

Chapter 5

**Surface Water and Aquatic
Resources Effects Assessment**

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5. Surface Water and Aquatic Resources

5.1 Introduction

This chapter forms part of a Comprehensive Study (CS) for the Parallel Runway Project (PRP) at the Calgary International Airport (YYC). The process followed shadows the environmental assessment (EA) process under the Canadian Environmental Assessment Act (CEAA). This chapter examines the potential residual and cumulative effects that the construction, operation and reclamation of the PRP may have on surface water and aquatic resources within the Local Study Area (LSA) and the Regional Study Area (RSA) of the PRP. The PRP consists of a 14,000 ft (4,267 m) runway and associated infrastructure. The project components are described in further detail in the project description (Volume II, Chapter 7 of the CS).

The development and construction of the PRP will cause significant alterations to the existing environment. The environmental effects assessment identifies potential effects of the PRP on the natural resources in the LSA and RSA. Project effects are changes to the biophysical or human environment caused by activities arising solely from a project. Effects may be direct or indirect. A direct effect is one in which the cause-effect relationship has no intermediary effects, and an indirect effect is one in which the cause-effect relationship between a project effect and the ultimate effect on a valued component (VC) has intermediary effects (Canadian Environmental Assessment Agency 1999).

The effects assessment for surface water and aquatic resources was completed following the general methods outlined in Chapter 1 of this Volume and the more specific methods in Section 3 of this document. In summary, the assessment was scoped by identifying the scenarios which may occur, the issues and Valued Components (VCs) that may be affected by the PRP, and defining the temporal and spatial boundaries that will constrain the scope of the assessment. Baseline information used for this assessment is taken from Volume V, Item 3 (Surface Water and Aquatic Resources Baseline Report) which was completed by AECOM in February 2010. The baseline report describes the pre-construction distribution and condition of surface water features within the LSA and RSA that may be affected by the PRP.

The environmental effects assessment not only examines potential direct and indirect environmental effects that might result from the PRP, but also examines ways in which effect levels can be reduced through mitigation. Estimates of the level and magnitude of residual effects that were predicted to remain following the implementation of mitigation measures were also completed. The general organization of this effects assessment is as follows:

- Scoping;
- Baseline Studies;
- Effects Assessment;
- Mitigation;
- Residual Effects and Evaluation of Significance;
- Cumulative Effects; and
- Follow-up and Monitoring.

5.2 Scoping the Assessment

5.2.1 Scenarios

Five scenarios were considered in conducting the component assessments as part of the PRP Comprehensive Study:

1. pre-construction conditions;
2. conditions in 2015 with the new runway in place;
3. conditions in 2015 without the new runway;
4. conditions in 2025 with the new runway in place; and
5. conditions in 2025 without the new runway.

With respect to the surface water and aquatic resources assessment, the pre-construction conditions were detailed in the baseline report (Volume V Item 3). The second scenario, *conditions in 2015 with the new runway in place*, is the only relevant scenario that will be considered in the following discussions. Because the land base for the PRP has essentially been frozen or excluded from consideration for alternate uses and cannot be developed in another manner, the fifth scenario, *conditions in 2025 without the new runway*, will also be essentially similar to the original baseline condition. Scenario four, *conditions in 2025 with the new runway in place*, may bear some relevance for consideration of operational effects assessment as runway use and traffic increases over time.

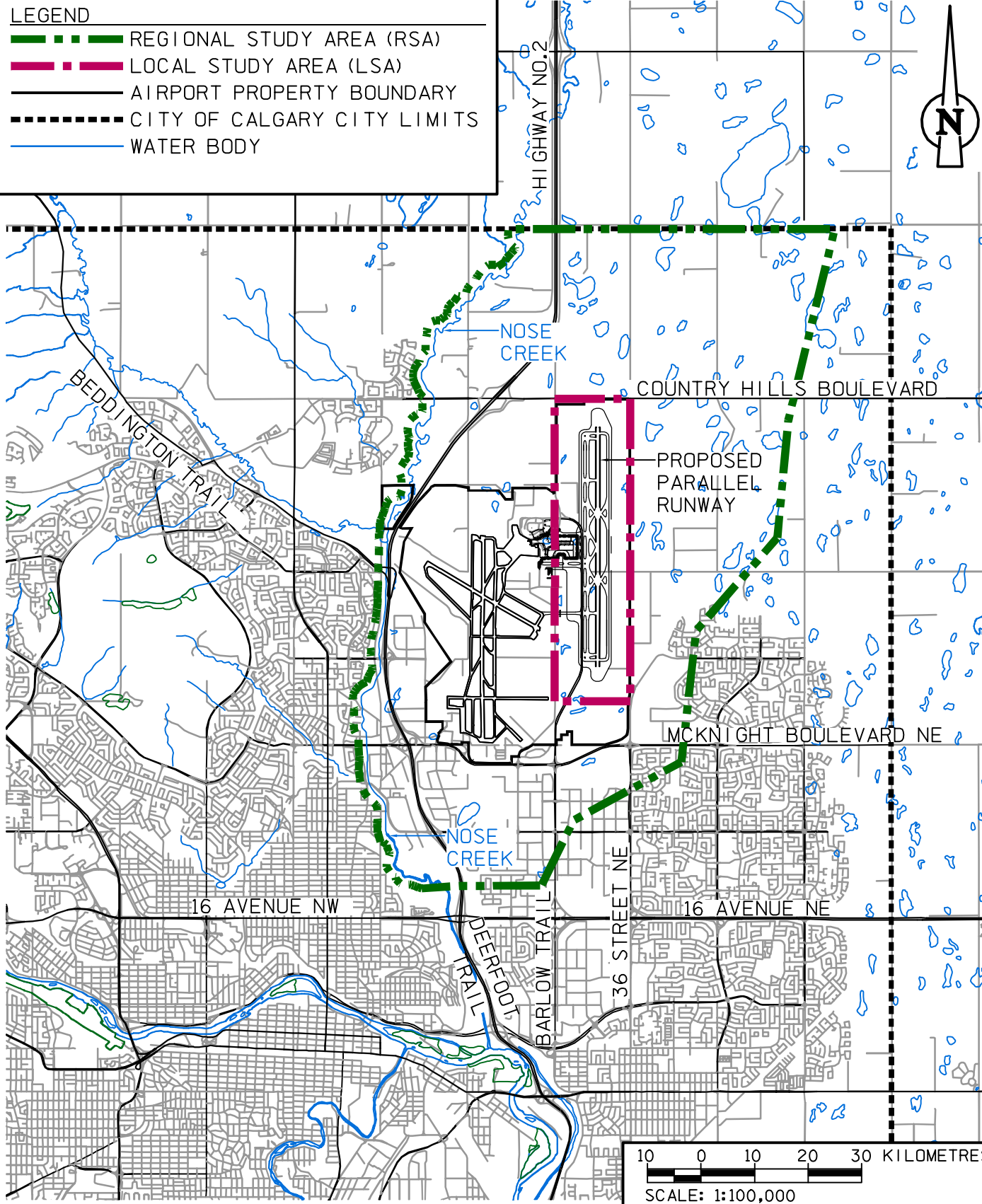
5.2.2 Spatial and Temporal Boundaries

5.2.2.1 Local Study Area

The Local Study Area (LSA) includes the actual footprint of the PRP and will encompass some four sections of undeveloped federal lands (landside) directly east of the existing YYC infrastructure (airside); it was defined based on the extent of the proposed PRP footprint to include an area bounded by Country Hills Boulevard to the north, Silverwing Golf Course to the south, 36 Street NE to the east, and McCall Way to the west (Figure 5-1).

The LSA is in the Foothills Fescue Natural sub-region of Alberta, with agriculture and residential acreages being the current land use within the LSA. The proposed PRP area consists primarily of agricultural crop fields in the northern portion and livestock pastures in the southern portion. There are a few permanent buildings and one residence within the LSA. There are no flowing waters or lakes within the LSA; however, there exist a number of ephemeral wetlands and several ponds.

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YYC CALGARY AIRPORT AUTHORITY

The Calgary Airport Authority
 Runway Development Program
 Parallel Runway Project

AECOM

Local and Regional Study Areas

Figure 5-1

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5.2.2.2 Regional Study Area

The Regional Study Area (RSA) includes the drainage basin around the LSA, including the existing Calgary International Airport (YYC) operations and an approximately 12 km section of Nose Creek (Figure 5-2). Nose Creek receives stormwater runoff from the existing YYC operations facilities and footprint directly and indirectly through the City of Calgary stormwater drainage system, and will receive runoff from the completed PRP. Any effects or alterations to water quantity or quality that result from the PRP would not extend beyond the RSA boundary.

Land uses within the RSA consist primarily of airport facilities, commercial buildings and associated roadways, and agricultural uses (crop, pasture, and livestock). Highway 2 (Deerfoot Trail) runs parallel to, and is located between, YYC property and Nose Creek. Numerous commercial and residential developments are located to the west and upslope of Nose Creek and its floodplain. As a result of storm discharges that contribute to Nose Creek, these upslope developments may affect water quantity and quality. These upslope systems will not be affected by the PRP.

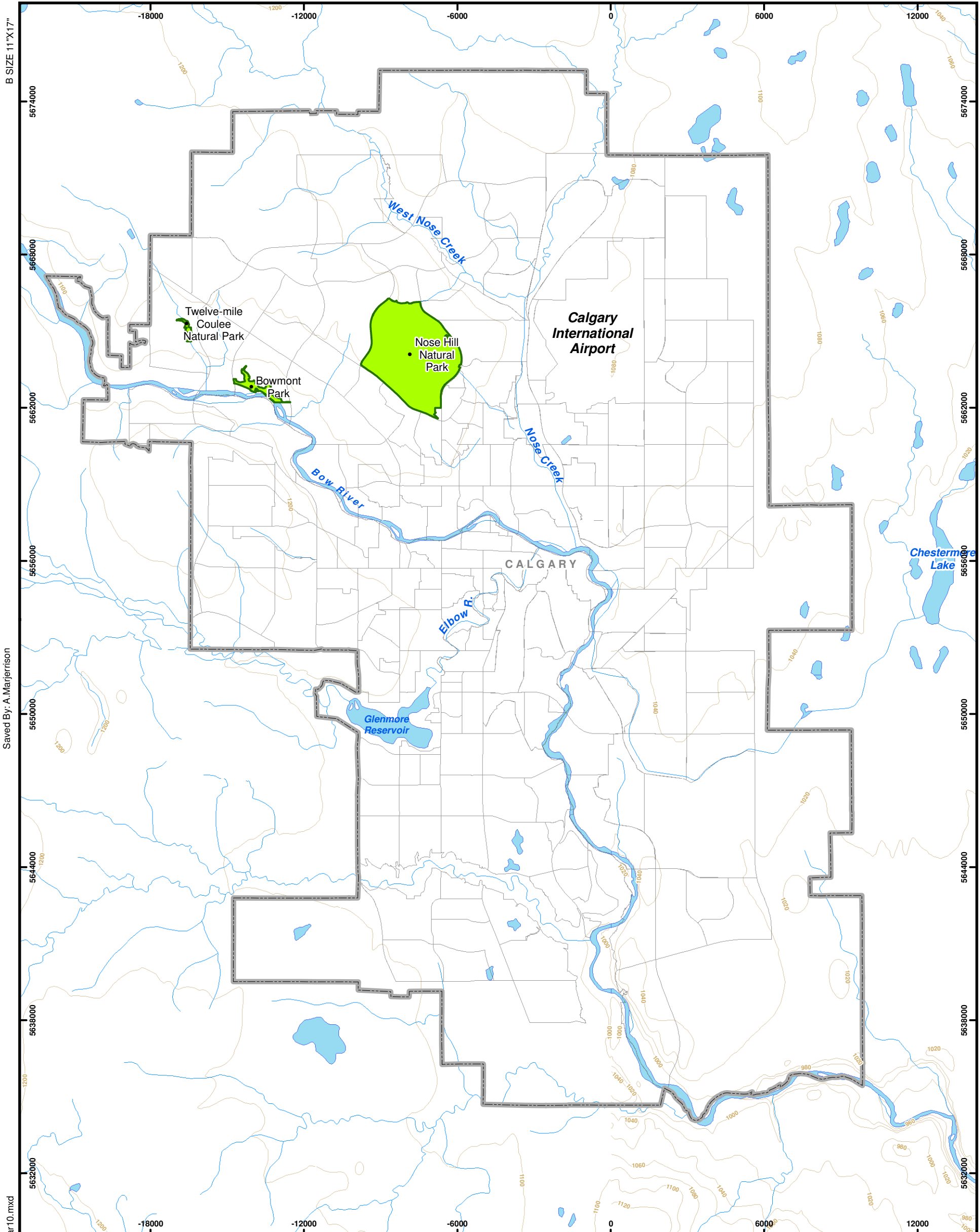
5.2.2.3 Temporal Boundaries

The temporal boundaries used for the baseline study and the effects assessment are the same as those used by other disciplines and can be found in Volume III, Chapter 1 Assessment Methods.

5.2.3 Issues Identified





As described in Volume II, Chapter 5, this Comprehensive Study (CS) is issues focussed. For each baseline discipline study, issues were identified through public consultation, communication with government agencies and other stakeholders, a review and assessment of the available data, and the professional experience of the assessment team. In the case of surface water and aquatic resources, no specific issues were raised by the public or other stakeholders, so the issues addressed were those identified by the assessment team.

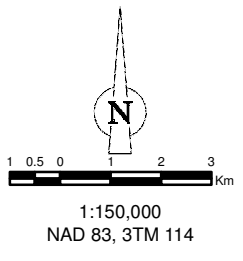
The primary issues related to the PRP for surface water and aquatic resources are whether activities related to the project during its construction or operations phases will result in measurable effects to surface water as measured by quantity and quality with respect to discharge waters leaving the LSA and YYC and entering Nose Creek. Project activities have the potential to adversely affect water quality and quantity during all stages of development (i.e., construction, operation, and reclamation). For example, effects on surface water quantity from the PRP during construction could result from a reduction or increase in discharge flows. Similarly, changes to discharge volume or velocity could change the ability of the water to carry more contaminants or result in a lower level of dilution that could result in water quality degradation. Potential changes to the volume of water discharged to Nose Creek could result from increases in the amount of runoff generated and draining from airport properties when the PRP is built. Significant effects on water quality could result from an increase in sediment loads during the PRP construction phases, from an increase in the release of polluting priority contaminants that are carried in runoff waters, or simply from airport operations that cause contaminants to enter surface runoff from operations aspects of the project, such as from de-icing, fuelling, and wear and tear substances related to increased aircraft movements. A summary of the key issues related to surface water quantity and quality are provided in Table 5-1.



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Data Source:
 Basemapping from NTDB 1:250,000.
 Communities provided by Calgary Airport Authority.
 Census boundary file from Geography Division,
 Statistics Canada, Census Subdivision Boundary Files,
 2008, 92-162-XWE/XWF.

-  Municipal Boundary
-  Community
-  Parks and Natural Areas
-  Watercourse
-  Waterbody
-  Elevation (m)



The Calgary Airport Authority
Runway Development Program
Parallel Runway Project



Surface Water Features

Figure 5-2

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Table 5-1 Identification of Potential Surface Water Key Issues to Selected VCs

Issue/Effect	VC	General Project Component or Activity
Degradation of aquatic habitat in Nose Creek (stream incising, sedimentation) from increased surface water discharge volume from project area	Surface water quantity	<ul style="list-style-type: none"> Construction, surface runoff during various construction activities, containment of runoff Construction and operation of runway, stormwater retention capacity, hardening of surfaces that will reduce the ability of the land to absorb and store runoff
Reduced water quality to Nose Creek from release of hazardous materials from construction/operation site runoff	Surface water quality	<ul style="list-style-type: none"> Construction and operation of runway, plane de-icing, hazardous materials releases, sedimentation, stormwater retention capacity
Removal of wetlands and seasonal sloughs during site preparations	Surface water quantity	<ul style="list-style-type: none"> Site clearing and grading operations in preparation for runway construction; wetlands will either be filled in or excavated depending on grade required.

5.2.4 Relevant Legislation

The applicable legislation governing surface water is outlined in Volume II, Chapter 4 of this CS. In addition to legislation, the national guidelines applicable to water and sediment quality originating and being discharged from YCC include:

- Canadian Council of Ministers of Environment (CCME) guidelines for the protection of aquatic life; and
- Guidelines for Effluent Quality and Wastewater Treatment at Federal Establishments (Environment Canada).

Legislated regulations that pertain to water quality entering a receiving environment such as Nose Creek include The Federal *Fisheries Act*, *Canadian Environmental Protection Act*, the CCME Water Quality Guidelines, and the Alberta Surface Water Quality Objectives (ASWQO). In addition, municipally, both the *Environmental Protection and Enhancement Act* Wastewater and Storm Drainage Regulation, and the City of Calgary Sewer By-Law Regulations can apply to surface water discharges.

The guideline governing the maximum permissible surface water runoff discharge rate from YYC to Nose Creek is 2.6 L/s/ha as outlined in the Nose Creek Watershed Water Management Plan (NCWWMP) (Palliser 2008) to which The Calgary Airport Authority (the Authority), along with The City of Airdrie, Rocky View County, and the City of Calgary are signatory. The Town of Crossfield and Alberta Environment also accept the plan as guidance for development approval. The plan states “The Nose Creek Watershed Partnership was formed to protect riparian areas and improve water quality in the Nose Creek watershed. The Partnership consists of the Rocky View County, City of Calgary, City of Airdrie, Town of Crossfield, and the Calgary Airport Authority with technical assistance provided by Alberta Environment, the Bow River Basin Council, Ducks Unlimited and Fisheries and Oceans Canada and Trout Unlimited Canada.”

5.2.5 Valued Components (VCs)

5.2.5.1 VC Selection

Surface water is an integral part of the environment; it is valued by the public and it has a potential to be affected by the PRP. VCs are the final recipients of effects from a project activity and must be clearly linked to project activities. For the purposes of the baseline study and the affects assessment, water quantity and water quality were chosen as VCs.

The selected surface water VCs were linked to project activities and key issues in Table 5-1. Water quantity without the implementation of appropriate mitigation measures and engineered stormwater control has the potential to be affected by the PRP as a result of the hardening (paving) of surfaces for runway development, which will reduce the land's natural ability to absorb surface runoff, thereby potentially causing an increase in peak runoff entering receiving environments. Water quality effects could also result by increasing the ability of surface water to mobilize and transport contaminants. Contaminants carried in surface water drainage from the proposed PRP also have the potential to affect receiving environments.

Other aquatic values, such as fish and fish habitat, were not chosen as VCs because they are not present in the LSA. Within the RSA, fisheries resources are limited and restricted to common non-sport fish species such as suckers and forage fish species. All of the fish species present in the RSA are only found in Nose Creek and are considered to be indicative of poor habitat quality and able to withstand extreme environmental conditions. Effects on these species would be very difficult to measure, quantify, and separate from YYC-caused effects because of the multitude of other potential effects from developments and activities within the RSA upstream of YYC. As a result, the VCs selected for this component (surface water quantity and quality) were considered as suitable surrogates from which their effects on other aquatic resources could be accurately inferred. The reader is referred to Volume V, Chapter 3 for the complete rationale regarding VC selection for surface water and aquatic resources, and to view the baseline report regarding existing environmental conditions in the LSA and RSA prior to the development of the PRP.

5.2.5.2 Surface Water Quantity

Surface water discharge from the LSA is minimal under current conditions. There are no flowing water systems within the area, and standing waters are restricted to a few seasonal ponds and wetlands. The baseline study outlines the surface water drainage system in place within the LSA, including the PRP lands. The majority of precipitation that falls on the area does not, in fact, accumulate or run off; rather, it is absorbed into the land and either infiltrates or is utilized by the vegetative cover present throughout the LSA. The low relief and topography present across the LSA also contributes to its ability to internalize runoff. Apart from a roadway and a major 4-lane arterial (Barlow Trail), there are no paved surfaces within the LSA from which runoff can be generated. Runoff from these two sources is currently handled by vegetated surface swales adjacent to the roadways and by means of infiltration and evaporation. Where runoff may occur, it is directed through a series of storm and golf course retention ponds in the southeast catchment area to Pond J in the northeast catchment area; it will be further directed to and captured in Pond K in the central east catchment area when the PRP is developed. The catchment areas within the LSA are shown in Figure 5-1. Directed runoff from the lands to the north and south of the PRP eventually discharge to Nose Creek, but only following treatment in the retention pond system controlled and operated by the Authority.

The timing, volume, and frequency of surface water discharges to a receiving stream such as Nose Creek can be critical to the maintenance and continued health of its aquatic ecosystem and is directly linked to fish use, habitat availability and quality, and other aquatic organisms, and is indirectly linked to its use by wildlife and humans. The proposed PRP is to be located in an area known to be poorly drained. The project will add, just from the runway development, 25.6 ha (63.3 acres) of paved surface within the LSA. Additionally, other paved surfaces such as taxiways, service roads, and other ancillary operations facilities that will be constructed as part of the PRP will, in combination, represent a significant increase in the runoff potential and generation capability in comparison to the existing condition. Although the number of seasonal sloughs located within the LSA is not great, these too will be infilled to make way for the PRP

and, as a result, the area will lose absorption capacity for storm events. Without appropriately sized and placed mitigation, increasing runoff and the resulting flows could have deleterious effects within the RSA. As noted previously, storm drainage from YYC at present is discharged to Nose Creek following treatment in the airport's storm retention facilities. An increase in peak discharge volumes, or an increase in the frequency with which peak flows occur, could contribute to the degradation of the aquatic environment in Nose Creek in comparison to present conditions. These effects would be manifested by bank degradation as a result of in-stream erosion to substrates and banks downstream of the outfall. If these effects were to occur, they would directly contribute to a reduction in the stream capacity to support aquatic productivity.

Under agreement with the Nose Creek Water Management Partnership, discharge from YYC facilities is limited to a maximum peak discharge of 2.6 L/s/ha (Palliser 2008), determined from a 1:100 return flow period. When the new runway is in place, the Authority has agreed to abide by this discharge limit in the future. How this discharge limit will be maintained and managed in the future is, therefore, the key indicator for the surface water quantity VC. The project components that were examined to identify key surface water issues as they relate to the selected VCs are provided in Table 5-1.

5.2.5.3 Surface Water Quality

Natural water quality is determined by climate, geology and landscape, and can be altered through anthropogenic activities. Various activities related to the development of the PRP during the construction and operation phases have the potential to decrease surface water quality. Water quality could be decreased as a result of an increase in the mass loading of suspended sediments, heavy metals, petroleum hydrocarbons, and other priority pollutants. The pathway by which such potential contaminants could affect the downstream environment would be through discharge to Nose Creek from storm drainage from the LSA. Changes to the ionic balance in surface waters could also result as the environment is altered during project development. During the construction phases of the PRP, the release and movement of sediment into the water column is considered to be the principal potential causative mechanism for an adverse effect to water quality and the aquatic environment. The amount of exposed cuts and disturbed soils that will occur as the site is prepared and re-contoured, if not properly managed, can allow sediments to be easily mobilized following precipitation events including snow melt. If sediment laden runoff waters are not intercepted and treated to remove sediment prior to their release into Nose Creek, adverse environmental effects will occur. During the operations phase, hazardous materials spills and non-recovered de-icing materials could enter the storm management system. Should the concentrations of these types of parameters exceed levels that are acceptable and required to maintain the health of the aquatic receiving system, water quality will have deteriorated and they will be of concern and require mitigation strategies, including monitoring to offset the effects.

The status of baseline water quality in the RSA and LSA was determined by comparing quality conditions prior to the development of the PRP to the CCME and ASWQO guidelines and objectives. During the construction and operations phases of the PRP, water quality will be measured against the same standards applicable to the baseline, but will also be compared to baseline to determine whether the overall quality has improved or deteriorated. Effects on the surface water quality VC would be caused by an exceedence of the water quality objectives outlined in Table 5-2. These standards apply to all water exiting YYC property and being discharged into Nose Creek.

5.2.6 Indicators

Indicators are environmental measurements that allow determinations to be made regarding whether or not an effect on a VC has occurred. The measurements used to determine whether or not there has been an effect on water quantity generated from within the LSA and YYC are the release rates to Nose Creek from airport-controlled discharge points. They indicate whether or not the agreed-upon maximum discharge limit of 2.6 L/s/ha has been adhered to. Adherence to this limit is made possible by design of the YYC stormwater drainage system and maintained by operating flow control in the system. Similarly, for surface water quality, adherence to the regulatory limits in discharge waters for the parameters listed in Table 5-2 would infer that effects had not occurred, while exceedences would indicate that water quality had deteriorated and that an effect was or had occurred to the receiving water (Nose Creek).

Table 5-2 Water Quality Indicators - Airport Water Quality Objectives for End of Pipe (Transport Canada Airports Group 1995)

Parameter	End of Pipe ^{1,2} (Environment Canada)	Protection of Freshwater Aquatic Life ³ (CCME)
Dissolved Oxygen	-	5-9.5 mg/L
Temperature	Not to alter ambient temp by more than 1°C	-
pH	6-9	6.5-9
Total Suspended Solids	25 mg/L	Variable (depends on background levels - see text)
Biochemical Oxygen Demand	20 mg/L (5 day)	-
Chemical Oxygen Demand	-	-
Phenols	0.020 mg/L	0.001 mg/L
BTEX	-	0.3 mg/L
Volatile Organics (total)	-	Variable
Total Glycols	100 mg/L	-
Ethylene Glycol	-	3 mg/L
Propylene Glycol	-	74 mg/L
Diethyl Glycol	-	31 mg/L
Total Petroleum Hydrocarbons	-	-
Oil and Grease	15 mg/L	-
Fecal Coliform Bacteria	40/100 ml	100/100 ml
<i>E. coli</i> Bacteria	-	200/100 ml
Total Organic Carbon	-	-
Ammonia	-	1.37-2.2 mg/L
Nitrite	-	0.06 mg/L
Nitrate	-	-
Total Phosphorus	1.0 mg/L	-
Fluoride (total)	-	-
Cyanide (total)	-	-
Cyanide (free)	-	0.05 mg/L
Arsenic	-	0.05 mg/L
Aluminum	-	0.005-0.1 mg/L
Antimony	-	-
Barium	-	-
Boron	-	-
Cadmium	-	0.0002-0.0018 mg/L
Chromium (total)	-	0.002-0.02 mg/L
Cobalt	-	None
Copper	-	0.002-0.004 mg/L
Iron	-	0.3 mg/L
Lead	-	0.001-0.007 mg/L

Parameter	End of Pipe ^{1,2} (Environment Canada)	Protection of Freshwater Aquatic Life ³ (CCME)
Manganese	-	
Mercury	-	0.0001 mg/L
Molybdenum	-	-
Nickel	-	0.025-0.15 mg/L
Selenium	-	0.001
Silica	-	-
Silver	-	0.0001 mg/L
Tin	-	-
Vanadium	-	-
Zinc	-	0.03 mg/L

¹ Environment Canada (1976)

² CEPA (1994)

³ CCME (1994)

5.3 Effects Assessment Methods

5.3.1 Determining Baseline Conditions

Based on the amount of data available, the baseline study for the project was completed through a review of the literature associated with the proposed project (LSA) and surrounding area (RSA) including YYC as already constructed. Key information sources included:

- Strategic Environmental Assessment of the Calgary International Airport 2004 Master Plan (Jacques Whitford 2006);
- The Calgary Airport Authority Parallel Runway 16L-34R Engineering and Construction Feasibility Study (UMA Engineering 2007);
- Stormwater Management Master Plan Update, 2003 (UMA Engineering 2003);
- Nose Creek Watershed Management Plan (Palliser Environmental Services 2008);
- Water Quality data collected by YYC (sampling sites are identified on Figure 5-3);
- Fish and Wildlife Management Information System (ASRD 2009);
- Maps of the proposed project development and stormwater drainage plan by UMA Engineering Ltd.;
- reference maps;
- regulatory documents; and
- other literature sources.

Much of the baseline study includes a description of the drainage management plan and operations for existing YYC operations. This was required so that an understanding could be gained of how the proposed PRP will utilize existing stormwater infrastructure to manage surface runoff and what potential effects on receiving surface waters may be associated with the PRP as a result.

5.3.2 Effects Assessment Method

The methodology used to determine whether or not environmental effects have occurred to surface waters VCs as a result of the development of the PRP are discussed in detail in Volume III, Chapter 1 and will not be repeated here.

5.3.2.1 Residual Effects Rating

A residual effect would occur if the primary effect could not be fully mitigated. The residual effect would then be rated using the following criteria: direction, magnitude, geographic extent, frequency, duration, reversibility, probability of occurrence, and ecological or socio-economic significance.

For water quantity, a predicted residual effect would occur if the maximum design criteria for discharges from YYC properties including the PRP and its stormwater systems of 2.6 L/s/ha was exceeded following the design and incorporation of mitigation measures.

For water quality, a predicted residual effect would occur if surface water entering the stormwater system from the PRP area after the imposition of mitigation measures still caused the water quality objectives set out by CCME, Environment Canada and CEPA (Table 5-2) to be exceeded at the end-of-pipe discharge point to Nose Creek.

5.3.2.2 Significance Determination

For all residual effects that could not be fully mitigated, a determination of significance was assigned. Volume III, Chapter 1 provides a detailed discussion on how significance determinations were made.

5.4 Baseline Conditions

5.4.1 Overview

The baseline study focussed on water quantity and quality in both project-specific (LSA) and regional contexts (RSA). The LSA consisted of the PRP footprint and associated infrastructure, and the RSA consisted of the existing YYC operations and a portion of the Nose Creek watershed adjacent to the proposed development. The detailed baseline report is found in Volume 5, Item 3.

A detailed description of stormwater management can be found in the Surface Water Baseline Report (Volume 5, Item 3). Currently, there is little development and runoff within the LSA. Within the RSA, runoff comes from the existing YYC facilities and operations, and from other commercial and residential developments in the area.

A stormwater drainage management plan for the existing YYC and proposed PRP areas was developed in 2000 and updated in 2003. The plan is currently being updated to incorporate all development on YYC lands.

There exists stormwater retention ponds associated with most of the stormwater outlets exiting YYC property. Associated with each pond is a control gate at the outlet that can be used to regulate the discharge rate of treated stormwater from the pond to YYC property if necessary or if required to meet the maximum discharge limit.

Within the RSA, potential contamination sources and issues were identified that included the release of fuels and glycol to the stormwater system, as well as the presence of petroleum hydrocarbons (PHCs) and BTEX compounds at some groundwater monitoring sites within YYC (Jacques Whitford 2006). No fertilizer is used on YYC property; however, a herbicide application program is undertaken each year.

Within YYC, the de-icing compound glycol is the most widely handled and managed chemical with the potential to enter the storm management system. De-icing occurs at the plane loading gates, most of which are in the north central catchment (Apron I and II), Apron VII, and on Apron VIII in the south central catchment (Figure 5-4). Peak de-icing activity takes place between November and March. After de-icing, glycol is captured using vacuum trucks and is taken to the glycol dump station near Pond A (North Retention Pond). Some glycol could enter Pond A via contaminated snow that is taken to the glycol dirty snow dump (adjacent to the glycol dump station) if the dump drains becomes frozen. Recovered glycol is either sent to the City of Calgary Treatment Plant or is stored in a retention pond and treated to the appropriate guideline before release into the stormwater system. There are no fluid releases from Pond A to the stormwater system during the winter months.

There has been no water quality monitoring in the LSA; however, monthly monitoring is done by the Authority at all stormwater exit points from YYC property. All water quality data are compared to established water quality objectives outlined by Environment Canada (1976), CEPA (1994), and CCME (1994). Where there is more than one objective or criteria, the more stringent one is used. Based on the potential contamination sources and materials, the following parameters are sampled at all end-of-pipe locations and analyzed for biological oxygen demand (BOD), glycol, chemical oxygen demand (COD), total suspended solids (TSS), pH, and oil and grease. Within Pond A, heavy metals, inorganic compounds, and additional organic compounds (e.g., BTEX) concentrations are analyzed. No stormwater is released from Pond A unless the water quality parameters meet the surface water objectives. If water quality parameters at the end-of-pipe sample locations exceed these objectives, then the exceedences are reported to Environment Canada and Alberta Environment. Hydrocarbon spills have occurred at YYC in the past, but based on the analyses of waters being discharged from the property at the time of the spills, no elevated levels of hydrocarbon parameters were detected. Glycol was recorded as exceeding water quality guidelines exiting YYC property only once over the period of the analytical record. Modification of the glycol management system used by one of the operators has successfully mitigated this issue. The Authority conducts water quality sampling at the Nose Creek stormwater outlet near Airport Trail (Water Quality Sampling Site 5). Based on a review of data collected over the period 1999 to 2002, for the water quality parameters tested and regulated, no chemical exceedences occurred.

5.5 Project Effects Assessment

5.5.1 Water Quantity

5.5.1.1 Potential Effects

Construction

Site preparation and removal of vegetation and seasonal sloughs will reduce the holding capacity of the LSA and particularly the area directly associated with the PRP.

Hardening of surfaces due to construction activities and the paving of large areas for runways, taxiways, holding areas, service roads, and other facilities related to the development of the PRP will reduce the ability of the lands within the LSA to absorb or contain surface runoff. The decrease in surface permeability will also directly cause an increase in the volume of runoff that will be generated by the lands adsorbed by PRP. The result of a loss in the internal capacity to handle runoff and the increase in expected runoff volume that will result from project development could cause an increase in peak runoff and the frequency of peak flows into the stormwater system (Table 5-3). These factors and the mitigation that would be required to offset potential water quantity effects from the development of the PRP are addressed in the following sections.

Operations

The volume of runoff generated by the PRP in comparison to the current conditions in the LSA is expected to increase substantially and remain high during the operational life of the new runway systems. Climate change is expected to change the frequency and magnitude of precipitation events in the future, with more intense storms predicted to occur at higher frequency than is currently the case. Additionally, the type of precipitation that occurs in the form of rain is also anticipated to increase under most climate change model predictions, although in terms of the annual quantity, precipitation cumulatively is tending to decrease. If these predictions are correct, it would suggest that runoff as a direct result of rainfall events for YYC and PRP will increase substantially from the present-day case.

5.5.2 Water Quality

5.5.2.1 Potential Effects

Construction

The potential project-related effects on water quality that have been identified that could result from construction of the PRP are:

- increased sedimentation from exposed soils, soil stockpiles, etc.;
- decreased water quality from hazardous materials entering the stormwater system as a result of accidental releases or spills; and
- discharge of groundwater from dewatering activities during excavation and potentially entering the stormwater system and reducing water quality.

Operations

Project effects on water quality from operations of the PRP are as follows:

- reduced surface water quality through runoff and suspension of soil particles to surface water resources (Nose Creek) from remnant soil stockpiles;
- decreased water quality from hazardous materials entering the stormwater system from spills;
- decreased water quality from non-recovered de-icing materials (glycol) entering the stormwater system. This would include glycol that is not recovered at the location of de-icing and glycol falling off planes between the de-icing location and the runway; and
- pesticide/herbicide application causing a decrease in water quality entering the stormwater system.

5.6 Mitigation Measures

5.6.1 Water Quantity

The increased runoff volumes anticipated to result from the PRP development, particularly from the addition of 0.0256 ha of new paved and non-permeable surface will be mitigated by design of the Stormwater Drainage Management System. The storm management system will be designed so that the maximum surface discharge from YYC in total (existing YYC operations and facilities plus the PRP development) does not exceed the 1:100 year peak discharge criteria of 2.6 L/s/ha. These criteria were established to reduce effects to Nose Creek. To meet this discharge criterion, the drainages from the PRP will incorporate storm retention ponds sized appropriately to meet anticipated runoff volumes from the design storm events (intensity and return period) that are incorporated into the existing YYC storm system. The details of the storm management system may be reviewed in Volume 2, Chapter 7; however, the interconnections between the PRP, LSA, and YYC areas that have been pre-designed to meet these mitigation objectives are shown in Figure 5-4 and are further discussed in the baseline report for Surface Water and Aquatic Resources (Volume V, Chapter 3).

Seasonal sloughs and wetlands that are currently within the PRP footprint will be either removed by excavation or filled in during grading operations associated with the site preparations prior to runway construction. These actions will result in permanent wetland habitat losses. Therefore, the effects are permanent and significant.

On-site mitigation for wetland losses is not consistent with the Authority's policy of deterring waterfowl use in the immediate vicinity of an operational runway. As a result, to mitigate against wetland losses associated with the construction of the PRP, the Authority is working with government agencies and other stakeholders to develop a plan to replace wetland function at an off-site location. A property has been purchased within the Nose Creek floodplain within which a future wetland will be constructed. At this time, although the lands for this purpose have been obtained, no final design of the wetland has been completed. However, because of the threat posed by waterfowl, especially to planes on takeoff and approach, the type of habitat created will be designed to not provide waterfowl habitat.

During construction, runoff waters will be collected and excavation waters directed to the storm retention ponds that were developed in anticipation of the development of the PRP. These ponds are Ponds J and K. Both of these ponds are connected into the existing YYC storm management system as shown on Figure 5-4. This follows the drainage patterns outlined in the Stormwater Management Master Plan Update prepared by UMA Engineering in 2003. By intercepting the runoff waters in these retention ponds, peak discharge flows can be controlled by valves to maintain their outflow to a level such that storm flows from the PRP drainage in combination with those from other YYC operations do not collectively exceed the allowable discharge limit to Nose Creek (2.6 L/s/ha). It should be noted that, at this level of discharge, no net increase in maximum flows to Nose Creek will result from the development of the PRP.

As part of the water management plan for runoff water control during the construction period, it is anticipated that storm runoff will be used to control dust caused by construction activity and also to improve compaction for materials being used to fill and form a base for the runways. Based on the calculated water demand criteria for these construction activities, it is likely that no free standing water will remain in ponds draining the LSA that could add to the YYC storm drainage system.

During the operations phases of the PRP, stormwater retained in the retention pond systems will be used for landscaping irrigation and diverted to the Silver Wing Golf course for their irrigation use. These actions will ensure the discharge limits to Nose Creek will be maintained.

5.6.2 Water Quality

Mitigation measures to be adopted during construction of the PRP are as follows:

- Construction best management practices (BMPs) will be followed during the development of the PRP, including during site preparation, grading, excavation, and surface packing phases of the project. Adherence to these published BMPs can mitigate the potential for increased sedimentation that could result from construction activities. As part of the Environment and Construction Operations Plan (ECO Plan), for example, a site-specific sediment management plan will be developed and implemented that will address potential sources of sedimentation. The reuse of runoff waters for compaction, dust control, and cement production within the PRP area will further mitigate the transfer of sediment from construction activities to the storm drainage system. The City of Calgary Wastewater & Drainage Urban Development Guidelines for Erosion and Sediment Control outline specifically the measures that can be taken.

- A supplement to YYC's emergency spill response plan (ERP) will be developed and in place, with the necessary equipment cached on-site during all construction phases. Personnel will be trained and aware of the plan and fully capable of implementing it, should it be required to prevent, identify, contain, and clean up any spills that may occur before hazardous materials enter the stormwater system or have the potential to discharge off of YYC property. As part of the ERP, the necessary communications linkages and notification agencies and personnel will be clearly identified, and this information will be readily available to supervisory personnel on the job site. Complete familiarity with the ECO Plan will be addressed at the initial site meeting held prior to construction activities commencing.
- All discharged water from dewatering activities and resulting from storm runoff during the construction phase will be directed to retention ponds (Ponds J and K). By retaining these waters and not allowing immediate release to the storm system, sediment carried in runoff or dewatering waters will allow the suspended matter carried to precipitate out of the water column and settle into the bottom. By then, taking the decant waters from the upper portion of the retention pond on discharge following a suitable period and analysis, the waters leaving the PRP area and entering the main YYC stormwater system will have their sediment load greatly reduced. By passing through a series of such ponds and retention systems, the water is expected to meet the required discharge standard for TSS when it finally leaves YYC properties for discharge to Nose Creek.

The measures that are to be implemented during operations to mitigate the effects of the PRP on surface water quality as described in Section 5.5.2 are:

- An Earthworks Management Guidance Document has been developed and will be implemented. This plan outlines how soil stockpiles will be dealt with so that they are not causing increased sedimentation.
- The ERP for the PRP will be incorporated into the master ERP that governs YYC operations. This plan is designed to prevent, identify, contain, and clean up any spills that may occur before hazardous materials enter the stormwater system or are discharged off YYC property into the receiving environment of Nose Creek.
- The surface water quality monitoring program will continue and will be expanded to take in discharges into the YYC stormwater system from the operations associated with the PRP.
- The airport BMPs will continue to be followed, and potassium acetate and sodium formate will be used as the runway de-icing chemicals, as opposed to urea-based compounds, to further protect surface water runoff from nutrient enrichment.
- A glycol recovery procedure is currently in place that is capable of recovering most waste glycol from plane de-icing locations using vacuum trucks. Other sources of waste glycol that cannot be recovered by vacuum trucks results from the product dripping off de-iced aircraft after they leave the treatment area and from snow contaminated by these waste products. To mitigate the potential for glycol contamination of the stormwater system or surface water runoff, the Authority is planning to construct a central de-icing facility situated between the PRP and the other main runways. This facility will service planes operating on all runway systems in the future. The area used for the central de-icing facility will be sloped to contain and control all runoff generated within it. These drainage waters will be transferred to a glycol retention pond for appropriate handling and disposal in accordance with the airport's waste handling requirements. Similarly, any snow that accumulates within the central facility that could be contaminated by glycol will be contained within the de-icing operations area so that any melt water generated will also be collected and handled appropriately. As an example, the Pearson International Airport in Toronto, as well as most major northern airports in the United States, currently utilize a central de-icing facility to effectively manage glycol wastes and drainage. Centralizing glycol

operations as outlined would mitigate the potential for wastes from this product entering the storm management system and being discharged from YYC.

- Pesticide/herbicide application plans will be refined, and the number of provincially certified applicator staff will be increased. A specialized herbicide applicator that the Authority currently uses will have a Global Positioning System (GPS) package installed on it in 2011 so that chemical use can be better documented in terms of coverage. The GPS system will also be used to define problem areas more precisely. The net result of these changes will be a reduction in the amount of chemical applied and used. The Authority is also actively looking for pesticides and herbicides that are environmentally friendly but effective. With the development of the PRP runways, during operation it is expected that herbicide control will be required. With this in mind, the Authority's operations staff is actively seeking an alternative to the chemicals currently in use in keeping with their environmental stewardship mandate of reducing chemical usage while maintaining safety standards. Pesticide/herbicide and other chemicals applied to the runway or surrounding land are also described in Volume III, Chapter 15 of the CS.

Other chemical usage tied to the operations phases of the PRP are runway maintenance and rubber removal compounds. YYC moved away from a potentially toxic chemical to a much more environmentally benign compound (Avisol) to remove rubber build-up on the runways that results from take offs and landings. The Authority is considering the purchase of a piece of equipment that is designed to remove rubber compounds from the runways without the necessity of using chemical additives. Both of these active mitigation strategies are designed to minimize the potential for the release of substances that could potentially enter the surface water drainage system and thereby affect the receiving environment on discharge from YYC properties.

5.7 Sustainability Measures

Aquatic environments such as wetlands, sloughs, and water catchments are key landscape features where urban development can have substantial effects.

The mitigation of the effects of the PRP on water quantity and quality are primarily directed to stormwater management and control. Mitigation efforts are aimed at maintaining the quality of the water discharged from the site and towards having no net increase in the quantity of water discharged even under conditions of increased runoff. Further to these types of mitigation, opportunities exist within the project to increase the overall sustainability as it affects water and water use, such as by integrating other measures with storm management systems to:

1. reduce potable water demand by using non-potable water for such purposes as dust control and fill mixing;
2. minimize wastewater generation and the treatment of wastewater to a standard that can be used for other opportunities within YYC;
3. treat stormwater to meet water quality objectives for reuse;
4. reuse stormwater within YYC lands for irrigation of landscaped areas to maximize the visual amenity of areas; and
5. look for opportunities to reuse water off-site if the potential is identified and use is beneficial.

Opportunities for such integration of stormwater management practices and water sustainability initiatives are available in the case of the PRP. These are discussed in further detail in Volume III, Chapter 2 of the CS.

5.8 Residual Effects after Mitigation

5.8.1 Water Quantity

No residual effects on water quantity were identified as remaining following the implementation of the outlined mitigation strategies during either the construction or operations phases of the PRP. During both phases, a well designed storm management plan and containment system will be in place to meet the maximum peak discharge criteria of 2.6 L/s/ha.

5.8.2 Water Quality

No residual effects on water quality from the construction phase of the project can be fully and effectively mitigated.

There may be a minor residual effect on water quality that could occur during the operations phase of the PRP. This effect could be derived from residual de-icing compounds. The PRP will use the existing de-icing procedure, which is de-icing at the gates and/or aprons. Most of the de-icing glycol is recovered; however, a small amount that cannot be recovered will remain on-site on the ground or in contaminated snow. Glycol from this source could eventually find its way into the stormwater drainage system during periods of melt and as a result of runoff. The unrecoverable residual glycol will:

- produce a minor, immediate adverse effect to surface drainage waters (dilution will occur before glycol reaches the stormwater system);
- be local in nature (mostly at the de-icing location and surrounding area), although some glycol in dilute concentrations could reach Nose Creek;
- be frequent (throughout the de-icing season);
- be of moderate duration (winter season);
- be reversible (glycol degrades over time and dilution will reduce effects);
- have a high probability of occurring during de-icing activities; and
- potentially affect an already highly affected watercourse (Nose Creek).

5.9 Significance of Residual Effects

5.9.1 Water Quantity

Following the implementation of the proposed mitigation measures and strategies outlined, no residual effects on water quantity will remain.

5.9.2 Water Quality

There will be no significant residual effects remaining following the adoption of the outlined mitigation techniques and strategies that were identified as being associated with the construction phase.

The only identified residual effect of the PRP during its operations phase that was identified and cannot be fully mitigated relates to the potential for waste glycol entering the stormwater drainage system. The current de-icing waste recovery and containment operations at YYC do not control all glycol waste to be centrally recovered and accounted for. The quantity of non-recoverable (residual) glycol is expected to be very low and local in geographic extent. To date, there have been no recorded water quality exceedences for glycol in waters that are discharged from YYC property. There exists a minor potential for glycol concentrations to exceed the allowable surface water objective in storm drainage from the combined PRP and YYC system as it leaves YYC. Based on the rating of the residual effect, the potential for residual

glycol having an effect on the receiving environment is considered insignificant. With the completion of the PRP, traffic at YYC will increase and, therefore, so will the need to de-ice; presumably this will likewise increase the volume of glycol used in the future. It is precisely for these reasons that YYC is planning to develop and operate a central de-icing facility to service all active runways at the airport. By centralizing the de-icing operations and providing a defined runoff and waste control area and system, the potential for glycol to cause effects in the future will be greatly reduced. Since no glycol concentration exceedences have been detected to date, even with no central de-icing strategy in place, the quantity of residual glycol that result from these operations is very small. Effects generated as a result are limited in geographical area and are considered insignificant and reversible. With a centralized facility to handle all de-icing operations in the future and full waste glycol containment and drainage control, there will be no measureable residual effects from the chemical usage in the receiving environment of Nose Creek.

It should be noted that dripping Glycol from taxiways and runways occurs during existing operations and does not reach detection limits in the existing storm water systems.

5.10 Cumulative Effects

As established earlier in this chapter, the PRP will comply with the NCWWMP. Therefore, the quantity and quality of water discharged from airport lands to the City of Calgary stormwater drainage system and hence to Nose Creek will not change significantly. However, by 2025, further development consistent with City of Calgary, City of Airdrie and Rocky View County land use plans is likely to occur in the Nose Creek watershed. Any such development will have to be constructed to comply with the NCWMP. The Department of Fisheries and Oceans and Alberta Environment have endorsed and are party to the Agreement. They will be in a position to take action should a developer fail to comply with the Agreement. Therefore, we conclude that there will be no significant cumulative effect on water quantity and quality in Nose Creek.

5.11 Follow-up and Monitoring

Prior to commencement of works, the Authority's existing water monitoring program will be assessed and updated to incorporate the PRP. The existing program samples water quality at several ponds and the discharge points directly into Nose Creek, and indirectly through the City of Calgary stormwater system. It is anticipated that this program will continue during the construction and operation of the PRP, as all surface water will drain through this existing stormwater network. Nose Creek Watershed Management Partnership has been monitoring Nose Creek and West Nose Creek since 2009. This is expected to continue during the construction and operation of the PRP.

A follow-up program will be prepared that will assess the water quality data collected by the Authority and by the Nose Creek Watershed Management Partnership (NCWMP). This will allow a comparison of results and an assessment of the accuracy of predicted effects within this chapter in addition to identifying success or failure of mitigation practices. From this comparison, recommendations can be made as to adjustments to the mitigation and monitoring in place if it is deemed necessary to further mitigate project effects.

A document will be prepared summarizing the details of the monitoring and follow-up program that is described in Chapter 21 of this Volume.

5.12 Conclusions

The potential environmental effects that could result from the PRP development during both the construction and operations phases of the project are shown in Table 5-3. Mitigation measures have been developed to address the potential effects on surface water quantity and quality that were identified. Based on the analysis conducted to date, the proposed PRP will, as a result of effective mitigation, have no measureable or significant effects on surface water quantity or quality. Following the application of the proposed mitigation measures to control runoff volume and discharge quality, the PRP development will not result in any residual effects being felt on the local environment within either the LSA or the RSA as summarized in Table 5-3.

By following and implementing the environmental control strategies proposed, discharge to Nose Creek will be maintained at a maximum allowable peak level of 2.6 L/s/ha as required under agreement and as specified in the NCWWMP. Similarly, by controlling flow and managing water quality to meet the water quality objectives and guidelines utilized by YYC, flow-through waters exiting their control area and systems, and being discharged to Nose Creek, will not result in any further degradation of the receiving environment as a result of the development of the PRP.

5.13 Response to Issues by the Public and the Stakeholders

Issue: Potential effects of glycol on surface water ecosystems (i.e., Nose Creek)

An existing stormwater management program is in place with the most recent update being in 2003. This plan will be updated to incorporate the runoff increase from the PRP. The primary objective of this plan is to ensure no decrease in the quality of water into Nose Creek. Both the NCWMP and the Authority will be monitoring Nose Creek. Any observations of a decrease in water quality in Nose Creek will immediately be reported and mitigation will be improved to prevent reoccurrence.

Issue: Increase in stormwater discharge volume in Nose Creek

An existing stormwater management program is in place with the most recent update being in 2003. This plan will be updated to incorporate the runoff increase from the PRP. The primary objective of this plan is to ensure that the quantity of water entering Nose Creek complies with the 2.6 L/s/ha limit established by the NCWMP. Both the NCWMP and the Authority will be monitoring Nose Creek. Any exceedences of the NCWMP criterion in discharge quantity in Nose Creek will be reported immediately and mitigation will be improved to prevent reoccurrence.

Issue: Reduced flow into Nose Creek during low flow period

An existing stormwater management program is in place with the most recent update being in 2003. This plan will be updated to incorporate the runoff increase from the PRP. Discharges into Nose Creek from the PRP footprint is currently zero, so any change will not decrease low flows in Nose Creek. Both the NCWMP and the Authority will be monitoring Nose Creek. Any changes in discharge quantity in Nose Creek requiring mitigation will be reported immediately and acted on by means of the stormwater management system.

Issue: Reduction of water quality in Nose Creek from release of hazardous materials and/or construction/operation site runoff

An existing stormwater management program is in place with the most recent update being in 2003. The YYC stormwater system and management plan is being modified to accommodate the PRP. The system includes control structures, settlement and evaporation ponds, and other features that would be used to prevent any contaminated or sediment-rich water from reaching Nose Creek. This plan will be updated to incorporate the runoff increase from the PRP.

Issue: Degradation of aquatic habitat in Nose Creek (stream incising, sedimentation) from increased surface water discharge from project area

An existing stormwater management program is in place with the most recent update being in 2003. This plan will be updated to incorporate the runoff increase from the PRP. The primary objective of this plan is to ensure that the quantity of water entering Nose Creek complies with the 2.6 L/s/ha limit established by the NCWMP. Both the NCWMP and the Authority will be monitoring Nose Creek. Any exceedences of the NCWMP criterion in discharge quantity in Nose Creek will be reported immediately and mitigation will be improved to prevent reoccurrence.

The modified stormwater management system will be capable of preventing changes in the quality of water discharged into Nose Creek and of maintaining the quantity of water to be consistent with the NCWMP criteria. Therefore, the PRP will not cause degradation of aquatic habitat in Nose Creek.

Table 5-3 Potential Environmental Effects Analysis

Environmental Components	Project Phase or Component	Description of Potential Environmental Effects	Recommended Mitigation Measures or (BMPs)	Residual Effect (Is there a residual effect that is likely to occur? If yes, provide a description)	Significance of Residual Effect*	Monitoring	Follow-up
Surface Water Quantity	Construction	Hardening of surfaces, increasing peak runoff during precipitation events	Contain surface runoff during construction phase. A stormwater containment pond (Pond K) was designed and built so that the surface runoff peak criterion (2.6 L/s/ha) is met for the PRP during construction. Reuse stormwater for compaction, dust control, and cement production to eliminate the need to discharge based on volume required to meet demand.	No	NA	NA	NA
	Construction	Removal of seasonal ponds and wetlands during site preparation	No recommended mitigations, off-site mitigation.	No	NA	NA	NA
	Operation	Hardening of surfaces, increasing peak runoff during precipitation events	Contain and control surface runoff during operations phase. Stormwater management plan designed to meet surface runoff peak criterion (2.6 L/s/ha)	No	NA	NA	NA
Surface Water Quality	Construction	Earth moving, exposed soils, and soil stockpiles can reduce the quality of surface water through runoff and suspension of soil particles to surface water resources (Nose Creek)	Install erosion and sediment barriers around soil stockpiles), BMPs for erosion control. Use retention ponds to precipitate and capture sediment from runoff waters. Reuse water for dust control, compaction, and cement production.	No	NA	NA	NA
		Deleterious substance spills	Emergency Spill Response Plan and containment	No	NA	NA	NA
		Discharge of groundwater from dewatering activities reducing water quality	All discharges of surface water will be contained in stormwater retention ponds (J and K) and only released when water quality meets applicable guidelines or reused internally within the LSA.	No	NA	NA	NA

Environmental Components	Project Phase or Component	Description of Potential Environmental Effects	Recommended Mitigation Measures or (BMPs)	Residual Effect (Is there a residual effect that is likely to occur? If yes, provide a description)	Significance of Residual Effect*	Monitoring	Follow-up
Surface Water Quality	Operation	Remnant soil stockpiles can reduce the quality of surface water through runoff and suspension of soil particles to surface water resources (Nose Creek)	Install erosion and sediment barriers around soil stockpiles . Soil piles will be used for other construction projects at YYC, such as the terminal expansion.	No	NA	NA	NA
		Deleterious substance spills - e.g. fuel, glycol	Emergency Spill Response Plan and containment, storage and handling of fuel products and other potentially harmful products.	No	NA	NA	NA
		De-icing activities, residual glycol not recovered can enter Nose Creek through stormwater system	Glycol management plan for handling and recovering glycol.	Yes. Residual glycol that is not recovered can enter stormwater system	NS	M	NA
		Pesticide/herbicide application - residue entering stormwater drainage into Nose Creek	BMP for pesticide/herbicide application (e.g., application timing).	No	NA	NA	NA

* Different methods/criteria can be used to define the significance of the effect (or the significance of residual effect).

- S: Significant adverse environmental effect
- ME: Minor adverse effect/ mitigable effect (not significant)
- NS: Not significant adverse environmental effect
- UN: Uncertain/unknown effect
- M: Monitoring required
- F: Follow-up required
- NA: Not required or not applicable