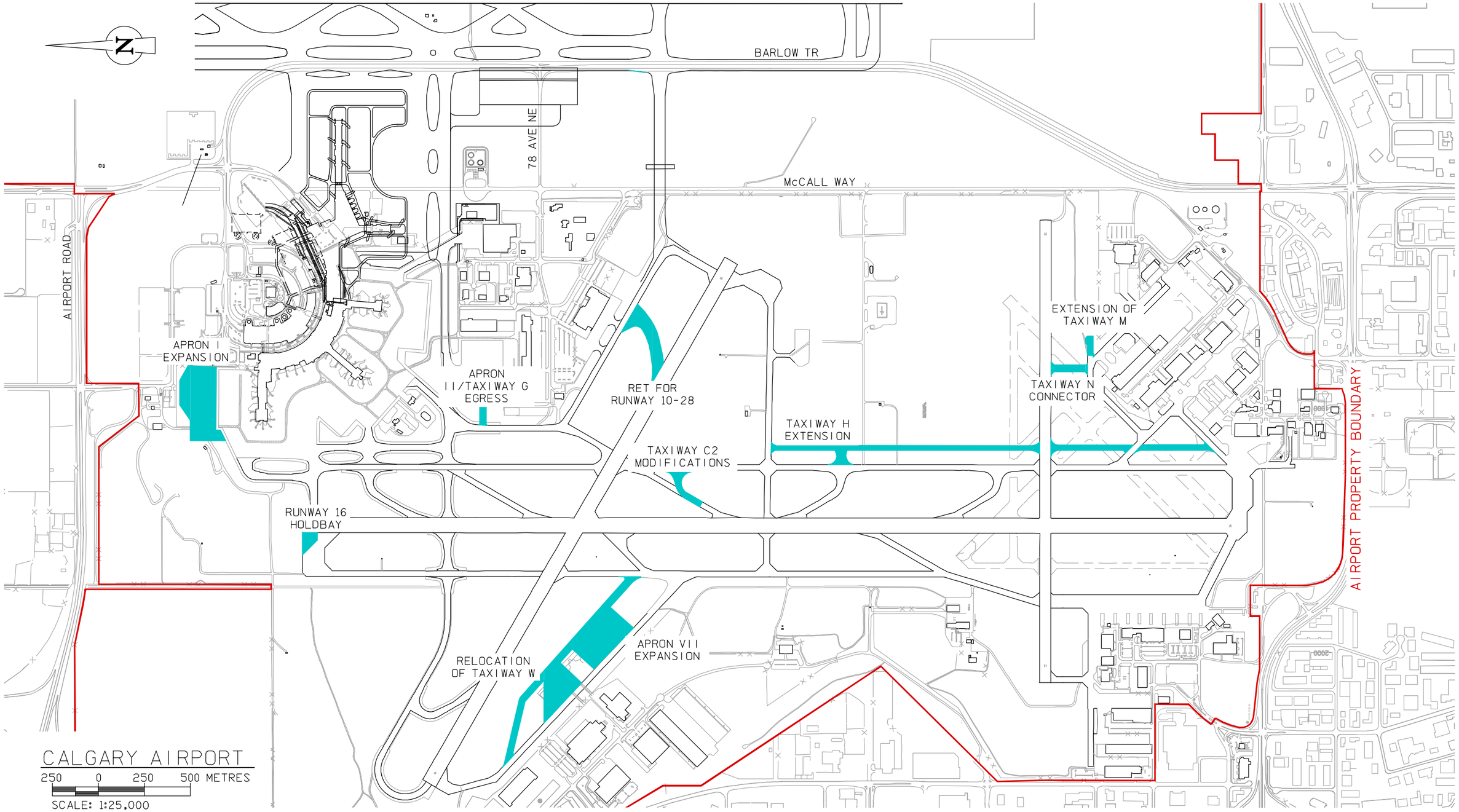
7.7.1 Taxiway Improvements

The following taxiway improvements, planned for completion prior to commissioning of the new runway, have also been considered in the airfield model simulating air traffic movements for the expanded airfield:

- Extension of Taxiway H
- Extension of Taxiway M
- Taxiway N Connector
- Relocation of Taxiway W
- RET for Runway 10-28 (F1)
- Taxiway C2 modifications.

7.7.1.1 Extension of Taxiway H

An evaluation of the planning for Taxiway H included in the 2004 Master Plan is currently underway. The Authority is evaluating projected air traffic volumes to determine the phasing of Taxiway H. Airfield modelling completed as part of the PRP Preliminary Design has considered the extension of Taxiway H as a parallel taxiway to the threshold of Runway 34. The result of this improvement will be reduced runway occupancy times for the 34/28 mode of operation and reduced head-to-head conflicts experienced on Taxiway C due to aircraft taxiing in both directions on this taxiway. The design is scheduled to be completed in 2010, with construction planned for 2011.



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Airside / Airfield Improvements

Figure 7-22

7.7.1.2 Extension of Taxiway M

A 90 m extension to Taxiway M will be completed to the east of the intersection with Taxiway N. This improvement will provide a run-up area without having to taxi to the Runway 28 holdbay and will allow Code D aircraft to turn around for engine run-ups.

Included in the 2004 Master Plan is a further extension of Taxiway M from the Runway 25 threshold to Apron VI.

7.7.1.3 Taxiway N Connector

A Taxiway N Connector will be completed to provide midfield access to Runway 07-25. The result is a circular route for access and egress to Apron V, adding alternate routes and reducing usage of Taxiway C in the vicinity of the Runway 34 threshold during peak usage periods.

7.7.1.4 Relocation of Taxiway W

The relocation of Taxiway W to the north of the existing alignment is planned to enable efficient access to Apron VII for the cargo carriers without crossing an active taxiway and to improve the ATC tower sightline to Runway 10 which is currently being obstructed by the aircraft tails on Apron VII. The current alignment of Taxiway W requires personnel to cross the active taxiway to access Apron VII. The relocation of Taxiway W will provide an unobstructed sightline for the new integrated ATC tower location.

7.7.1.5 Rapid Exit Taxiway for Runway 10-28

A RET from Runway 10/28 to Taxiway F near the West Jet complex is planned for the 2010-2011 timeframe.

7.7.1.6 Taxiway C2 Modifications

Modifications to the alignment of Taxiway C2 have been made to address safety concerns and provide a perpendicular approach to Taxiway C.

7.7.2 Apron / Holdbay Improvements

The following apron / holdbay improvements are planned:

- Apron I Concourse D
- Apron II / Taxiway ‘G’ Egress
- Apron VII Expansion
- Runway 16 Holdbay

7.7.2.1 Apron I / Concourse D

The expansion of Apron I is currently in the construction phase to provide additional overnight off-gate parking for Concourse D.

7.7.2.2 Apron II / Taxiway G Egress

An egress from Apron II to Taxiway G will be completed in 2009 to provide power in and power out access / egress to aircraft and opportunities for de-icing on Apron II.

7.7.2.3 Apron VII Expansion

The Deerfoot South Aviation Tradepark is the preferred location for air express freight and associated surface distribution systems. Included in the 2004 Master Plan is the expansion of Apron VII to accommodate the centralization of the cargo carriers. The previously mentioned relocation of Taxiway W to the north of Apron VII provides the cargo carriers access to the apron without crossing an active taxiway to load and unload aircraft.

7.7.2.4 Runway 16 Holdbay

Expansion of the Runway 16 holdbay bringing the north edge of the holdbay flush with the end of Runway 16 is planned for 2010.

7.7.3 Airfield Pavement Restoration Projects

The Authority's Pavement Management System is in place to maintain the current airside and groundside pavement infrastructure on the Authority campus and is updated periodically. The Pavement Management System prioritizes the maintenance requirements and is the main driver of the five-year capital pavement restoration programs.

7.8 Project Construction and Activities

Scheduling of the PRP construction will follow a logical sequence of site services, earthworks, drainage, airfield lighting and FEC, pavement layers and landscaping. Airfield electrical work and navigational aids must be coordinated throughout the phases of construction to allow for buried conduits and connections necessary to the new and/or existing FEC and the new ATC tower.

7.8.1 Site Services

7.8.1.1 Utilities

The existing utilities currently traversing the PRP site must be relocated or terminated to accommodate construction of the expanded airfield. An extensive investigation to identify all of the affected utilities has been completed, and conflicts with the new PRP facilities have been identified. The three general solutions are abandonment, deepening, and re-routing of the existing utilities. At this time, all known existing utilities have been successfully identified and all utility providers have been engaged to identify potential solutions to re-route existing utilities, resolve conflicts, and maintain utility supply to the various on-airport customers. Routes for relocation of the existing utilities are identified in Section 7.6.4.

7.8.1.2 Stormwater Sewers

The southern end of Runway 16L/34R will cross an existing minor stormwater pipe. It is unknown at this time whether this pipe can be used for PRP stormwater management or if it will be removed. A detailed stormwater design will be generated to address the drainage and stormwater handling requirements of the PRP and will be issued as a separate document at a later date.

7.8.1.3 Communications Lines

A communications duct bank that runs along McCall Way comprises sixteen 100 mm hardened ducts in a 4 x 4 pattern encased in concrete and buried at a depth of approximately 1.0 m. Fourteen of the ducts are owned by TELUS, the two remaining being owned by the Authority. SHAW and MTS Allstream currently lease ducts from TELUS. The duct bank contains services to YYC as well as a line that continues further north to provide service to customers north of Country Hills Boulevard. The required lead time for TELUS from inception to completion of the re-routing of the lines is approximately 18 months. The re-routing of these lines may be a critical task for maintaining the PRP's accelerated schedule.

Re-routing of the lines is necessary, though all services to YYC will be accommodated through the Authority-owned services buildings and common duct space. Options being explored for the re-routing of the lines are:

- Re-routing of the lines east along the proposed 36 Street utilities corridor. This option would allow for maintenance and repair access to the lines without requiring airside access. The approximate cost of this option, not including installation, is $2.6 million and would be dependent on the planned development of 36 Street.
- Re-routing of the lines east at 78 Avenue and then north between Taxiway B and Taxiway D to Airport Trail, before being re-routed west to the existing duct bank along Barlow Trail. The approximate cost of this option, not including installation, is $1.2 million.
- If required, temporary solutions may be considered for the re-routing of the lines to be replaced by the permanent installation following the construction of the IFP and PRP.

7.8.1.4 Electrical Power Lines and Supply

Re-routing, reconnections, temporary construction power, and service to existing and new customers are the responsibility of ENMAX. ENMAX is also responsible for delivering power to the main substation. The lead time required for a new line design and its construction is approximately 12 months. If required, provisions for temporary power will require a minimum of six months lead time.

The majority of ENMAX services, within the PRP footprint, will be terminated with the demolition of residences and structures. This will allow for the safe disconnection of the power lines. ENMAX customers along the outer boundary of the PRP may remain during and after PRP construction. Power to these customers will be supplied from a source outside YYC land.

A conflict exists between the PRP footprint and a recently installed 25 kV underground line that runs east to west along the Airport Trail alignment and is one of the two main power supply lines to YYC. Actual depths of the 25 kV line must be compared with the vertical profile of Runway 16L/34R and the west taxiways. Lowering and/or realignment of the line may be required based on assessment of the record drawings from the original installation.

7.8.1.5 Fuel Pipelines

There are two aviation fuel pipelines that will be affected by the PRP and IFP in proximity to the Apron I expansion and Taxiway J. The conflicts of the fuel pipelines have been identified as part of the IFP scope. The primary stakeholder is the CFFC represented by FSM Management Group, which is contracted by CFFC to manage the aviation fuel distribution system.

7.8.1.6 Resource Pipelines

The factors that will affect the relocation or deepening of resource pipelines are the as-built depth of the pipeline, the pipeline owner requirements and the required depth of the Runway 16L/34R subgrade and stormwater subdrains. The storm ater subdrains are expected to be approximately 2.0 m below the finished pavement grade. Pipelines located between 36 Street NE and Barlow Trail are typically either in direct conflict with the construction of the PRP or will be affected by construction activities.

The Jumping Pound West Trunkline is a main natural gas feed for the City of Calgary, and abandonment is not possible. As routine maintenance and inspection are required for the trunkline, the solution is to re-route the pipeline to the north of the PRP. This would involve cutting the line between Taxiway B and Taxiway T and installing approximately 3,300 m of new pipeline. The ATCO pipeline servicing TransCanada Turbines is required to be maintained long term and cannot be abandoned. This pipeline will need to be re-routed around the PRP to allow for routine maintenance and inspection. The proposed solution is to re-route the pipeline east of Taxiway T and install approximately 5,600 m of new pipeline.

There are several low and intermediate-pressure pipelines that directly conflict with the PRP. With the exception of one line that feeds a customer on the SE corner of 36 Street NE and 96 Avenue, all the other pipelines can be removed with the demolition and removal of existing residences. The line to the remaining customer will need to be re-routed. The two options for relocation are to install a new regulator station near the customer to connect high-pressure sources to the existing low-pressure feed, or the installation of approximately 200 m of pipeline to the nearest low-pressure source.

Any permits required by agencies (e.g., National Energy Board, Alberta Environment, or the Alberta Energy Utilities Board) will be the responsibility of the pipeline company, therefore they were considered to be separate projects and not part of the scope of the PRP.

7.8.2 Temporary Facilities / Construction Staging Areas

Temporary facilities and construction staging areas to service the PRP site are illustrated in Figure 7-23, and include:

- Temporary project offices
- Batch plant operations and pavement material storage
- Construction lay-down areas and bulk material storage.

7.8.2.1 Temporary Project Offices

Temporary project offices will be required to conduct the day-to-day administration of the PRP and serve as a central meeting place. Anticipated services required for the site trailers include:

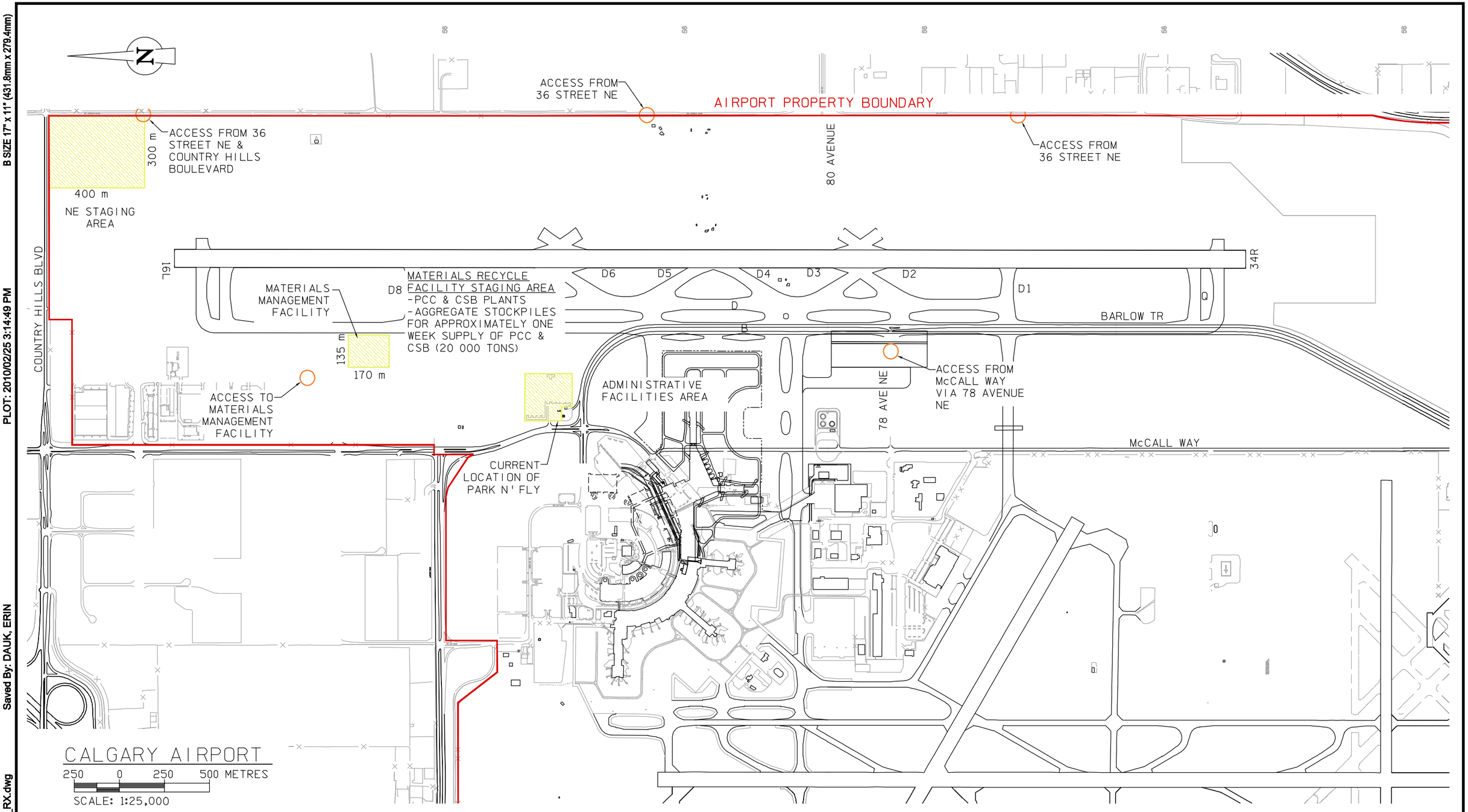
- Power – anticipated connection to pole-mounted power source (ENMAX).
- Communications – phone and fax lines, as well as email and internet access are required.
- Potable water – supply.
- Sewer – combined usage of either outhouses and/or indoor washrooms located in the trailers with a holding tank for sewage. According to Occupational Health & Safety (OH&S) regulations in Alberta, it is expected that there will be a minimum of eight toilet facilities located on site, with at least two of those facilities for women.
- Heat – propane heat required during colder months.
- Lighting – anticipated connection to ENMAX poles to provide lighting for the staging areas.

Suitable office space for the program management team, construction management team, prime consultant and major contractors will be required. Modular Trailer units will be assembled to accommodate Project Administration for the Program Manager, Design Consultant, and Contractors Up to 9 trailer units of varying sizes are required and will include office space, meeting space, washroom facilities and document storage. The temporary project offices must meet the requirements of Alberta's OH&S legislation, allowing for site orientation training, first aid and emergency response planning.

The peak construction work force is forecast to be approximately 300 people. The temporary project offices will accommodate upwards of 50 people, with adequate parking adjacent to the structure to allow for larger site meetings and project events.

A viable option for the temporary project offices is the current Park N' Fly location, as it is large enough to accommodate the trailer units and parking. The existing paved surface will allow all-weather and dust-free conditions. Office facilities will be required at the start of 2011.

The PRP construction site is extensive stretching from Country Hills Boulevard to the Silver Wings Golf Course and from 36 Street NE to McCall Way. Security fences and gates with locks and access restrictions will be put into place around the construction site. Gates will be manned during regular construction hours to accommodate the flow of vehicles entering and leaving. Access entry points need to be wide enough to accommodate equipment and other oversized loads. Bulk materials storage and individual materials storage areas, by discipline, will also have security fencing and gates with locks.



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Temporary Facilities and Construction Staging Areas

Figure 7-23

7.8.2.2 Batch Plant Operations and Pavement Material Storage

The Authority Airport Recycle Facility is located south of 100 Avenue and east of Barlow Trail, with access off 100 Avenue NE. The recycling facility is the proposed location for Batch Plant Operations to produce Portland cement concrete pavement (PCCP) and cement stabilized base (CSB) produced for the PRP. Asphalt concrete pavement (ACP) may also be produced at this site depending on the quantity of ACP material included in the final design. The timeline will be from April 2012 until the completion of construction. Bulk aggregates for the PCCP, CSB, and ACP will be stored at the Airport Recycle Facility in sufficient quantities to meet production demand for the PRP site. Site storage will potentially be necessary for the Portland cement and asphalt cement binders. A preliminary estimate of the space requirements for batching operations is 135 m by 170 m (or 23,000 m^2), which accounts for approximately 60% of the total area of the Airport Recycle Facility. The location of the site has considered proximity to the runway and taxiways to minimize haulage distances, access to road networks, and site services.

7.8.2.3 Construction Lay-Down Areas and Bulk Material Storage

The nature of the PRP will warrant construction lay-down areas throughout the PRP development site to accommodate materials storage, field administrations trailers, and servicing/maintenance of equipment The preliminary estimate for the site is for a site approximately 300 m by 400 m (or 120,000 m^2), the northeast corner of the PRP development site near the intersection of Country Hills Boulevard and 36 Street NE is a potential location. Site grading must be completed by September of 2011 in order to construct the lay-down area. This location has been selected because the northern limits of the construction site have suitable access and the location is upwind of the construction site. Access to this staging area for both vehicles and equipment would be located off 36 Street, south of Country Hills Boulevard. The site can be partitioned to accommodate the needs of various contractor operations and storage of bulk materials supplied to the site (i.e., electrical, drainage, pavements, etc.). It is anticipated that there will be access at the quarter points of the construction site along 36 Street NE for equipment and materials to be moved around the site efficiently.

An all-weather driving surface, drainage, and dust abatement are necessary for operation of the lay-down area. Gravel surfacing with dust suppressing stabilizers, such as calcium chloride or magnesium lignosulphonate will be used. Large vehicle turning radii must be considered for all entrances where equipment or trucks will be entering the lay-down areas and/or construction site. Equipment storage will be primarily on site and dependent on the construction operations in progress. Servicing of equipment and fuelling operations, which are a necessary part of construction activities will occur in accordance with the Authority's environmental policies and the ECO Plan developed specifically for the PRP (see Volume V, Item 14).

Site trailers for the Construction Manager, field engineers and major sub contractors will be located in a Field Administration compound located in the North East corner of the Barlow Trail, Airport Way intersection at the existing Park and Fly facility. Site parking will also be available for the construction workers.

7.8.3 Earthworks

7.8.3.1 Site Preparation

The PRP site is relatively flat with occasional rolling hills. The land in the northern quarter of the proposed parallel runway is primarily agricultural land cultivated for cash crops such as alfalfa and canola. The southern quarter of the site is pasture land used for grazing livestock.

In the central area of the site there are several farms, private residences and private structures. Occasional trees and shrubs exist throughout the site, the majority of them being on the east side of Barlow Trail NE along the length of the proposed parallel runway (refer to Volume V, Item 4 for more information).

Site preparation for the PRP site will include clearing and grubbing of the trees and brush material, and demolition and removal of the existing residences and structures. Debris from clearing and grubbing should be disposed off YYC land, as outlined in the Authority's Earthworks and Soils Management Guidance Document. Trees should be relocated, rather than eliminated, where possible. A possible option for the relocation of trees is to the Silverwing Golf Course, which adjoins the east airfield to the south. The Silverwing Golf Course currently has few mature trees. Removal of trees should be conducted during the time when migratory birds are not nesting in order to comply with the provisions of the Migratory Birds Convention Act. The timeline for the demolition and removal of existing residences, structures, and associated utilities is from January of 2011 to August of 2011.

7.8.3.2 Mass Earthworks

The combined earthworks volume to complete the grading of the PRP is approximately 6.7 million m^3. This quantity comprises 5.4 million m^3 generated from the cut/fill within the PRP footprint and 1.5 million m^3 of earth hauled from the foundation excavation for the IFP.

- The PRP site is approximately 5,040 m long (end of clearway to end of clearway) by 620 m wide (top of slope to top of slope in cut area); from north to south the terrain generally consists of undulating hills and local low areas.
- The preliminary vertical geometry shows the north 810 m of the site to be in fill with a maximum fill depth of 6 m.
- Proceeding south, the next 1,120 m is primarily cut to a maximum depth of 6 m some of which is within bedrock.
- The next 800 m is at or near grade, and the 2,310 m at the south end of the PRP site is primarily fill to a maximum depth of 5 m.

Soil conditions identified in the geotechnical investigation completed for the PRP indicate conventional earth moving equipment will be adequate to move the soil quantities with the exception of bedrock interfaces where hydraulic breakers may be required. Scheduling for earthmoving will be coordinated with the IFP and requires approximately 13 months to complete. A target of 22,000 m^3 (average) of earthwork per day is planned for the PRP site. Some excavation activities for the IFP will be completed concurrently with the PRP earthworks; however daily productivity will be less due to the longer haul distance, potential road crossings and space restrictions of the foundation excavation. The IFP excavation will begin in 2010 and continue throughout the 2011 construction season PRP earthworks will begin in April of 2011 and be completed in August of 2012. Earth excavation from the IFP site will be hauled to the south end of the project; earth cut from the PRP will be hauled both north and south to complete the fills at each end of the site.

A balanced earthwork design is to be achieved considering the ultimate build out of the expanded airfield in the design model. Some sections of taxiway pavement structure will not be constructed in the PRP timeframe.

Initial earthworks operations warrant the removal of the upper organic layers of topsoil, which will be completed in a manner consistent with Authority practices. The Authority recognizes the value of topsoil as a non-renewable resource. The A Horizon and B Horizon will be stockpiled separately, where feasible and/or required, to prevent mixing of the horizons and degradation of the topsoil. Care will be taken so that subsoil is not mixed into the topsoil stockpiles. Stripping operations should be conducted in a manner consistent with the established municipal, provincial and federal requirements for earthworks projects.

The topsoil will be stripped in A and B horizons and stockpiled for later redistribution. Timely redistribution of topsoil and seeding will be included in the construction staging operation to mitigate the spread of dust on the PRP site, as specified in the Authority's Earthworks and Soils Management Guidance Document.

Areas covered by saline and non-saline topsoil will be stripped and stockpiled separately. All saline topsoil will be retained on site.

7.8.3.3 Dust Abatement

The spread of dust is a concern through the construction phase of the PRP and is dependent on weather conditions. The integration of dust abatement into construction practices and staging of construction will take seasonal weather into account. The following construction practices are proposed:

- Haul routes will be established on site. Haul routes will be stabilized and have a treated surface using a dust abatement material, such as calcium chloride or magnesium lignosulphonate to create all-weather dust-free surfaces. Reclaimed asphalt pavement millings will also be used to create an all-weather dust-free surface.
- Water is needed to construct and compact the grade while abating dust. The required volume of water is dependent on the seasonal weather, temperature and wind. Licences/permits that may be required under the Water Act are detailed in Volume III, Chapter 5. The optimum moisture content is verified as the layers are constructed. Site haul routes should be established on the graded taxiways and runway once they are constructed.
- Topsoil stockpiles will be constructed and maintained to prevent the spread of dust. Stockpiles will be seeded in accordance with the Authority's Earthworks and Soils Management Guidance Document.
- Graded areas where pavement layers or shallow utilities will not be installed will be top soiled and seeded promptly to prevent the spread of dust.
- Active monitoring of the dust conditions on the PRP site and sensitivity toward and prioritization of dust concerns will be required.

7.8.4 Drainage

The PRP stormwater management consists of the major overland drainage system and the minor stormwater piped system. Each follows the Stormwater Management Master Plan prepared for YYC. As detailed in Section 7.6.5.1 of this report, the PRP site is included in the North East and Central East catchment areas; an integrated design drainage scheme with the IFP is in place. The major overland drainage system will be constructed during the PRP earthworks.

The minor stormwater infrastructure consists of deep utilities including the network of storm trunk pipelines, catch basins and manholes. The deep stormwater utilities aid in routing stormwater from the major overland drainage to the stormwater detention ponds located throughout the airfield and ultimately the natural drainage courses off the airport lands. A network of shallow perforated pipe drains located along the edges of the taxiways, runways and aprons feeds into the storm trunk system.

The deep stormwater utilities will be installed between September 2011 and December 2012. The shallow perforated pipe edge drains will be constructed in the same timeframe as the pavement structure for the taxiways and runway. Storage of the bulk materials will be in the northeast material lay-down area.

7.8.5 Airfield Lighting and FEC

The PRP preliminary design has proceeded based on a CAT II/III ILS with the understanding that the final decision on ILS Category will be made during the detailed design stage, as detailed in Section 7.6.10.1 of this report. Airfield lighting-related works will occur throughout the PRP construction, as deep utilities will be integrated into the rough grading that includes installation of ducting for cables, power and communications lines. The second phase of the airfield lighting construction will be integrated into the construction of the pavement layers and will include the wiring, pulpits and connections. The final phase of the airfield lighting will be the installation of the fixtures and navigational aids, which will take place once the pavement layers are nearing completion.

A new FEC is required to support the airfield lighting infrastructure. A preliminary single-line diagram and load calculations have been developed to size the facility and a preliminary FEC floor plan has been developed.

7.8.6 Pavement Layers and Markings

Similar to airfield lighting and the FEC, the construction of the pavement layers will take a phased approach: subgrade preparation, installation of edge drains, granular layers (GSBC and GBC), and then the PCCP and ACP. The estimated volumes of the granular and pavement layers, based on the assumption that only the shoulders of the runway and taxiways will be paved with ACP, are:

- Granular sub-base course (GSBC) – 22,500 m^3
- Granular base course (GBC) – 160,000 m^3
- CSB – 140,000 m^3
- PCCP – 35,6100 m^3
- ACP – 25,000 m^3

The PRP will require high-volume production of PCCP, estimated at 2,000 m^3 per day with two concrete slip form pavers operating simultaneously to meet the accelerated schedule. The decision has not yet been made whether to pave the runway and taxiways with ACP or PCCP; it and will be made during the preliminary design stage. The construction of the pavement layers is scheduled from April 2012 to October 2013. The pavement markings will be completed in October and November 2013, once the pavement layers are completed.

7.8.7 Landscaping

The two primary activities that form the landscaping task are the placement of topsoil and the seeding of vegetation. The topsoil must be able to support the growth of adequate vegetation for erosion control, regardless of stripping practices. The seed mixture may have to be tailored to the specific soil conditions depending on topsoil characteristics. Where stockpiled separately, the B Horizon topsoil should be placed beneath the A Horizon topsoil. Separation of the horizons when stockpiling and placing topsoil will result in better growth of vegetation.

Various low-impact development procedures, such as increased depth of topsoil, use of bio-swales, etc., will be considered during detailed design.

7.8.8 Workforce, Equipment, and Construction Package Dates

The expected workforce, number of pieces of equipment, and schedule are outlined by construction package in Table 7-2. The scheduling of the construction packages is illustrated in Figure 7-24. From both Table 7-3 and Figure 7-24, it was calculated that, at peak operations, which are expected to occur from April 2012 to August 2012, there may be up to 300 workers on site and 280 pieces of equipment, including trucks. The working hours will be 10 hours per day, six days per week, where seasonably permitted. Operations such as the pavement layers and landscaping are sensitive to the weather.

Table 7-2 Workforce Projections

Construction Package	Workforce	Equipment	Scheduled Start Date	Scheduled End Date
Site Services	100 workers	55 pieces	January 2011	August 2011
Earthworks	125 workers	100 pieces	April 2011	August 2012
Drainage	75 workers	50 pieces	July 2011	January 2013
Airfield Electrical and FEC	30 workers	15 pieces	October 2011	February 2014
Pavement Layers	175 workers	115 pieces	April 2012	October 2013
Landscaping	20 workers	15 pieces	October 2013	February 2014
Taxiway F Underpass	50 workers	20 pieces	May 2011	December 2011
Taxiway J Underpass	50 workers	20 pieces	May 2011	December 2011
TOTAL	**625 workers**	**390 pieces**		

7.8.8.1 Site Services

Site services encompass the advanced work to prepare the site for construction. A variety of activities are required, including utility relocations, demolition / removals, and clearing and grubbing. Many crews will be required to perform the various tasks. The time frame for the completion of the site services work is January 2011 to August 2011.

7.8.8.2 Earthworks

The combined earthworks volume for the completion of the grading of the PRP is approximately 12 million m^3. For the scheduled earthworks operations, from April 2011 to August 2012, an average of 22,000 m^3 per day must be moved, which will require high-production equipment and coordination to meet the accelerated time frame.

7.8.8.3 Drainage

Drainage works will include the installation of the deep storm utilities and the edge drains, and civil electrical ducts. It will be time sensitive and integrated with the other construction works. For the drainage works, it is expected that there will be several crews working independently in various locations on the airfield.

7.8.8.4 Electrical

The airfield lighting and FEC operations are expected to take place from October 2011 until February 2014 and will require several crews working independently.

7.8.8.5 Airfield Pavement

The airfield pavement layers will be constructed in five stages: subgrade preparation, GSBC and GBC, CSB, PCCP and ACP. It is scheduled to take place from April 2012 to October 2013. It is expected that there will be several crews working independently in various locations on the airfield. To meet the accelerated time frame, during the PCC paving operations, an average of 2000 m^3 per day will be required.

7.8.8.6 Taxiway F Underpass

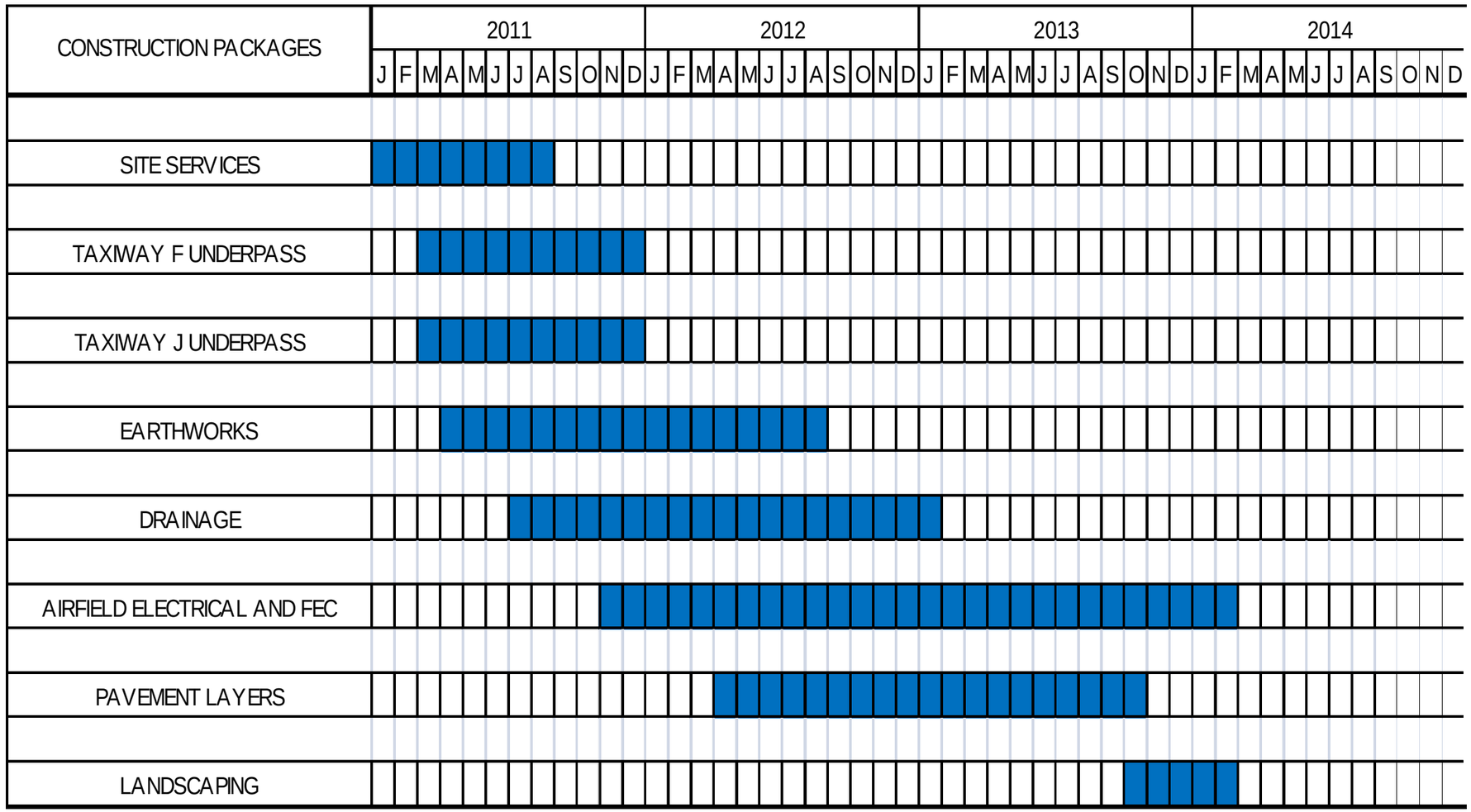
At peak operations there would be approximately 50 workers and 20 pieces of equipment. Equipment will be parked primarily on the construction site. The construction of the Taxiway F underpass is expected to take place from March 2011 until December 2011.

7.8.8.7 Taxiway J Underpass

At peak operations there would be approximately 50 workers and 20 pieces of equipment. Equipment will be parked primarily on the construction site. The construction of the Taxiway J underpass is expected to take place from March 2011 until December 2011.

7.8.9 Cost

For the current scope of the PRP, which includes a new AMC and new fire hall, the cost estimate is $460 million (2009 dollars). The total cost is inclusive of program management, planning and engineering, construction management, insurance, airside security, and related program delivery costs and contingencies.



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Construction Schedule

Figure 7-24

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7.9 Operations and Maintenance

When the PRP is completed in 2014, it will be commissioned and become an important element in the overall operation of YYC. The activities for the operation and maintenance of the new parallel runway and associated facilities will be consistent with the procedures and policies of the Authority. The entry into the operations phase will also result in the operations and maintenance programs being subject to the Authority's environmental management system and will be included in the annual reports.

Upon completion of construction a number of commissioning steps will be completed prior to the new facilities being turned over to the Authority. These will include:

- Operational checks of the runway lighting system
- Painting of markings on runways, taxiways, and flight checks
- Checks of the surface quality of the runway and taxiways, including skid resistance and surface water runoff
- Installation and checking of new signage and revision of existing signage
- Ground and flight checks

The operations and maintenance activities associated with the new runway and facilities will not be different from those that are being employed for existing runways, facilities and grounds. These include:

- Snow clearing and de-icing of the runways and taxiways.
- Grass cutting and vegetation management. Herbicides are selectively used to control weeds. These broad-leaf herbicides are to be applied selectively by a certified applicator, as is done on the remainder of the airport property.
- Runway patching and pavement repairs.
- Repainting and repair of runway markings.
- Emergency response to aircraft incidents, spills etc. These are covered in more detail in the Airport Emergency response Procedures and Volume III, Chapter 19.
- Bird strike prevention measures.
- Operations associated with the maintenance facility building.
- Electrical repairs to the runway lighting system, including bulb replacement.

7.10 Decommissioning and Abandonment

YYC was Canada's fourth busiest airport in 2008, and is a hub for domestic, transborder (United States), and other international passengers and air cargo. In view of this critical function, it is highly unlikely that Runway 16L/34R will be decommissioned within the foreseeable future. The Authority does not have plans that would eventually lead to making the project site available for other uses.

Should decommissioning occur, the runways and taxiways could be removed and the concrete and asphalt recycled. Other structures could also be removed and their components recycled. The areas disturbed would then be covered by topsoil and seeded, unless a new development on the site begins immediately.

Decommissioning would require a new environmental assessment under applicable legislation at the time.

7.11 Other Projects

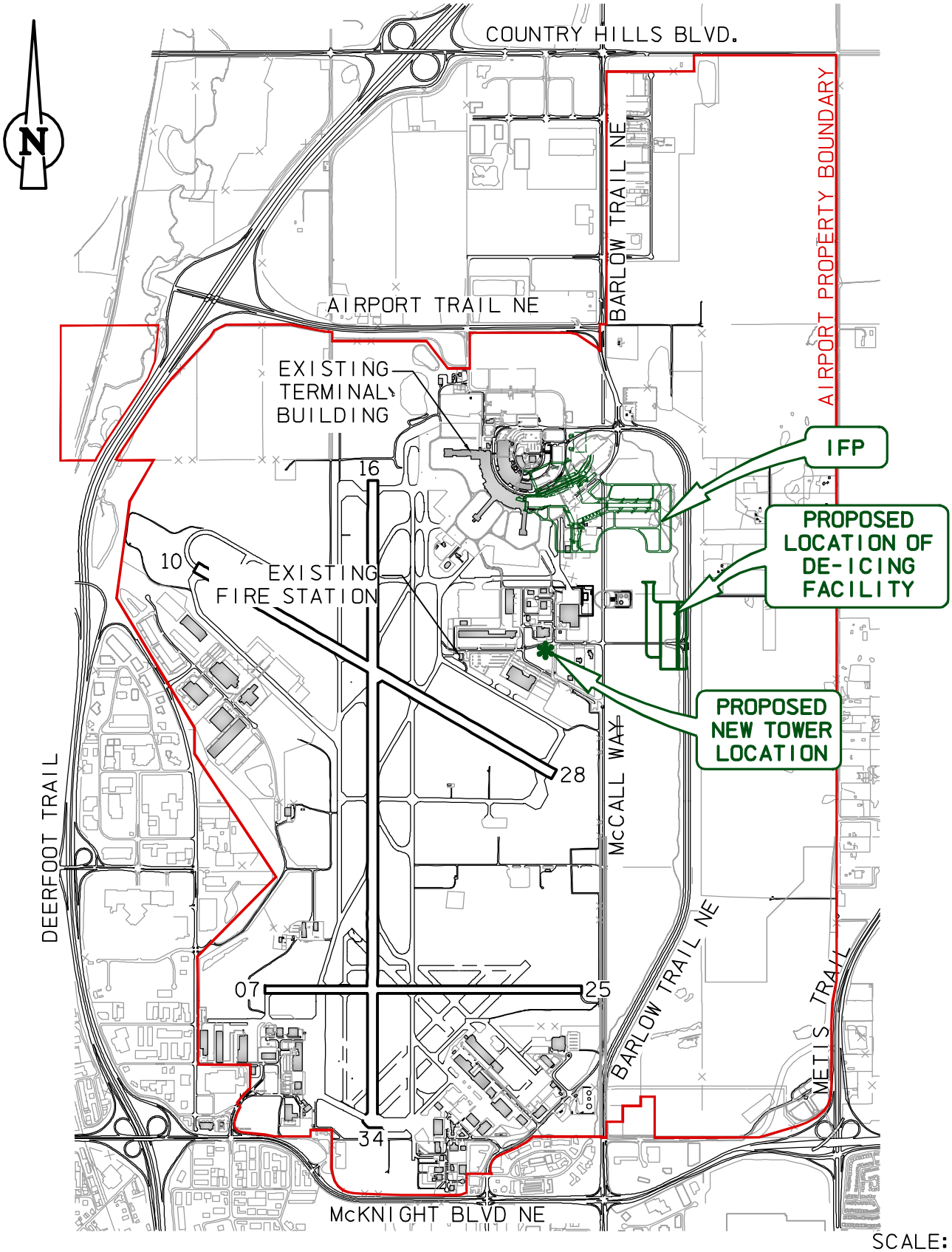
In order to accommodate the extraordinary growth in passenger levels that has occurred and is anticipated to continue into the future, YYC has prepared plans to construct additional facilities to meet the predicted demand in passengers and aircraft movements (see Volume II, Chapter 2). In conducting the environmental assessment, the potential impacts of these developments is to be considered to the extent that construction and operation of concurrent developments contribute to cumulative effects. The most significant of the planned facilities are summarized in the subsections which follow. City of Calgary, Airdrie and Rocky View County land use and transportation plans will be reviewed in order to assess other developments that may contribute to cumulative effects.

7.11.1 International Facilities Project (IFP)

In order to meet future air traffic demands and alleviate congestion, additional terminal facilities will be required to meet the future demands, particularly in the sectors of international and transborder operations. The IFP is a project, which in conjunction with the parallel runway, is intended to meet the gate demand beyond 2025. The IFP will bring the total capacity to approximately 100 loading bridges processing approximately 35 million passengers per annum. The IFP primarily consists of a Greenfield terminal to be constructed to the east of Concourse A. The new terminal is to be expandable so as to accommodate additional traffic beyond 2025. It consists of the new terminal building, apron, roadway, and associated works and will have a total floor area of 172,000 m^2 spread over basement, arrivals, international departures, transborder departures and a mezzanine airline lounge. This compares to the existing terminal which has a floor area of 142,000 m^2. The project as a whole is designed to encompass all of the requirements for international and transborder travel, including:

- An arrivals and departure roadway that will link the IFP to the existing road system.
- A check-in hall with baggage drop points, retail, food and beverage facilities, and links to parking, curb-site drop-off, and the existing terminal.
- Pre-clearance customs processing area, including space for Customs personnel, offices, secondary processing, cells, meeting rooms, and locker space.
- Holding areas for passengers awaiting aircraft departure, including retail and food and beverage opportunities.
- An international pier and a transborder pier with fixed links and passenger boarding bridges.
- A baggage claim hall with carousels.
- A meet-and-greet area.
- A utility tunnel.
- An outbound and inbound baggage handling system.
- Utility areas for waste handling, mechanical and electrical rooms, IT facilities and central stores.
- Emergency power generators and uninterruptible power supplies.
- An apron to link the IFP to the existing apron and taxiway system.
- Ground service equipment.
- Aircraft parking area.

The buildings are to incorporate a high degree of sustainability in the design, including the use of daylighting, reduced need for vertical transportation, highly efficient building envelope, rainwater harvesting, and efficient heating and cooling systems cogenerating heat and power. The 2004 Master Plan incorporates a phased development in which Phase 1 consists of 24 new loading bridges available in 2015, with an additional three phases adding additional capacity in the international and transborder piers through to 2025 and 2030. It will be integrated with the existing facilities to provide seamless connection for connecting passengers.



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Other Airport Projects

Figure 7-25

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7.11.2 Land Development

The Authority completed the Calgary International Airport Master Plan 2004 (Authority 2004) to provide the framework for orderly, rational, and systematic development of the airport over a 20-year period. The most significant planned development is the Deerfoot North Development Project, which will occupy approximately 136 ha (approximately 337 acres) of undeveloped land in the northwest corner of YYC. The development area lies to the east of Deerfoot Trail NE and south of Airport Trail NE. The planned uses of this land will be subject to individual development proposals, but it is anticipated that the commercial activities to be conducted on these lands will include air cargo services, warehousing, airport-related light industrial, office, retail, restaurant, and hotel services, as well as associated roads and a stormwater pond.

Outside YYC lands, development is within the control of the City of Calgary, the City of Airdrie and Rockyview County. There are no known approved developments that would contribute in a substantive way to an assessment of cumulative effects. However, long-term land use plans for future development are included in the City of Calgary's 'Plan-It' Calgary document. Further development northeast of the airport is anticipated.

7.11.3 Air Traffic Control (ATC) Tower

The existing ATC tower at YYC, located at the southern end of Aero Drive NE, has been operational since 1992 and was designed and constructed with the knowledge that it would not provide the necessary line of sight to the expanded east airfield. The 1996 Master Plan reserved an area for a satellite ATC tower in the vicinity of 78 Avenue NE in the McCall North Development, which provides the necessary line of sight. NAV CANADA has since expressed a preference for a single integrated ATC tower rather than a proposed main tower and satellite tower. The current recommended positioning for the integrated ATC tower is south and further west than the original location. The current recommended positioning meets line of sight requirements and tower positioning requirements, though it will need to exceed the elevation of the horizontal limitation surface. The location has been finalized and is shown on Figure 7-25.

7.11.4 Emergency Response Services (ERS) / Satellite Fire Hall

The existing Fire Station #13 is centrally located near the intersection of Taxiway F and Taxiway G, near Gate 37. Currently, Fire Station #13 provides the required amount of equipment necessary to respond to the existing airfield as well as the east airfield.

In 2008, an investigation was undertaken to determine if there is need for an additional Emergency Response Services (ERS) fire hall to meet required emergency response times to the east airfield. Emergency response tests require that, within three minutes of the alarm sounding, ERS vehicles sufficient to apply the extinguishing agent at 50% of the total discharge capacity can reach the midpoint of the furthest runway serving commercial passenger-carrying aircraft, under optimum conditions. Within four minutes of the alarm sounding, all additional firefighting vehicles required to apply the extinguishing agent must arrive.

Testing was completed using the Authority ERS vehicles, driving on equivalent test routes on the airfield to simulate response times to Runway 16L/34R. Response times to the midpoint of Runway 16L/34R from Fire Station #13 were within eight seconds of the three-minute time limit. While emergency response times fell within the required range, the Authority is considering a satellite fire hall to improve response times. Consideration for future growth and the timing of commissioning of a satellite fire hall will consider critical categories for fire fighting and response times.

7.11.5 De-icing Facility

The overall de-icing strategy at YYC will have to consider the growth plans identified in the Calgary International Airport Master Plan 2004 to ensure de-icing areas are safeguarded and that sufficient de-icing capacity is made available as the development plan is implemented. The IFP (also referred to as Concourse E) and associated infrastructure are currently under design development, and the existing on-gate de-icing practiced by the air carriers on Concourses A to D will not be sufficient when all concourses are integrated.

A new Central De-Icing Facility (CDF) is planned for YYC, but it is not a component of the PRP. The size and location of the proposed CDF has not yet been determined; however, the general concept is to permit the safe and efficient de-icing and anti-icing of aircraft in a centralized, controlled area so that de-icing fluids may be controlled and not permitted to impact local waterways. Initially the CDF will be used to de-ice aircraft departing from gates at the proposed IFP East Concourse and will eventually be used to de-ice all commercial aircraft originating from the main terminal building. Two potential CDF locations are being considered; one near the intersection of Taxiways J and B, and the other located east of the existing Runway 16/34, approximately 200 m north of existing Runway 10/28.

The Authority Apron 1 De-Icing Facilities Study (2008) assesses current and future de-icing needs at YYC. Based on the preliminary sizing analysis in this report, the basic de-icing facility would be designed to accommodate six Code C aircraft simultaneously. This configuration actually consists of two modules, each with the capability of servicing either six Code B, three Code C, or one Code D/E/F and one Code C aircraft.

Each de-icing bay would have a 10 m staging/safety area along each side. Each bay would have a minimum wing tip clearance for a Code C aircraft of 4.5 m. In addition, the bays are lengthened to accommodate two Code B aircraft nose to tail, with a 10 m safety zone and two 3 m aircraft clearances from the safety zone. The basic module also includes a 60 m wide by 98.5 m support area for the ice house, with vehicle parking, glycol storage and dispensing, pink snow stockpiling, and glycol effluent storage tank and pumping station.

7.11.6 City of Calgary Road Network

The City of Calgary road network forms a ‘skeletal network’ around the airport, as detailed in Section 7.6.8.7 of this report. The improvements being considered by the City of Calgary are detailed below.

Métis Trail / Country Hills Boulevard

The City of Calgary has plans to extend Métis Trail between 80 Avenue NE and Stoney Trail to provide more direct access to Deerfoot Trail, Stoney Trail, Country Hills Boulevard and McKnight Boulevard Commuter traffic currently traveling on Barlow Trail will have an access route around the expanded airfield once the extension is complete. The City’s current plans are to construct Métis Trail to a four-lane divided standard. Country Hills Boulevard will extend east in a four-lane divided configuration.

Discussions with the City of Calgary indicate that the network revisions to Métis Trail and Country Hills Boulevard may be completed by the fall of 2011.

Airport Trail

Airport Trail east of Deerfoot Trail will be a primary access to the Terminal; the extension of Airport Trail east under the airfield is included in the City of Calgary's long-range transportation plans but it is not part of the PRP.

McKnight Boulevard

Commuter traffic currently travelling on Barlow Trail will be required to make use of different routes around the expanded airfield.

7.12 Airspace

7.12.1 Air Traffic Forecasts

Transport Canada (TC) issues long-term passenger and aircraft movement forecasts for all major airports in Canada, including YYC. The data were analyzed to determine how traffic movements had historically related to TC traffic movement forecasts. Forecasts dating back to 1998 were reviewed against actual traffic (Airbiz 2009). This analysis confirmed that both actual passenger and aircraft annual movement trends were closer to the historical TC "high" than the TC "base" forecasts. On this basis, the TC high forecast was adopted for planning for the new parallel runway.

The 2008 actual and 2015 forecast annual passenger and aircraft movements are shown in Table 7-3.

Table 7-3 Forecast Annual Movements

Year	Annual Passenger Movement	Annual Aircraft Movements
2008 (actual)	12 million	245,154
2015 (TC high forecast)	16 million	310,200

7.12.2 Forecast Planning Day

The requirement for additional runway capacity at YYC can be justified by comparing the forecast demand to the available capacity. While airport traffic levels are often expressed in terms of annual aircraft movements, it is the number of movements in a busy period and the frequency of occurrence of such busy periods that determines the "level of service" provided, the level of delays experienced at the airport and the justification for the significant investment in capacity enhancements such as a new runway. There is no single industry-accepted method for selection of a representative busy period (day, hours) for analysis of demand versus capacity.

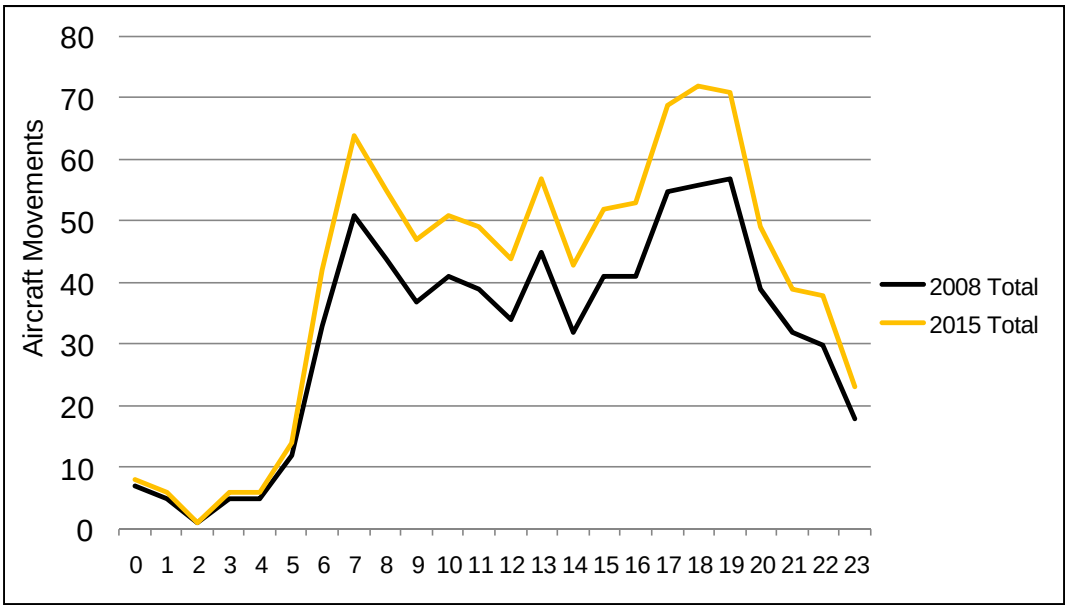
Detailed records of every aircraft movement in the 2008 calendar year (provided by NAV CANADA from its electronic flight data system) were analyzed using a range of metrics from the literature, as used in airport planning practice. These were compared based on the requirements to study the airfield performance under a range of scenarios. The 90th percentile day was selected as the most appropriate for use in the airfield modeling to be undertaken as part of the environmental assessment (EA) studies.

The 90th percentile day represents a daily aircraft movement demand level that is exceeded on average at least every second week and is considered a reasonable basis for planning and justification of infrastructure investment. The 90th percentile day from the 2008 flight logs was Wednesday 10 September 2008. The traffic patterns for this day – hourly absolute peaks, relationship of arrivals to

departures and other aspects of the traffic profile were checked to ensure they were representative of other busy days at this level of traffic. The TC "high" growth rates were applied to this daily traffic level to generate a projected 2015 traffic level. Considering the current characteristics of specific market segments (international, transborder, domestic, cargo and general aviation) in terms of fleet mix and scheduling constraints, a projected 2015 representative busy day schedule (90th percentile day) was generated for use in EA studies.

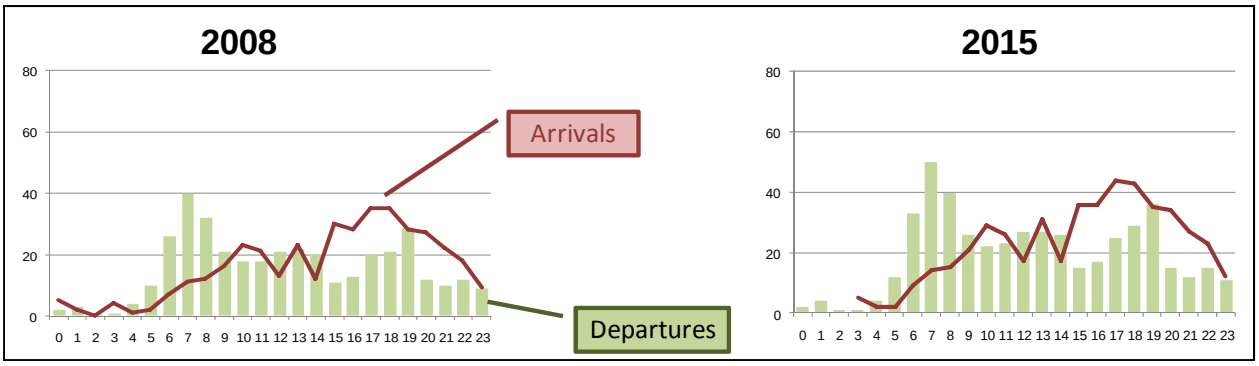
Figure 7-26 show the hourly aircraft movements in the 2008 base busy day schedule and 2015 projected schedule. Both are characterized by a sharp morning peak (growing from around 50 hourly aircraft movements in 2008 to over 60 in 2015) and a sustained afternoon peak (growing from around 55 hourly aircraft movements in 2008 to over 70 by 2015).

Figure 7-26 Hourly Aircraft Movements



The current and projected schedules can be compared at a greater level of detail as shown in Figure 7-27, which breaks down the hourly movements between arrivals (red line) and departures (green bars). This shows the morning peak as a departures peak, growing from around 40 movements to around 50 departures in the 7 AM hour in 2015. The sustained afternoon peak starts as an arrivals peak in the mid-afternoon and then becomes a combined arrivals/departures peak toward evening.

Figure 7-27 Aircraft Flight Schedules



7.12.3 Terminal Airspace

Major airports have their own airspace sector called “Terminal Area” in which arrivals and departures are staged in order to maintain a controlled inflow and outflow of air traffic. NAV CANADA is the Air Navigation Service Provider (ANSP) and controls the airspace across the country. It is their role to monitor, control, maintain and enhance the Canadian airspace in a safe manner. NAV CANADA is a private sector, non-share capital organisation that is regulated by TC.

NAV CANADA area control in Edmonton manages the Calgary Terminal Area, which forms a 35 nautical mile radius around the airport and extends to an altitude of 25,000 feet above sea level (ASL). The next level of control is conducted by NAV CANADA in the Calgary Tower located on-site at YYC. The “Tower” controls the airspace directly in the vicinity of the airport (approximately 5 nautical miles radius around YYC) – often referred to as the tower “control zone”. As it covers such a vast area and amount of airspace, YYC operations directly affect many airports in its vicinity.

Springbank and Airdrie Airfields are within the Calgary Terminal Area and are directly affected by Calgary aircraft operations since they share the same airspace on a daily basis. Other airfields within the region experience less interaction with the Calgary Terminal Area as the proximity to Calgary decreases.

In the case of Springbank, which has its own control zone, there is a controlled corridor between the Calgary Tower control zone and the Springbank control zone. This connection between the two controlled areas exists due to high traffic levels between the two airfields. Within the Springbank control zone aircraft must adhere to Springbank procedures, but once aircraft leave the Springbank control zone they must follow Calgary Terminal Area procedures. Most other airfields in the Calgary terminal area are VFR (Visual Flight Rules) airfields; aircraft from these airfields will remain below Calgary terminal IFR (Instrument Flight Rules) routes. However, all airfields within the terminal area are directly affected by the Calgary Terminal Area, as they must adhere to the operational requirements, be it IFR or VFR requirements.

These NAV CANADA operational procedures are critical in assessing noise in the vicinity of the airport.

7.12.4 Existing Terminal Airspace Operations

YYC is at an elevation of 3,557 ft. All aircraft planning on entering this area must report to NAV CANADA ATC prior to entry so that a controlled amount of aircraft can be maintained.

There are currently five fixed entry and exit waypoints to the Calgary Terminal Area which are on different radials in order to maintain adequate separation between arriving and departing aircraft. Within the terminal area aircraft follow either instrument procedures or visual flying procedures. These procedures are all outlined in NAV CANADA documentation that all pilots must follow.

Most aircraft operating to and from YYC follow instrument procedures defined in the “Canada Air Pilot – Instrument Procedures” manual. This manual outlines Standard Terminal Arrival Routes (STARs) and Standard Instrument Departures (SIDs) which follow a series of waypoints within the terminal area and supplement the direction given to pilots by ATC.

ATC has a systematic method of sorting aircraft in the terminal area to ensure safe separation is maintained and minimal amounts of “crossovers” occur. The airspace is essentially split into two segments for each of the main modes of operation (mode 1 and 2, see Section 7.12.7). Each runway within each mode will have certain entry and exit waypoints allocated to it. This means that when an aircraft enters the terminal area at a certain entry waypoint, ATC will assign it to a predetermined runway to ensure safe and efficient movement through the airspace; an equivalent system is applied for departures. A “crossover” is defined as a situation when an aircraft requests a runway that isn’t assigned to its exit or entry location for the mode of operation that is being used. These situations can be common for aircraft that request a certain runway due to operational requirements (e.g., larger aircraft will request the longer runway) and ATC will handle these situations on a case-by-case basis.

The arrival and departure airspace segments are defined in Figures 7-28 and 7-29 for the two main modes of operation (Mode 1 and 2). The arrivals segments are based on the five inbound waypoints (also called “bedposts”). Departure segments differ slightly due to the larger amount of exit waypoints compared to entry waypoints. Exit waypoints that fall within a certain range of radials defined in Figure 7-30 will be allocated to a certain runway (e.g., Departures off Runway 16 will be allocated to exit waypoints clockwise between the radials 137 and 358).

7.12.5 Capacity and Runway Operations

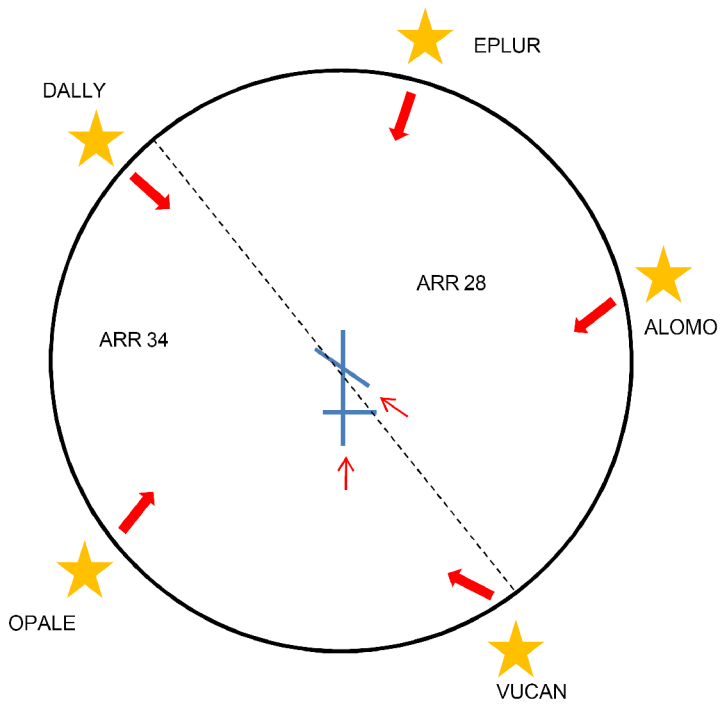
In suitable wind conditions, YYC uses Runways 34 and 28, in combination, for arriving and departing aircraft. Normally, aircraft will land on either Runway 34 or 28, and depart from one of these runways as well. When it is desired to favour departures, during the morning rush for instance, arrivals can be restricted to Runway 34 only, while both Runways 34 and 28 are used for departures. Runway 07/25 is generally used by corporate and General Aviation (GA) aircraft in Visual Meteorological Conditions (VMC).

The lateral spacing of the new runway will allow for fully independent departure and arrival movements. Thus, each runway could be used for either simultaneous departures or arrivals.

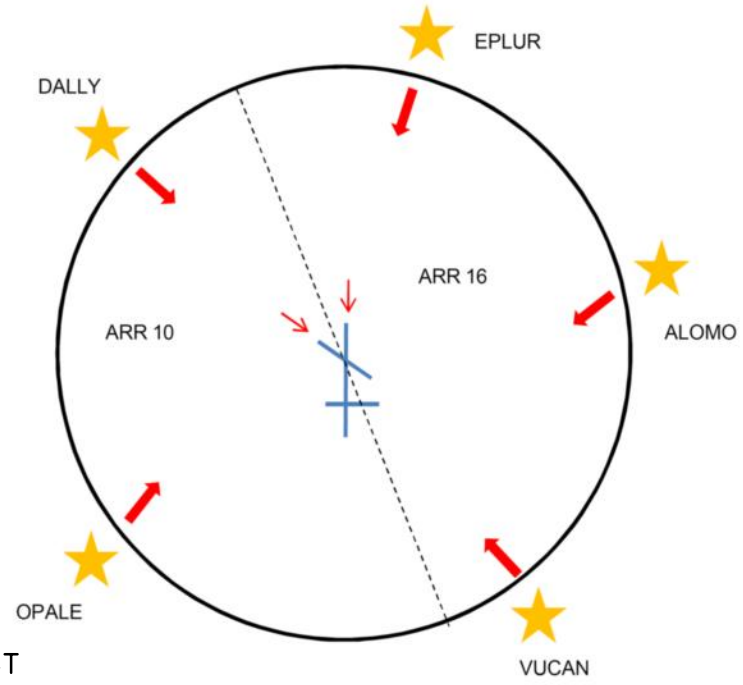
Volume II, Chapter 2 described the modelled capacity of the existing runway system of 60 movements (departures and arrivals) per hour. The existing busier peak hours have around 45 movements (departures and arrivals). Based on the forecasts of air travel growth demand will exceed existing runway capacity between 2013 and 2015.

The new runway could increase capacity to at least 95 movements (arrivals and departures) per hour during normal weather conditions, when the airport is operating in a north to south orientation (95% of the time). This is more than 70% greater than the base case of around 55 movements per hour. During Chinook weather conditions when the airport is operating on a southeast to northwest orientation (less than 5% of the time) the hourly capacity would be no different from the current situation.

Mode 1: ARR 28/34



Mode 2: ARR 10/16



LEGEND:

★ INBOUND BEDPOST

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Arrival Airspace Sorting

Figure 7-28

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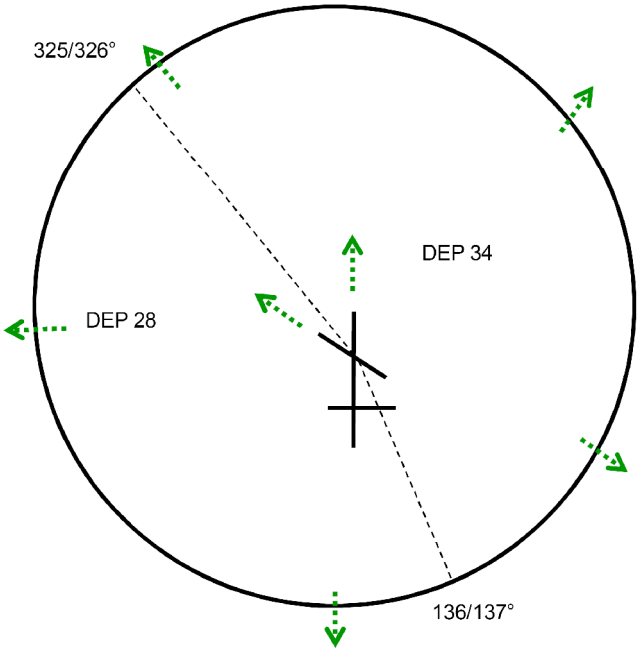
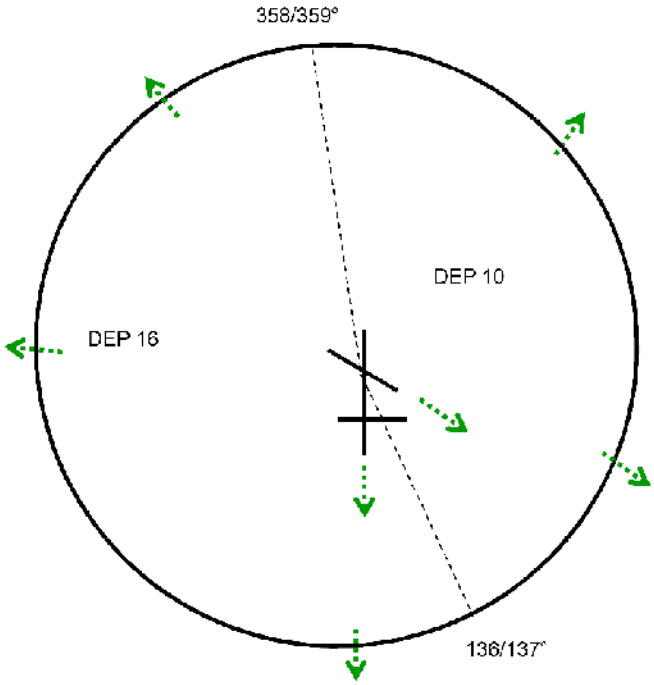
3. Current Airspace Layout

Mode 1: DEP 34/28



Mode 2: DEP 34/28



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Departure Airspace Sorting

Figure 7-29

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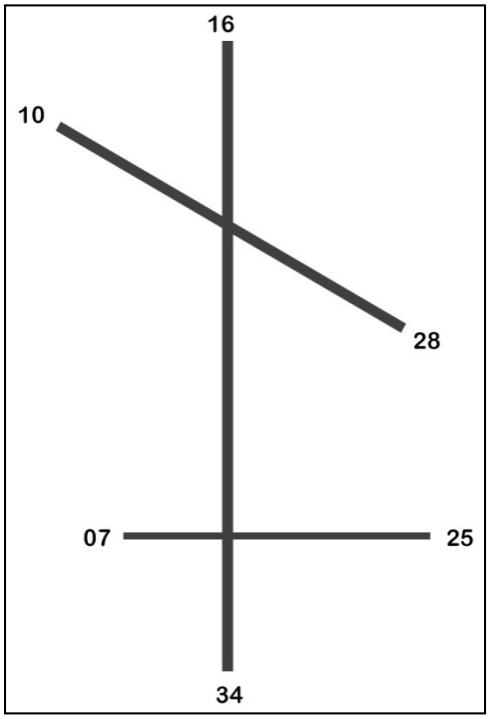
7.12.6 Existing Runway Designations

Due to changing wind direction throughout the year, each runway operates in both directions. This means that on the north-south runway, if the wind permits, arrivals will land from the south and departures take-off to the north or vice versa. Currently, YYC has one main north-south runway (16/34) and two intersecting runways; one on an east-west alignment (07/25) and one on a northwest-southeast alignment (10/28). Runway selection considers many factors and is discussed later in this chapter. The runway designations for the existing runway layout are illustrated in Figure 7-30.

Figure 7-30 Existing Runway Configuration

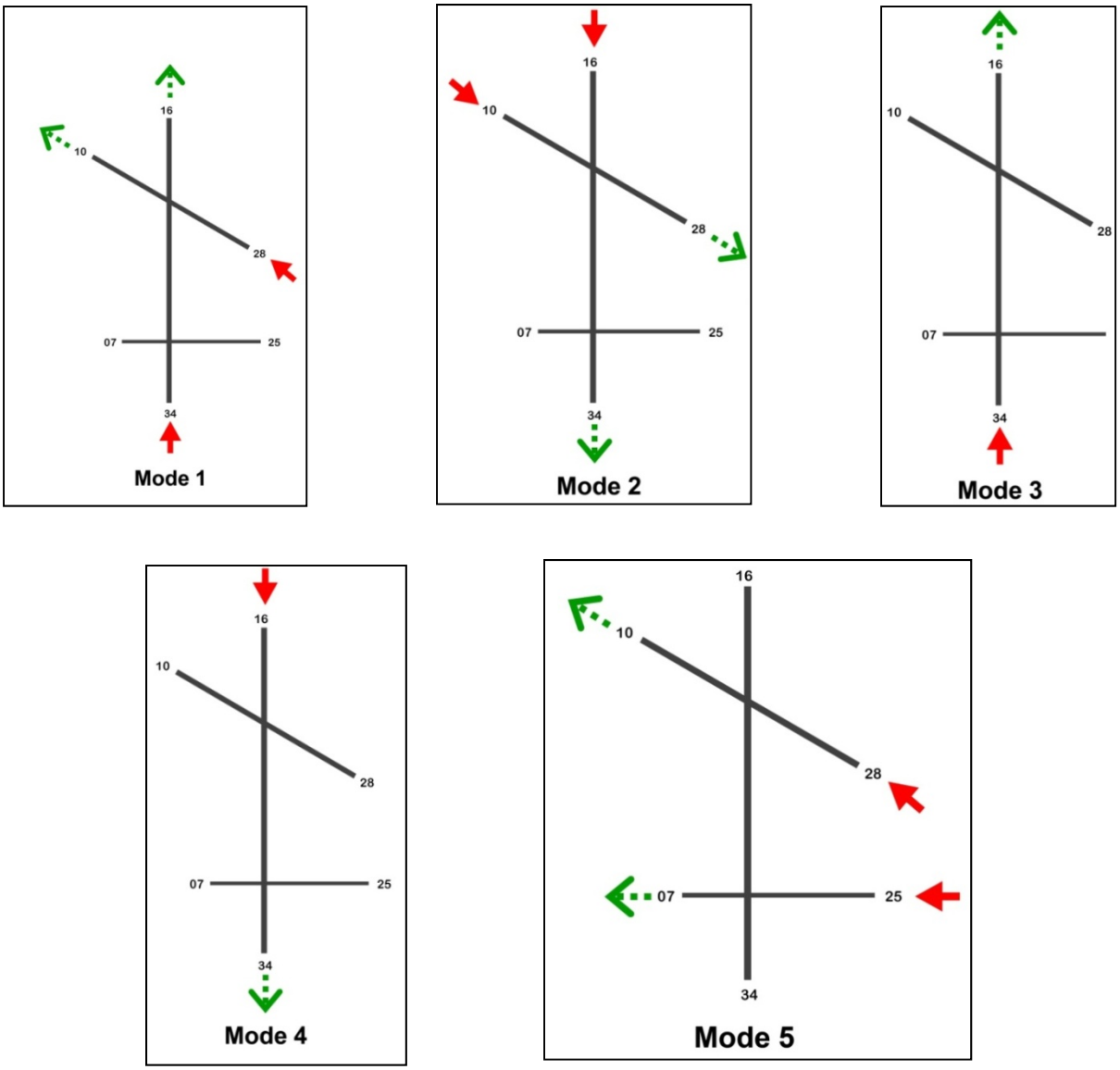


- Runway 07 – arrivals from the west and departures to the east
- Runway 10 – arrivals from the northwest and departures to the southeast
- Runway 16 – arrivals from the north and departures to the south
- Runway 28 – arrivals from the southeast and departures to the northwest
- Runway 25 – arrivals from the east and departures to the west
- Runway 34 – arrivals from the south and departures to the north

7.12.7 Existing Modes of Operation

YYC currently operates five different modes of operation. These are illustrated in Figure 7-31.

Figure 7-31 Existing Modes of Operation



- Mode 1: aircraft arrive from the south and depart to the north on Runway 34 and arrive from the southeast and depart to the northwest on Runway 28
- Mode 2: aircraft arrive from the north and depart to the south on Runway 16 and arrive from the northwest and depart to the southeast on Runway 10
- Mode 3: aircraft arrive from the south and depart to the north on Runway 34 only
- Mode 4: aircraft arrive from the north and depart to the south on Runway 16 only
- Mode 5: aircraft arrive from the southeast and depart to the northwest on Runway 28 and arrive from the east and depart to the west on Runway 25. This mode is specifically used for Chinook wind conditions

7.12.8 Navigational Aids

Various radio navigational aids are available in the Calgary Terminal Area due to the range of technology available in aircraft. Conventional instrument rated aircraft generally use computerized onboard equipment that displays both global positioning system (GPS) (satellite based) information combined with position information received from ground-based navigation aids such as:

- ILS
- Very High Frequency Omni-directional Radio (VOR) (4.6 nm from YYC)
- Distance Measuring Equipment (DME) (4.6 nm from YYC)
- Non-Directional Beacon (NDB)

The three main arrival runways (Runway 16, 28, and 34) have ILS equipment that provides aircraft with lateral and vertical guidance on the final approach leg to the runway. This system brings aircraft in line with the runway heading on a 3 degree glide slope down to the runway threshold, meaning aircraft capable of performing ILS approaches will generally follow a consistent flight path when they are on final approach.

ATC also utilize ground-based radar systems to monitor and control aircraft. YYC has primary and secondary radar installed at the airfield. Both are used to identify and locate aircraft in the air (and to a certain extent on the ground), which is vital to ensure a safe operating environment for aircraft.

7.12.9 Future STARs and Runway Approaches

STARs define the approach routes and give pilots guidance from the relative terminal area entry point to a waypoint from which an instrument approach to the runway can be commenced.

STARS are used only by IFR aircraft. VFR aircraft navigate predominantly by visual reference to the ground and generally approach the airport below 5,500 ft ASL. This ceiling for VFR aircraft increases further out from the Calgary control zone but vertical separation is always maintained between VFR and IFR traffic. These VFR aircraft are normally light aircraft and helicopters. Weather permitting; VFR aircraft at YYC predominately use the general aviation runway of 07/25. However, in peak times 07/25 will be used as a taxiway, and arrivals and take-offs will predominantly be on the main runways (Runway 16/34 and 10/28).

Vectoring of aircraft from their STAR to their final approach point for the runway is also common. Aircraft flight paths are spread across a large area as many STARs often converge on a common final approach point. ATC must often radar vector aircraft in order to maintain separation between all aircraft within the terminal area. This can be seen in Figure 7-32 and 7-33 (which give an example of approach routes for September 2008) on the main runway (Runway 16/34) and illustrate the flight tracks and associated spread that can occur as aircraft join final approach.

NAV CANADA implements a procedure called Dependent Converging Instrument Approaches (DCIA) to help them more efficiently manage the arrival and departure of aircraft. The procedure uses Converging Runway Display Aid (CRDA) technology to help keep the appropriate minimum spacing between arriving aircraft on converging approaches (Mode 1 and 2). This also allows ATC to better sequence arrivals and departures.

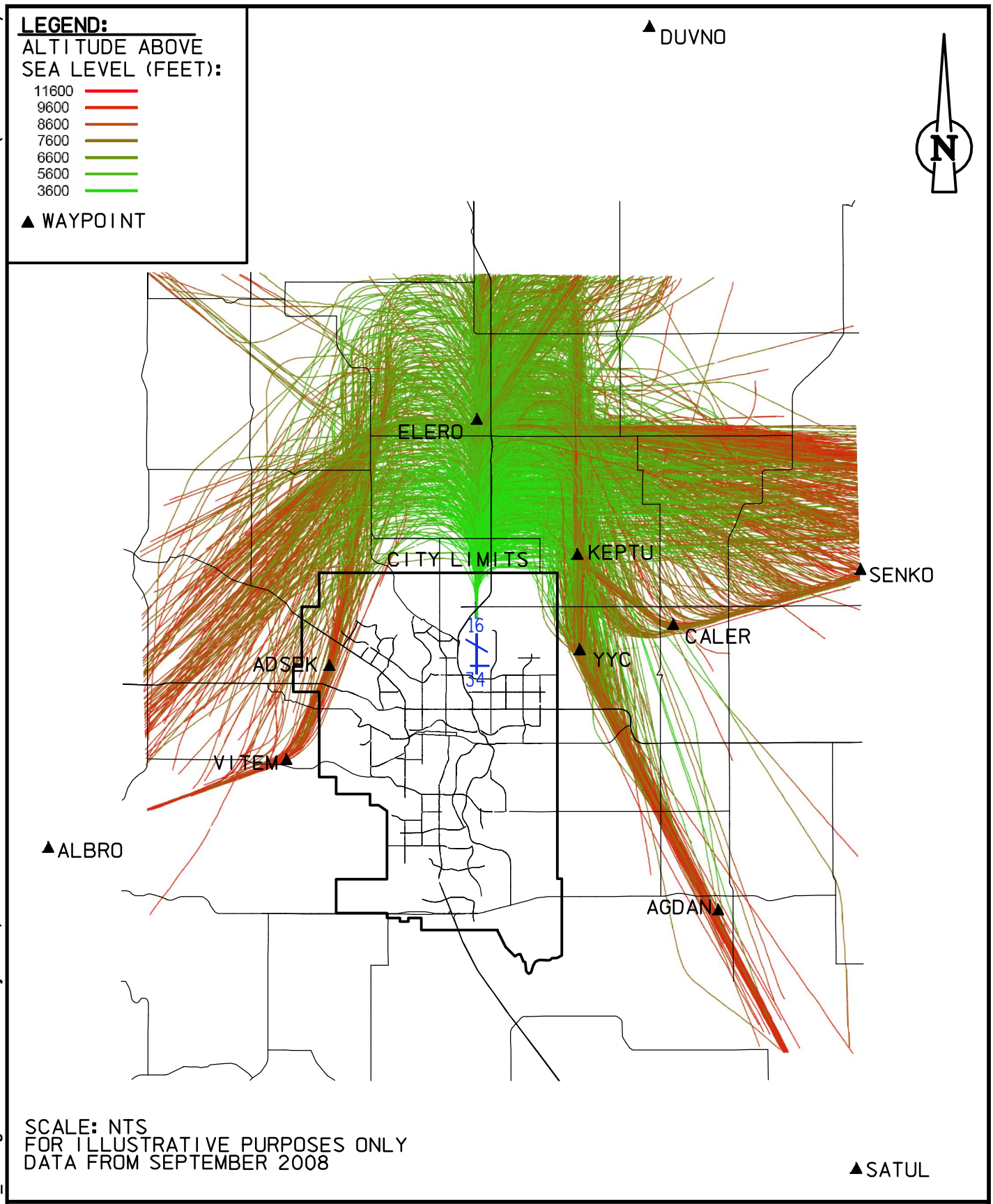
The choice between a number of possible instrument approaches to each runway depends upon the navigation equipment carried in the aircraft; however, by far the largest type of instrument approach to the

runways is either an ILS approach or a Required Navigation (RNAV) approach using a Global Navigation Satellite System (GNSS).

The ILS is a ground based navigation aid associated with outfitted runways (Runway 10, 16, 28, and 34); it produces an accurate radio signal to guide the aircraft down the centre line (the localizer) and another signal to guide the aircraft down the glide path (normally 3 degrees). The ILS can also incorporate marker beacons (outer, middle, and inner) combined with DME to provide the pilot with distance-to-touchdown position.

The RNAV approach is similar to the ILS approach to the runway except that the position information is derived from on-board equipment such as GPS and inertial navigation systems, and may be supplemented with additional information from the ground.

The intercept point for the final approach path to the runway (either ILS or RNAV) can vary in distance due to the radar vectoring of aircraft from their STAR; however, aircraft will generally be lined up with the runway by the Initial Approach Fix (IAF) for the instrument approach to the runway, which is around 10 to 16 nautical miles from touchdown at 7,000 ft ASL. IFR aircraft will not turn onto their final approach segment inside the Final Approach Fix (FAF), which is usually 4 nautical miles from the runway threshold, and not below 4,800 ft ASL. Generally, IFR aircraft will be aligned with the ILS localizer before 6 nautical miles out from the runway, unless they have been approved a visual approach from ATC.



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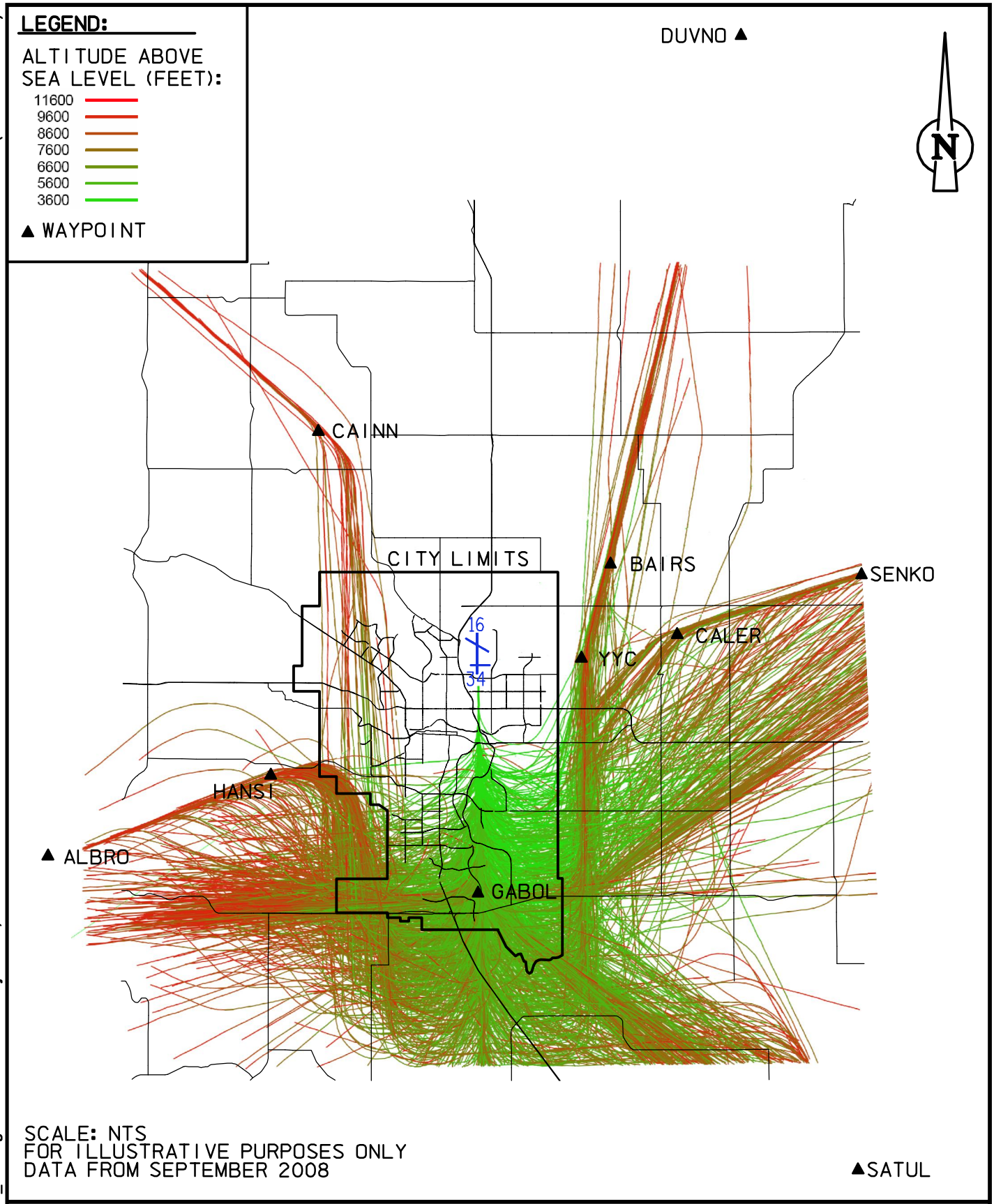
Flight Tracks Approaches Runway 16

Figure 7-32



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Flight Track Approaches Runway 34

Figure 7-33

7.12.10 Future SIDs and Departure Routes

SIDs define routes that give pilots guidance from the departure runway to a terminal area exit waypoint. In Calgary, terminal area radar SIDs are used. This means aircraft, once they pass a defined altitude after initial climb, will be radar vectored by ATC to a certain exit waypoint. Generally, ATC will make it possible for aircraft to continue to climb at a constant rate directly toward their assigned exit waypoint.

SIDs are used only by IFR aircraft and are used in the terminal airspace from take-off to until reaching the exit waypoint. VFR aircraft do not use SIDs, as they are navigating predominantly by visual reference to the ground and generally depart the airport below 5,500 ft ASL.

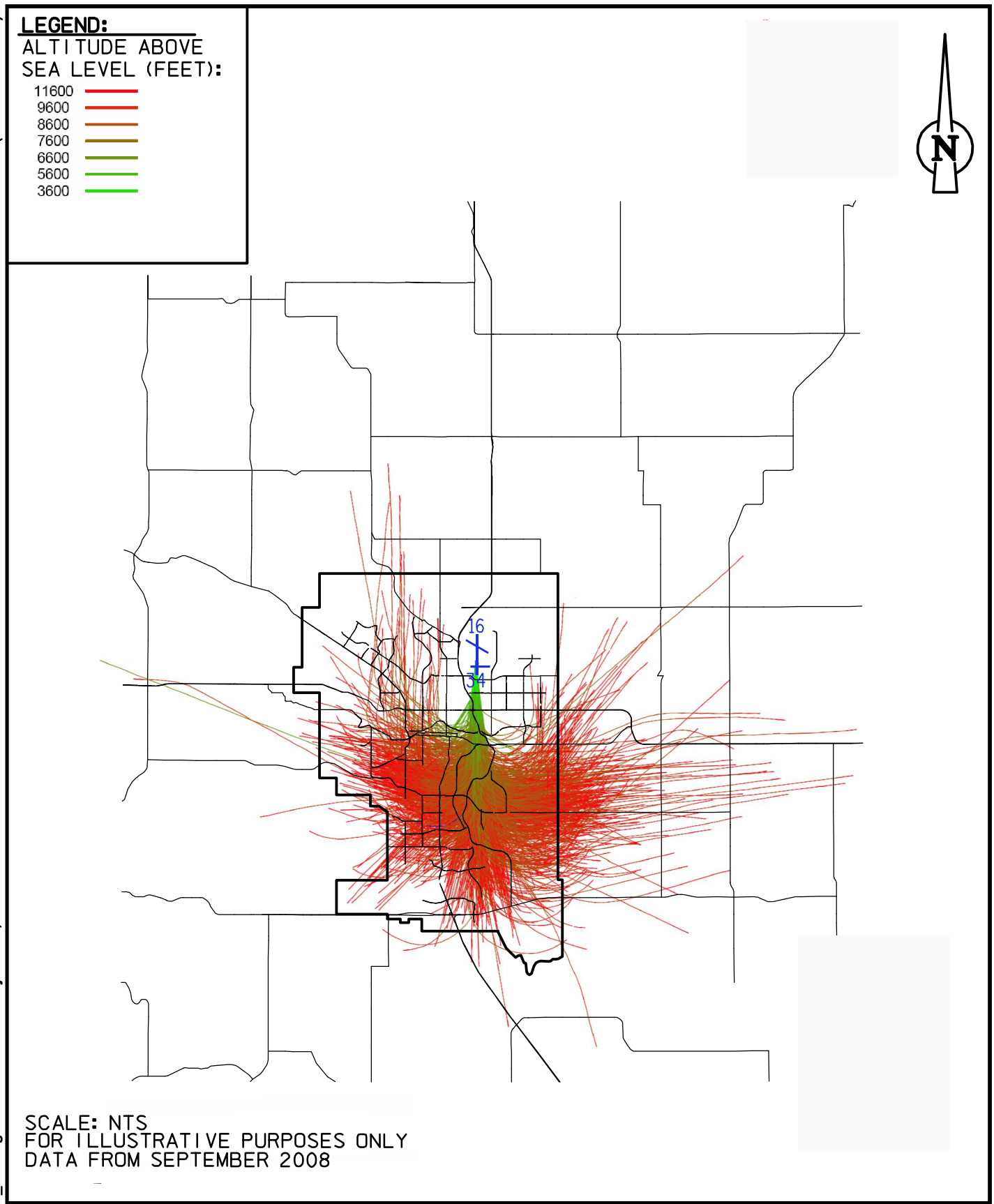
Due to the YYC SIDs being radar SIDs (containing fewer defined waypoints than a procedural SID in the terminal airspace), aircraft will be radar vectored on departure, which means the departure routes will be spread over a larger area than if all aircraft were following a published procedural SID. However, the initial climb phase of departures has set requirements due to noise abatement rules. Jet aircraft are required by noise abatement procedures to hold their departure heading until they reach 6,500 ft ASL, and published SIDs require aircraft to climb to at least 7,000 ft ASL before vectoring to the assigned route. Non-jet aircraft are not restricted by noise abatement procedures and will generally hold their departure heading until approximately 4,000 ft ASL. The spread of radar SIDs on the main runway (Runway 16/34) can be seen in Figures 7-34 and 7-35, which illustrate flight tracks for September 2008.

7.12.11 Future Aircraft Separation Rules

Aircraft separation in the terminal area can vary for many reasons; however there are general rules that govern the minimum aircraft separation. The governing consideration in aviation is safety and ATC will always ensure safe separation standards are maintained as per defined flight rules. A general rule applies that all aircraft must maintain a minimum 3 nautical miles lateral or 1,000 ft vertical separation in the terminal area.

Another defining factor that determines aircraft separation is wake vortices. All aircraft create turbulent air in their wake, otherwise known as wake vortices, which is a result of the flow of air being disturbed as it passes over the wings – the larger the aircraft the larger the wake vortices. Aircraft must maintain a certain minimum distance behind other aircraft based on the weight category of aircraft. Four aircraft weight categories exist:

- Super heavy (J) – A380
- Heavy (H) – aircraft more than 136,000 kg
- Medium (M)– aircraft between 7,000 kg and 136,000 kg
- Light – aircraft less than 7,000 kg



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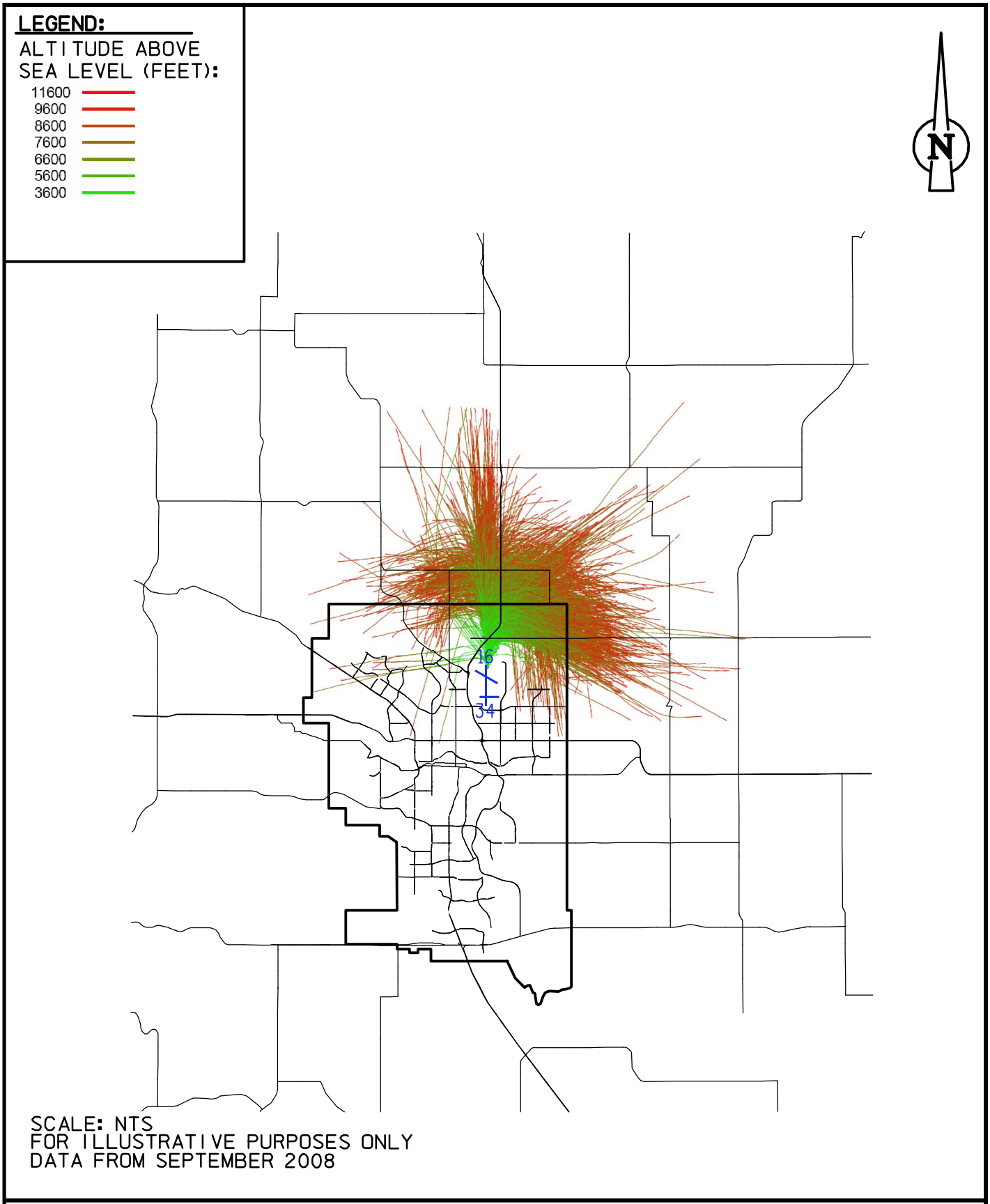
Flight Track Departures Runway 16

Figure 7-34



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Flight Track Departures Runway 34

Figure 7-35

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The following wake vortex separation rules for apply for these weight categories (Transport Canada 2009):

- Super behind super – 4 nautical miles separation
- Heavy behind super – 6 nautical miles separation
- Medium behind super – 8 nautical miles separation
- Light behind super – 10 nautical miles separation
- Heavy behind heavy – 4 nautical miles separation
- Light behind heavy – 6 nautical miles separation
- Medium behind heavy – 5 nautical miles separation
- Light behind medium – 4 nautical miles separation

Super heavy aircraft are a special category set up for the A380, which currently does not fly within Canada. The separation standards for this super heavy category have been set by the ICAO.

7.12.12 Runway Selection Rules

Runways are selected by NAV CANADA controllers after consideration of many governing factors. Safety is always the highest priority in aviation, so runways will be selected on the basis of wind speed and direction and any other meteorological conditions; runways can also be requested by pilots due to aircraft requirements. When meteorological conditions or any other safety requirements do not govern the selection of the runway, the preferential runway will be selected as per noise abatement procedures (NAP) defined for YYC. These procedures apply to jet aircraft, including turbo-jets, turbo-fans and fan-jets, and are in effect at all times unless otherwise specified. It is the pilot's responsibility to adhere to published NAPs.

The following procedures are taken from the current Canada Air Pilot (CAP) (October 22 – December 9, 2009):

Consistent with safety operations, ATC will designate runways to divert as many take-offs as possible from flight over residential areas in proximity to the airport. Thus, aircraft will use preferential runways listed in Table 7-4. Use of other than the designated preferential runway should only be requested to meet an operational necessity (safety) and therefore, must be authorized by the ATC. These (five) operational necessities are:

1. Physical condition of surface
2. Effective crosswind component not to exceed 15 knots for arrivals, 20 knots for departures
3. Effective tailwind component not to exceed 5 knots
4. Other safety considerations declared by the Captain of the aircraft
5. For aircraft landing at night on runway 25, aircraft are to fly the runway 28 ILS until interception of the extended centreline of runway 25 for visual straight-in approach

Table 7-4 Preferential Runways and Hours of Operation

Hours	Operation	Preferential Runways
All Hours	ICAO Annex 16 Chapter 2 (FAA Stage 2) and non-noise certified	34
Day Operations 0700-2300 (Mon-Fri) 0900-2300 (Sat-Sun)	Departures	34, 28
Night Operations 2300-0700 (Mon-Fri) 2300-0700 (Sat-Sun)	Departures	34
	Arrivals	16, 28, 34

7.12.12.1 Departure Procedures

SID cancellation does not terminate NAP. ICAO Annex 16, Chapter 2 (FAA Stage 2) and non-noise certified military aircraft will be assigned runway 34 for departures when runways 28 and 34 are in use. See Table 7-5 for jet aircraft departure NAPs.

Table 7-5 Runway Noise Abatement Departure Procedures

Runway	Noise Abatement Procedures
25	Restricted to ICAO Annex 16, Chapter 3 (FAA Stage 3) jet aircraft under 44,100 lb GTOW. Climb runway heading to 6500' ASL before proceeding on course
07, 10, 16	Climb runway heading to 6500' ASL before proceeding on course
28	Climb runway heading to 6500' ASL before proceeding on course
34	No left turns below 6500' ASL south of "SARCEE" (ZYC) NDB

7.12.12.2 Arrival Procedures – Visual Approach

Visual approaches are aircraft approaches that allow the pilot to proceed, visually, to the active runway without the aid of the ILS. This type of approach must be authorized by ATC and is usually only given under specific circumstances, including good visibility and minimal air traffic. Clearance for approach or for landing does not cancel the arrival procedures described below. Pilots are requested to use delayed gear and flap extension and low power/drag configurations consistent with operating procedures and safety. See Table 7-6 for arrival NAPs at the Authority.

Table 7-6 Runway Noise Abatement Arrival Procedures

Runway	Noise Abatement Procedures – Visual Approach
All Runways	Military jet aircraft multiple circuits and all overhead breaks prohibited
07	Not authorized
10	Join final approach at or above PAPI (Precision Approach Path Indicator)
25	Join final approach at or above the VASIS (Visual Approach Slope Indicator). For landing at night, aircraft are to fly the runway 28 ILS until interception of the extended centreline of runway 25 for a visual straight-in approach
16	Intercept final approach from the west at or above 4800' ASL and prior to the NDB or FAF
28, 34	Intercept final approach at or above 4800' ASL and prior to the NDB or FAF for the runway use

7.12.13 Runway Utilization

As defined in Section 7.12.12 of this report, runway utilization is selected by NAV CANADA after consideration of many influencing factors. Figures 7-36 and 7-37 outline the runway usage for the past 9 years.

Figure 7-36 Runway Utilization Jet Aircraft Arrivals

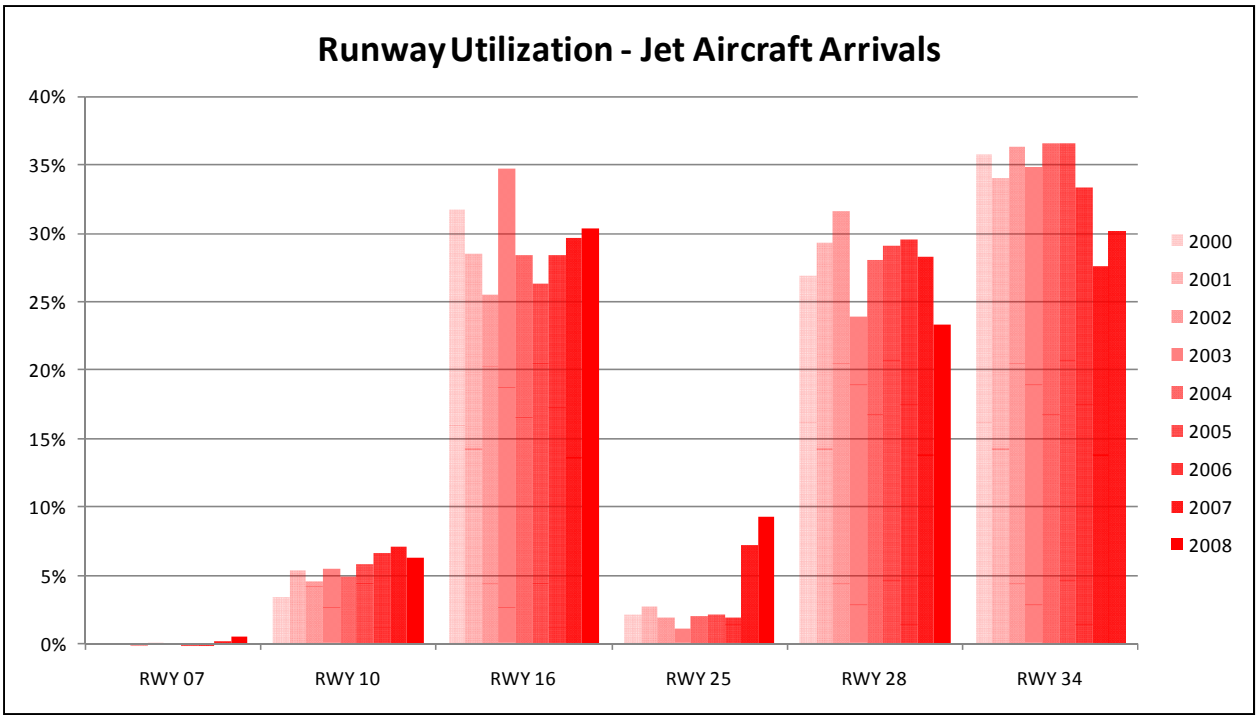
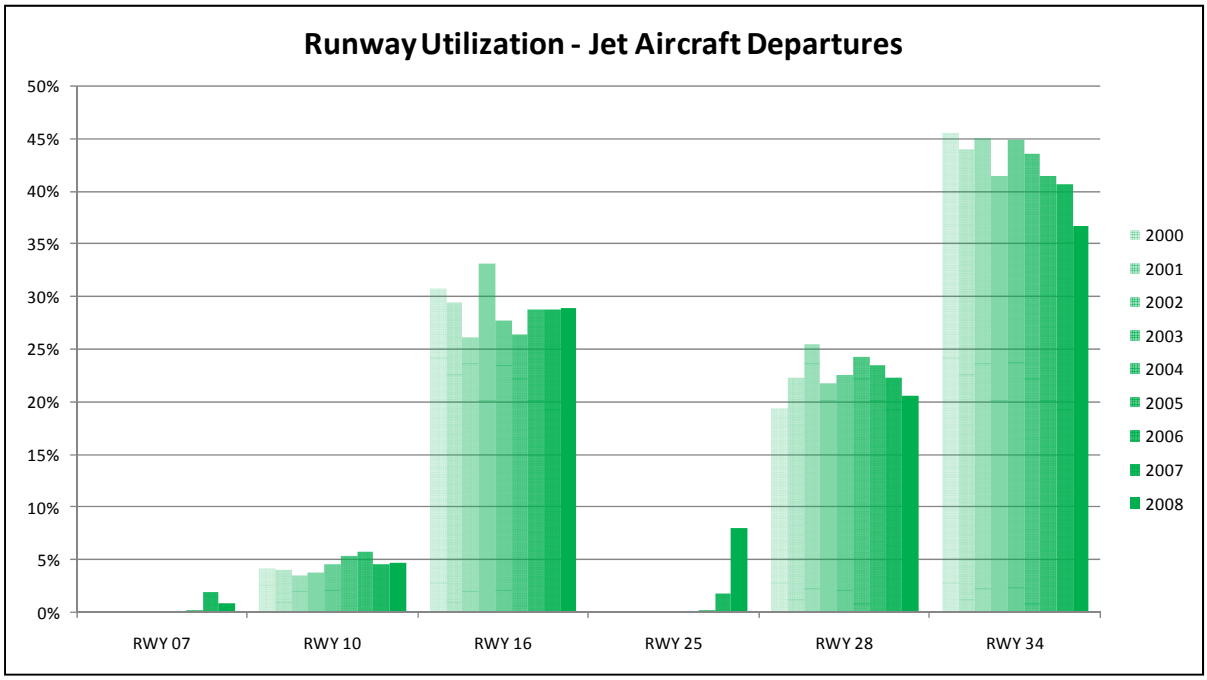


Figure 7-37 Runway Utilization Jet Aircraft Departures



7.12.14 Future Runway Designations and Characteristics

The proposed construction of the new parallel runway at YYC will cause a change to the runway designations to avoid confusion for pilots. Similar to current operating conditions, wind direction changes throughout the year will result in each runway operating in both directions. The new runway designations for the proposed future runway layout are listed below.

The existing runway, 16/34 will heretofore be designated 16R/34L; the new, parallel runway will be designated 16L34R. Their arrival and departure characteristics are:

- Runway 16L (new) – arrivals from the north and departures to the south
- Runway 16R (existing) – arrivals from the north and departures to the south
- Runway 34L (existing) – arrivals from the south and departures to the north
- Runway 34R (new) – arrivals from the south and departures to the north

The existing intersecting runways (Runway 10/28 and 07/25) will retain their designations.

The centreline of the new Runway 16L/34R will be situated 2,170 m (7,120 ft) east of the centreline of the existing runway 16R/34L. This centreline spacing is sufficient to permit independent parallel operations (approaches and departures) in instrument meteorological conditions provided certain technical conditions are met.

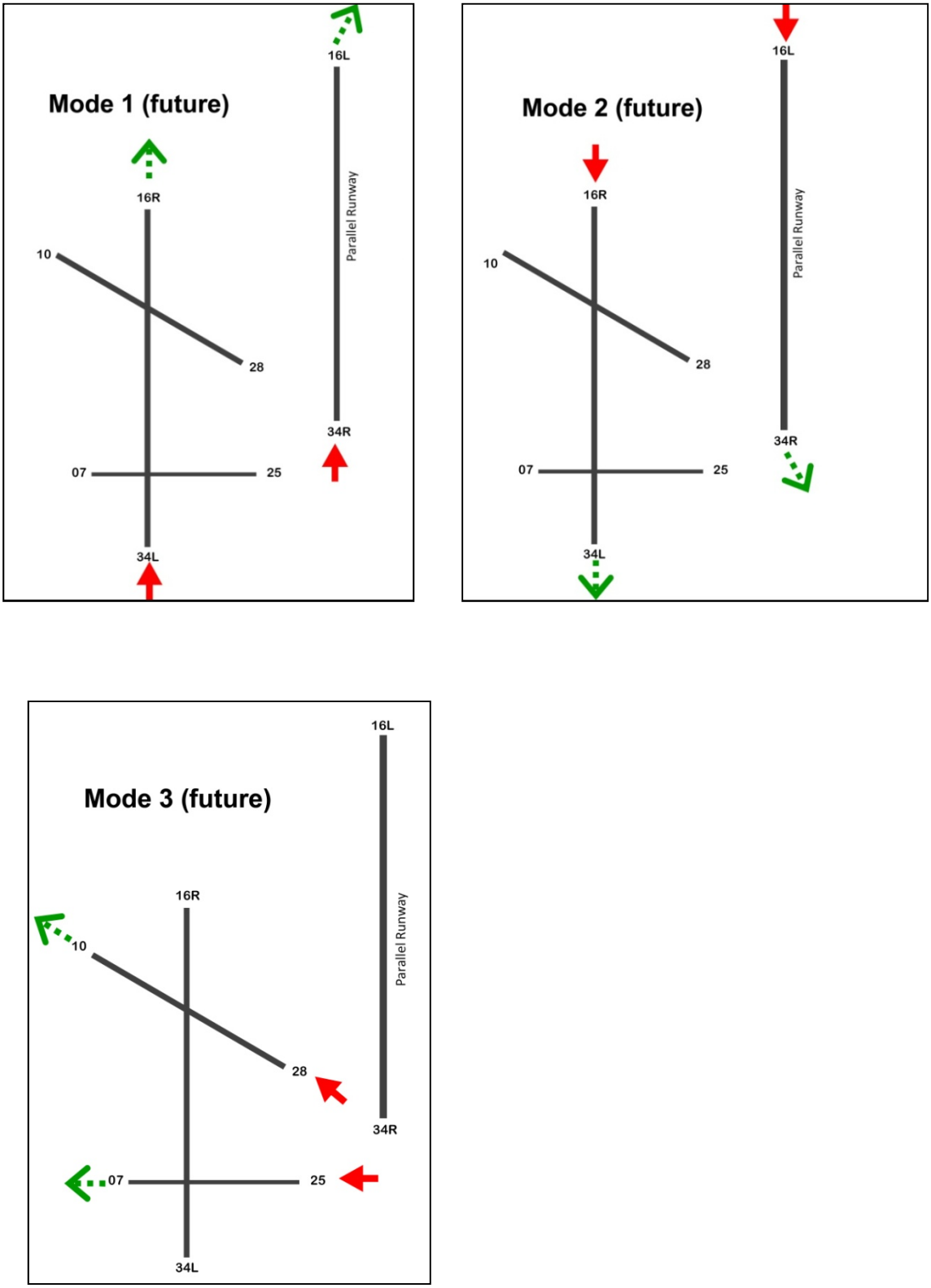
The advantages of independent operations on parallel runways include:

- Maximizing the number of aircraft that can be accommodated in a given time frame due to the larger volume of airspace available to process air traffic
- Increasing traffic throughput by dividing the airspace laterally between two air traffic controllers and doubling the workload capability
- Providing independent traffic flows within the terminal airspace that are separated laterally rather than having more complex vertical arrangements
- Designing traffic flows separately for each runway so that aircraft do not have to cross over a flight path for traffic using the other runway. This can permit unrestricted climb and thus lower environmental impact and safer operations.

7.12.15 Future Modes of Operation

With the proposed new runway, YYC will operate under three main modes of operation; essentially northbound, southbound and westbound. These are illustrated in Figure 7-38.

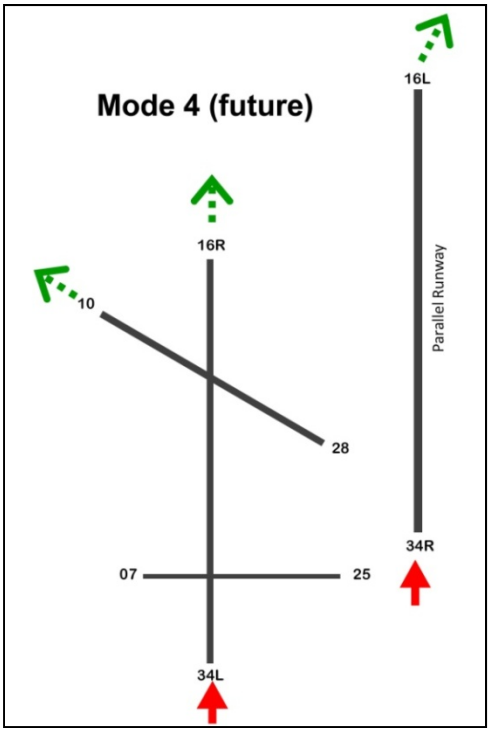
Figure 7-38 Future Modes of Operation



- Mode 1: aircraft arrive from the south and depart to the north on Runway 34L and 34R.
- Mode 2: aircraft arrive from the north and depart to the south on Runway 16L and 16R.
- Mode 3: aircraft arrive from the east and depart to the west on Runway 28 and arrive from the east and depart to the west on Runway 25. This mode is specifically used for Chinook wind conditions.

One extra mode of operation may be utilized in the future if operational constraints require, as detailed in Figure 7-39.

Figure 7-39 Potential Future Mode of Operation



- Mode 4: aircraft arrive from the south and depart to the north on Runway 34L and 34R and aircraft depart on Runway 28

However, this mode cannot be reproduced in the south flow direction due to restriction on the use of Runway 10 during Runway 16L operation. Since Runway 10 departures and missed approach procedures will impede on the new runway operation, these two runway directions will not be used coincidently.

There may be situations where other modes of operation are required due to operational requirements.

7.12.16 Future Terminal Airspace Operations

The bounds of the Calgary Terminal Area should remain the same with the opening of the proposed new runway with a 35 nautical mile radius around the airport and extending to an altitude of 25,000 ft ASL. The structure of the airspace and routing of aircraft will, however, need to be adjusted to suit the new modes of operation.

Similar to the existing airspace, there will be entry and exit waypoints that ensure appropriate separation between arriving and departing aircraft. The STARs and SIDs will change upon opening of the proposed new runway; however, they will still serve the same purpose. STARs will provide pilots of instrument-rated aircraft with a sequence of waypoints to follow, which will lead them to the final approach segment, while SIDs will provide guidance from the runway to a terminal area exit point.

The layout of the terminal airspace is determined by NAV CANADA; any new procedures will be provided in updated versions of the “Canada Air Pilot – Instrument Procedures” manual prior to the opening of the proposed runway. As the service provider, NAV CANADA will design the new terminal airspace based on practices regulated by TC.

The new airspace design will operate similarly to the current operational layout, with certain entry and exit points allocated to certain runways for the main modes of operation. It is likely that requests for “crossovers” will decrease as both runways offer sufficient length for take-off and landing requirements for most large aircraft.

7.12.17 Future Navigational Aids

The same navigational aids will be available upon opening of the proposed new runway. Existing ILS, VOR, DME and NDB ground equipment will remain. This equipment will be used to produce equivalent terminal area navigational procedures for the proposed runway. The proposed new runway will also have ILS equipment that provides aircraft with lateral and vertical guidance on the final approach leg to the runway. This is a requirement for the operation of simultaneous parallel runways.

Regulation requires that certain navigational requirements be met for simultaneous parallel runway operations. The requirements for parallel runway operations are governed by TC, NAV CANADA and the ICAO. Simultaneous parallel runway operations may be either ‘independent parallel approaches’; ‘dependent parallel approaches’ or ‘segregated parallel operations’. Regarding navigation aids, the following will be required to conduct independent parallel approaches (runways separated greater than 1,525 m):

- A suitable surveillance radar must be available that has a minimum azimuth accuracy of 0.3 degrees and update period of five seconds or less.
- ILS approaches are conducted on both runways.
- A no transgression zone (NTZ) at least 610 m (2,000 ft) wide is established equidistant between extended runway centrelines and is depicted on the radar display.
- Separate radar controllers monitor the approaches to each runway and ensure that, when the 1000 ft vertical separation is reduced aircraft do not penetrate the NTZ, and the applicable minimum longitudinal separation between aircraft on the same ILS is maintained (normally 3 nautical miles).

7.12.18 Future STARs and Runway Approaches

The STARs will need to be redefined prior to the opening of the proposed new runway as mentioned previously. Similar to current operating conditions all IFR aircraft will not exactly follow the same route between the entry waypoint to the runway approach waypoint as ATC may need to radar vector aircraft in order to achieve lateral separation between aircraft and this will cause divergence from the published STAR route within the terminal airspace.

This final approach segment is essentially the same for all ILS-equipped runways. The intercept point for the final approach path to the runway (either ILS or RNAV) can vary in distance due to the radar vectoring

of aircraft from their STAR; however, aircraft will generally be lined up with the runway by the IAF for the instrument approach to the runway, which is around 10 to 16 nautical miles from touchdown at 7,000 ft ASL

Strict regulations are outlined for simultaneous parallel runway operation by the ICAO and are applied by NAV CANADA. These regulations require aircraft be radar vectored by ATC onto final approach due to the proximity of adjacent approach routes.

For simultaneous parallel runway operations separation regulation requires aircraft to have at least 3 nautical miles lateral or 1,000 ft vertical separation in the terminal area. This means that, since aircraft on simultaneous approach are within 3 nautical miles of each other, they must maintain a 1,000 foot vertical separation until they are fixed on their ILS approach. Regulations also require that a missed approach track for one approach diverges by 30 degrees from the missed approach track of the adjacent missed approach track.

The basic procedures involved in ILS approach will remain the same with simultaneous parallel runways. Aircraft on instrument approaches will generally line-up with the runway at the IAF, which ranges normally from 10 to 16 nautical miles from touchdown. ATC may choose to radar vector aircraft onto their final approach as early as the FAF (approximately 4 nautical miles from the runway threshold) if pilots are approved a visual approach.

VFR aircraft will continue to navigate by visual reference to the ground and will likely remain below 5,500 ft ASL, which provides separation from the generally larger and faster IFR aircraft.

7.12.19 SIDs and Departure Routes

The SIDs in the Calgary Terminal Area will also need to be redefined as entry and exit points will be redefined for the proposed new runway. Currently Calgary Terminal Area only has radar SIDs, which means that aircraft, once they pass a defined altitude after initial climb, will be radar vectored by ATC to a certain exit waypoint. There are two types of SID designs that are common in terminal airspace; radar SIDs and procedural SIDs. Procedural SIDs have a more defined structure than radar SIDs where aircraft will follow a sequence of waypoints, which are defined by altitude and location, until they reach their assigned terminal area exit point. As RNAV procedures become more common it is more likely that procedural SIDs will be used. If radar SIDs are used for the future terminal airspace design they will follow a similar pattern to current operational procedures; after reaching the required altitude on the initial climb phase aircraft will be radar vectored by ATC to their respective terminal area exit location.

Whether radar or procedural SIDs are used aircraft will still be required to follow the restrictions imposed on simultaneous parallel runways. Departures on the proposed new runway will be required to make an immediate 15 degree turn away from the existing parallel runway. This ensures track divergence and minimizes the risk of aircraft drifting off-course. Equivalent initial climb procedures to those applied currently will also be applied. Jet aircraft are expected to be required to climb to at least 6,500 ft ASL, and non-jets to 4,057 ft, before they can follow their assigned SID.

VFR aircraft, similar to current procedures, will not use SIDs as they are navigating predominantly by visual reference to the ground and generally depart the airport below 5,500 ft ASL.

7.12.20 Runway Selection Rules

Runways will continue to be selected by NAV CANADA controllers after consideration of many governing factors with safety being the most important. Runways will be selected on the basis of wind speed and direction and any other governing meteorological conditions. Although runway selection may also be determined upon requests from pilots due to aircraft requirements, in independent parallel runway modes, this will be rare due to the fact that both runways will provide sufficient take-off and landing distance for most aircraft types. This means less “crossovers” will be requested and the entry and exit location to the terminal area will predominantly decide what runway an aircraft is allocated.

7.13 Issues Raised by Stakeholders

Issue: Include aircraft viewing areas within the scope of the project

Response: An aircraft viewing area is included as a potential project component, as stated in Section 7.6 and shown on Figures 7-5 and 7-6.

Issue: Include sequential centreline taxiway lighting.

Response: The parallel runway and its taxiway system will be built to Cat IIIa electronic and visual navigational air standards. Those standards include centreline lighting for the runway and taxiways.

Issue: Why can’t you widen the existing runway and takeoff in parallel?

Response: There are regulated minimum separation distances for aircraft taking off in parallel and there is insufficient space to the east and west of the existing runway to accommodate this. The existing passenger terminal and the buildings to the south would have to be removed.