AECOM

CANADIAN CONSULTING ENGINEERING AWARDS 2012

ENVIRONMENTAL REMEDIATION

CALGARY AIRPORT PARALLEL RUNWAY **ENVIRONMENTAL ASSESSMENT**

SUBMITTED BY AECOM

THE ONLY WAY TO DISCOVER THE LIMITS OF THE POSSIBLE IS TO GO BEYOND THE IMPOSSIBLE

-Arthur C. Clark, Author

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Introduction

The Calgary Airport Authority (the Authority) is currently constructing a new 14,000 ft (4,270 m) parallel runway at the Calgary International Airport (YYC) to meet increasing demand for passenger and cargo service in southern Alberta. YYC is Canada's fourth busiest airport, with a record 12.8 million passengers in 2011, and the new runway will be capable of landing the world's largest aircraft (ICAO Code F, such as the Airbus A380). The project is referred to as the Parallel Runway Project (PRP).

AECOM completed the Comprehensive Study Environmental Assessment (EA) for the PRP. Canadian airport authorities are not currently subject to the Canadian Environmental Assessment Act (CEAA); however, the Authority decided to subject this major project to a self-directed EA which shadowed the CEAA model. The Authority's self-assessment process seeks to verify that the environmental effects of a project are fully considered and that measures designed to reduce or avoid adverse effects are implemented during design, construction, and operation. The key aim of the project was to describe environmental and socio-economic components occurring within the project area, evaluate the potential effects of the project on those components, and describe measures for mitigating potentially adverse effects.

Innovation

The Authority had not completed a self-directed major EA previously; therefore, AECOM **pioneered** the project methodology and approach. This was the **first** parallel runway project completed under the current regulatory framework in Canada. AECOM provided advice and guidance to the client on completing a self directed assessment that shadowed the CEAA model, with no direction from a Regulatory Authority, such as the Canadian Environmental Assessment Agency.

Innovation and **originality** was integral to the successful approval of the PRP. Innovative mitigation measures were recommended to control, reduce, and/or minimize potential project effects. These include mitigation-by-design measures (recommended for the design and construction stages) and discipline-specific measures intended for application during construction, operations, and reclamation.

Examples include improving **sustainability** of water use by integrating measures with stormwater management systems, maximizing the use of existing disturbances and areas with limited vegetation values, and incorporating natural vegetation communities into project planning and design.

Success

AECOM **exceeded** all the project goals and objectives and the EA was successfully delivered to the client **ahead of schedule** and significantly **under budget**, which is virtually unheard of for a major, complex environmental approval process. Upon request from the client the original schedule was successfully **accelerated** by the project team and the EA was approved six months ahead of the original schedule. This ambitious goal was achieved by **proficient** project management, risk management, and a **collaborative** effort from the entire multi-discipline team and allowed construction activities to commence several months ahead of schedule.

The PRP involved the collaboration of a multi-disciplinary team across Canada, the United States of America, and the United Kingdom, utilizing resources from AECOM's Environment, Planning Design and Development, Water, and Transportation business lines. The team structure enhanced cross-business line relationships, technical expertise, and communication skills.

Technical

Employees gained market leading experience in complex computer modelling. Robust computer modeling was integral to the assessment of noise for the project. Historical data from the existing noise monitoring network, and on-site monitoring was used to validate a computer based noise model which predicted the future distribution of aircraft noise for scenarios with and without the parallel runway in years 2015 and 2025. The noise modeling took into account a wide range of factors that affect aircraft noise including the number of aircraft, type, flight paths and profiles, engine thrust settings, and operational factors. AECOM implemented creative mitigation-by-design measures that reduced the potential for disturbance to 26 (2015) and 24 (2025) residential communities.

Air dispersion models mathematically predicted the behavior of contaminant emissions by accounting for emission rates, terrain effects, geometry and location of the sources, receptor locations, and meteorology.

The noise and air quality assessments were closely integrated within a detailed Human Health Risk Assessment to ensure that thresholds of effects and exposure levels were not exceeded.

Innovative sustainability initiatives and measures were developed at workshops and through consultation with the Authority, design engineers, and stakeholders. Application of the measures will enable the Authority to meet social, environmental, and economic criteria of sustainability. On balance, the net effect of building the new runway will be overwhelmingly positive. This has led to the implementation of a formal sustainability scoring process and scorecard throughout the design and construction phases.

4. Full Project Description

Introduction

The Calgary Airport Authority (the Authority) is currently constructing a new 14,000 ft (4,270 m) parallel runway at Calgary International Airport (YYC) to meet increasing demand for passenger and cargo service in southern Alberta. The work is referred to as the Parallel Runway Project (PRP) and is illustrated in Figure 1.

Canadian Airport Authorities are not currently subject to the Canadian Environmental Assessment Act (CEAA); however, the Authority has decided to subject all major projects to a self-directed environmental assessment (EA) which shadows the CEAA model. The self-assessment process seeks to verify that the environmental effects of a project are fully considered and that measures designed to reduce or avoid adverse effects are implemented during design, construction, and operation.

The purpose of the parallel runway is to accommodate current and future increased demand for passenger and cargo service at YYC. The PRP is a long term initiative, planned over 40 years ago, elaborated in the Authority's 1996 and 2004 Master Plans, and is now being implemented. It will provide sufficient capacity to meet demand well beyond the 2025 time horizon examined in the EA.

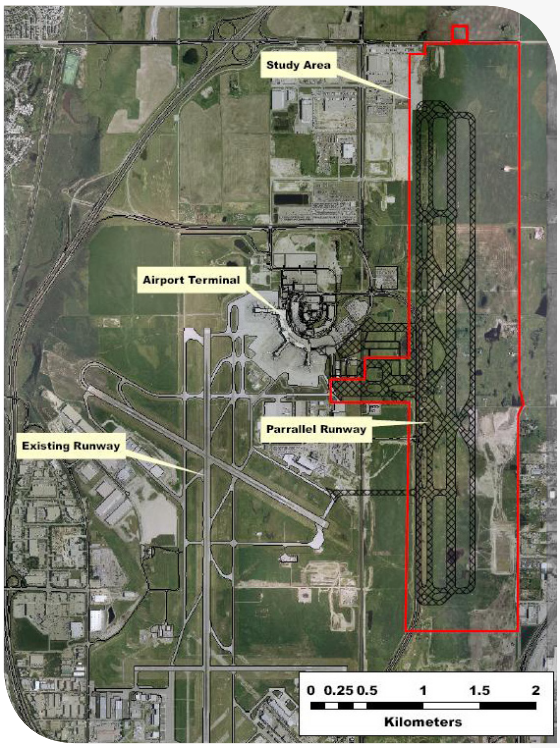


Figure 1 Parallel Runway Project

Key features of the project include:

- Construction and operation of a new 14,000 ft runway, including taxiways, navigational aids, and land-based infrastructure
- Changes to the roads leading to and from the airport to accommodate the new runway
- Changes to the storm drainage systems
- Development of changes to current airspace design and air operations
- Airfield underpasses for Taxiway Foxtrot and Juliet Extension

4.1 New application of existing techniques/originality/innovation

In the 1970s, Transport Canada, the Province of Alberta, and The City of Calgary had the foresight to put in place land use regulations in the vicinity of the airport that anticipated the addition of a parallel runway (the Airport Vicinity Protection Area), illustrated in Figure 2. As a result, there will be no changes to existing land use designations due to the runway construction, and less effect on land use, communities, and residents when compared to other new runway projects at major North American airports. Analysis of property values in Calgary found that changes over time were independent of proximity to the airport. Construction of the new runway is not expected to significantly affect property values and the assessment concluded that there will be no effect on traditional land use.

Following the completion of the EA, AECOM developed an Environmental Mitigation and Monitoring Plan and is currently responsible for the construction inspection and monitoring of the PRP. Daily, weekly, and monthly inspection reports are completed via AECOM's proprietary Electronic Reporting System. This system features compact software applications for field data collection hardware (notebook computers) and enterprise editions for central database applications. The electronic field reporting database has an easy-to-use Personal Digital Assistant (PDA) interface, which allows real-time inspection reporting and documentation combined with robust database management.

Advancement of Technology and Technical Excellence

Computer modelling was integral to the assessment and mitigation of the noise, air quality, and greenhouse gas chapters of the EA. Currently, noise from aircraft approaching and departing the airport is monitored by an extensive network of noise monitoring terminals (NMTs) distributed around the city of Calgary. Historical data, obtained from the NMTs, has been used to validate a computer based noise model which as part of the study has predicted the future distribution of aircraft noise for scenarios with and without the new parallel runway in the years 2015 and 2025. The noise modelling took into account a wide range of factors that affect aircraft noise, including the number of aircraft, the type of aircraft, the flight paths and profiles, engine thrust settings, and other aircraft operational factors. These factors can vary significantly from one aircraft to

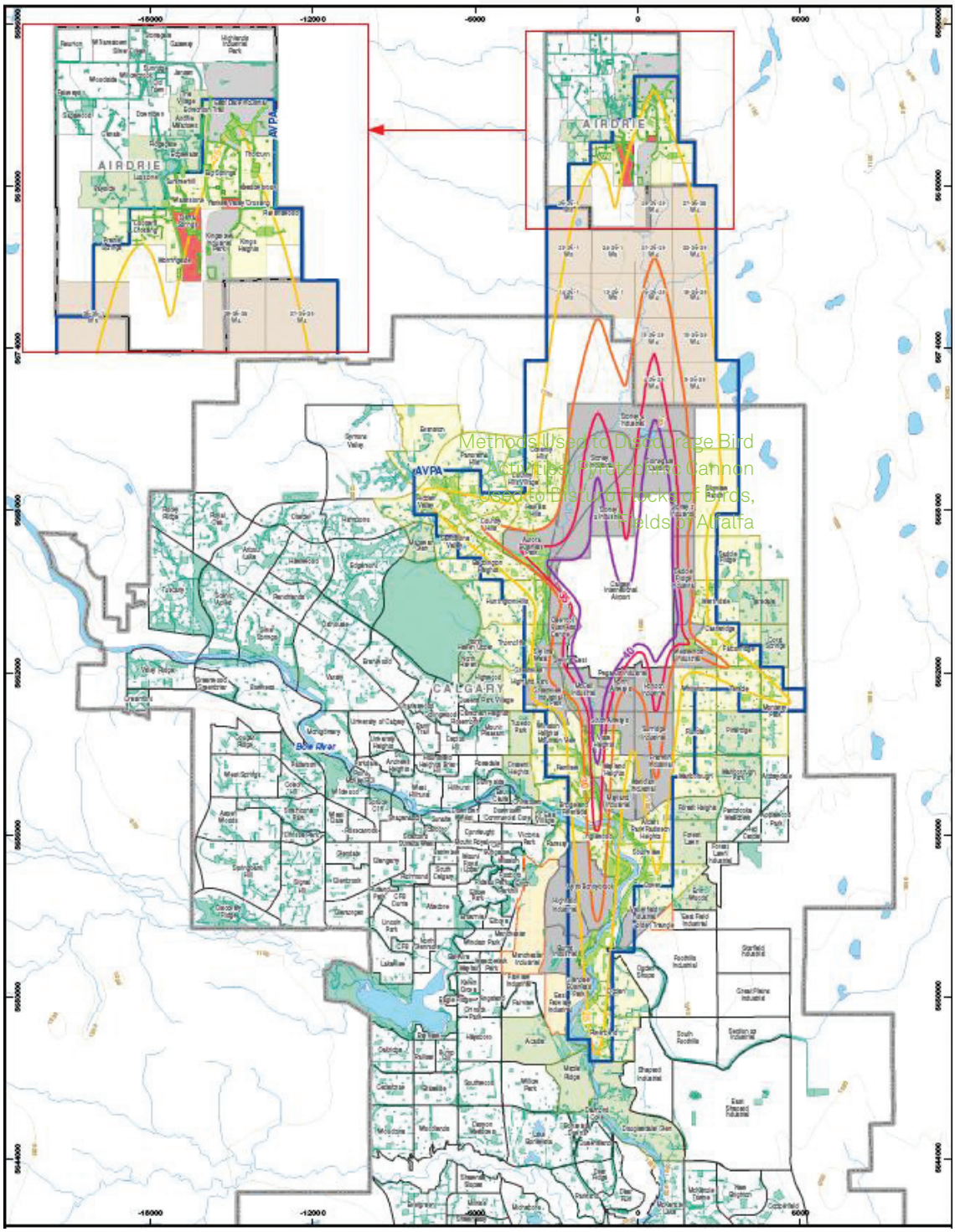


Figure 2 Airport Vicinity Protection Area

Figure 3 Mobile air quality monitoring system

another and from one day to another in the airports operations. Consequently, in order to develop a robust noise model these factors were all selected tending towards the worst case scenario in order that the study should be based on the typical widest distribution of aircraft noise at higher levels. In regard to flight paths, the modelling assumed that aircraft would approach and depart from YYC in a straight line on axis to the centre line of each runway.

Air dispersion models are important tools that can be used to assess the likelihood of compliance with air quality criteria at a particular location and used to assess the air quality effects resulting from project activities. The dispersion models mathematically predicted the behaviour of contaminant emissions by accounting for emission rates, terrain effects, geometry and location of the sources, receptor locations, and meteorology. A review of readily available air quality literature and information sources showed that Alberta Environment and Water (AEW) and Calgary Regional Airshed Zone (CRAZ) maintain three air quality monitoring stations within Calgary, which were supplemented with additional project-specific monitoring in order to provide representative information of the existing environmental conditions in the vicinity of the PRP (Figure 3).

The modelling included real-time monitoring and time weighted average sampling at all five monitoring stations.

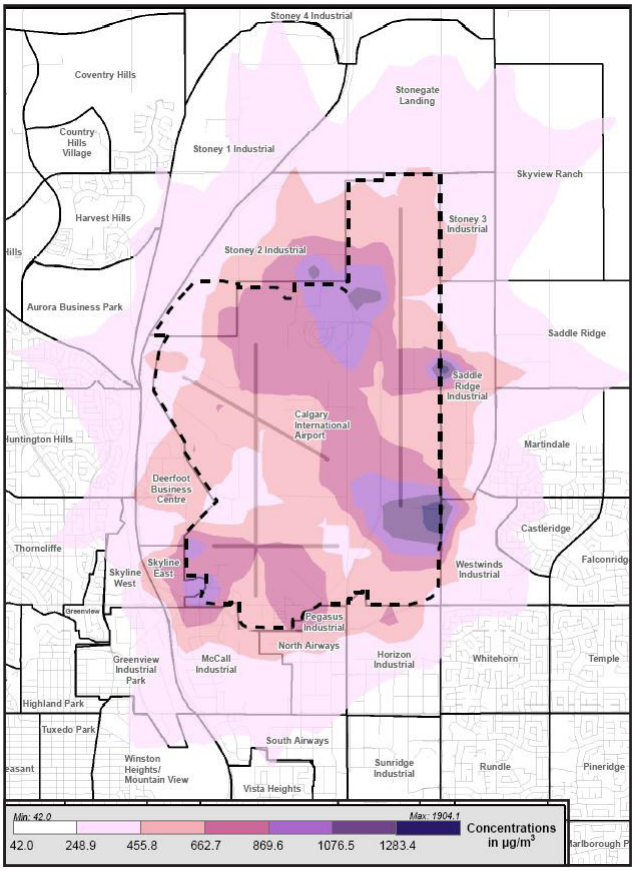


Figure 4. Example of air quality dispersion contours with the parallel runway operational

An example of the air dispersion model results is provided in Figure 4.

The noise and air quality assessments were closely integrated within a detailed Human Health Risk Assessment (HHRA) as the predicted effects have the potential to affect human health. The HHRA also considered the possible health effects that may result from the use of chemicals on YYC lands for vegetation control, runway maintenance, and de-icing. The potential for health effects arising from the PRP may arise from aircraft noise, traffic noise and airport ground noise and vibration, air quality changes resulting from aircraft, and other emissions and changes in the amounts and mode of chemical use. Noise may affect human health by increasing annoyance, disturbing sleep, interfering with speech, and impairing the cognitive development in children.

The importance of the inter-relationships between noise, air quality, and human health are atypical for EAs in Canada, as the urban setting and land use regulations surrounding the airport result in insignificant biophysical effects.

4.2 Complexity

Degree of Difficulty

As Canadian Airport Authorities are not currently subject to the CEAA, the PRP was self-directed which added a great degree of difficulty to the project. It was imperative that the project shadowed the CEAA model, even though the process was not being overseen by a regulatory authority. The Authority had not completed a self-directed major EA previously; therefore, AECOM pioneered the project methodology and approach. This was the first parallel runway project completed under the current regulatory framework in Canada. AECOM provided advice and guidance to the client on completing a self directed assessment that shadowed the CEAA model, with no direction from a regulatory authority.

Coordinating a large multidisciplinary, global team also increased the difficulty of the project. In order to undertake a satisfactory cumulative effects assessment, it was important to encourage efficient communication between each discipline lead and to distribute relevant information throughout the team.

Regular progress meetings were held to promote dialogue between the discipline leads across Canada and the UK, which enabled identification of any gaps in data, potential issues with meeting the set programme, and to provide feedback on work already submitted.

4.3 Environmental Impact

Environmental Value

The EA details mitigation measures that are currently being used to control, reduce, and/or minimize potential project effects. These include mitigation-by-design measures recommended for the design-build stage and discipline-specific measures intended for application during construction, operations, and reclamation. The principle behind mitigation-by-design was to incorporate measures that represent a direct effort to avoid sensitive areas and minimize unnecessary loss of, or disturbance to, these areas.

For example, although soil conservation, in accordance with the Alberta Soil Conservation Act and other legislation is not a requirement of projects conducted on Federal lands, in situ conservation and reclamation opportunities

Methods Used to Discourage Bird Activities: Pyrotechnic Cannon Used to Disturb Flocks of Birds, Fields of Alfalfa

and mitigation measure is being pursued during all phases of the PRP wherever possible in order to optimize sustainability.

Other examples of the substantial environmental value in the vicinity of YYC include:

- Improving the sustainability of water use by integrating measures with stormwater management systems to reduce potable water demand by using non-potable water for dust control and fill mixing and to reuse stormwater and wastewater
- Maximizing the use of existing disturbances and areas with limited vegetation values and incorporating natural vegetation communities into project planning and design
- Conservation strategies to protect or buffer sensitive plant communities from further disturbance
- The redistribution of noise when the new runway is built (as opposed to if it is not), which will result in many people experiencing less noticeable noise and none experiencing more
- A net beneficial change in the number of noise events likely to result in sleep disturbance and the number of people likely to be highly annoyed by noise generated from the combined facility in the future

Bird strike mitigation

- A net beneficial effect on community well-being
- Minor and major beneficial effects on skills and labour supply, and on economic development services

An Environmental Construction Operations (ECO) Plan, detailing environmental practices, mitigation, and oversight measures to be employed during the construction phase has been prepared for the PRP. It includes a description of the measures the Authority is undertaking during the construction of the PRP. The objective of the ECO Plan is to prevent and/or minimize environmental impacts and to enhance the environmental value of the air, land, and water affected by the PRP during all phases of the project (pre-construction, construction, and operations). The ECO Plan is a working document and is being developed as construction work packages for the PRP progress.

Added Value

During the course of the assessment, a large number of sustainability and mitigation measures were identified and summarized in the report. Application of the measures enables the Authority to meet social, environmental, and economic criteria and the summary table is used as a management tool during detailed design, construction, and operation of the runway to oversee implementation of the measures. On balance, the net effect of building the new runway will be overwhelmingly positive.

The noise contours developed in the assessment reflect the long term pattern of use of the runways at the airport and aggregate this pattern to provide information on the long term trends in the propagation of noise from the airport. This is the conventional approach in Canada, the USA, the UK, Europe, Asia, and Australasia; however, the approach in the EA was further refined towards the worst case by the use of the peak planning day (PPD) number of aircraft in the assessment that is approximately a 90th percentile day in terms of the number of aircraft movements at the airport over a year. As a result of implementing appropriate mitigation-by-design measures, the noise assessment results show a reduced potential for disturbance of activities at community and recreational features for between 26 (2015) and 24 (2025) residential communities. These communities will be exposed to fewer noticeable overflights and improved day-night noise levels after the construction of the parallel runway. There is also a reduced potential for disturbance of people's use and enjoyment of private property after construction of the parallel runway in many residential communities, and for between 56,000 and 86,000 residents.

4.4 Social and economic benefits

Benefit to Society

The PRP will result in major beneficial effects on employment, business activity, and visitor spending. Other beneficial effects of the PRP will be experienced by the tourism sector and other businesses due to increased visitor spending, improved air service capacity, and reduced congestion at YYC. The PRP will increase total income and enable increased property tax revenues for the city. These are considered minor beneficial effects.

Air traffic at YYC is expected to increase whether or not the new runway is built. The EA compares conditions today and predicted conditions in 2015 and 2025 with and without the new runway. The differences show what the effects of increased air traffic might be and how the new runway might avoid or reduce them. Figure 5 shows a typical delay curve, which illustrates the relationship between airfield delay and demand; as hourly demand increases, delay will eventually begin to increase at an exponential rate. Building a new parallel runway at YYC will enable the airport to meet increasing demand for service to 2025 and beyond. Examination of

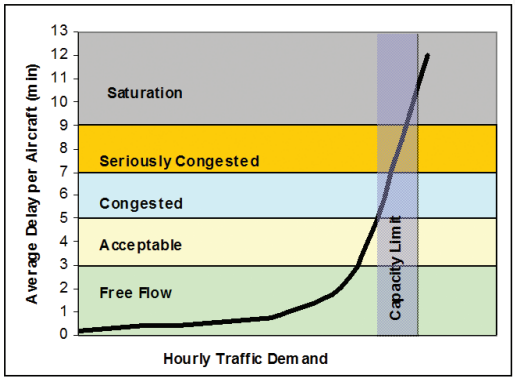


Figure 5 Typical Delay Curve

Sustainable Design: LED lighting significantly reduces energy consumption

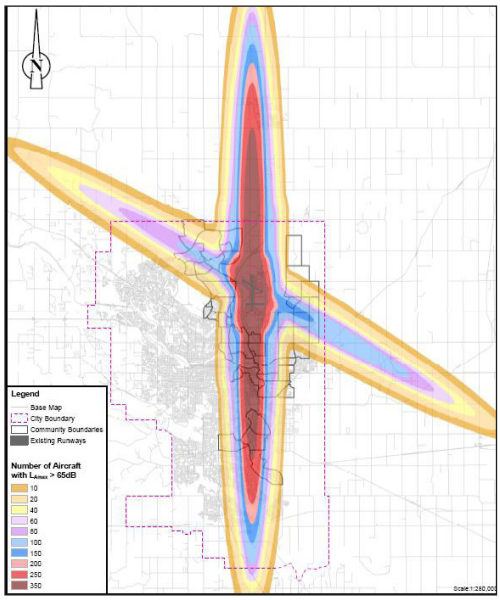
Sustainable Construction: Warm mix paving reduces CO_2 emissions

alternatives shows that adding the new runway is the most sustainable way of meeting the demand. Public attitude surveys found that a large majority of Calgarians support their airport and the PRP.

The new runway will be able to accommodate the largest aircraft in operation today under the most severe weather conditions. This means that YYC will be able to handle more long haul passenger and cargo direct flights to more destinations. The addition of the new runway will relieve congestion and eliminate delays on arrivals and departures through 2025 and beyond; a further benefit to passengers.

Directly or indirectly, YYC contributes $2.9 and $6 billion to regional Gross Domestic Product (GDP) and generates employment for 40,000 people. Construction of the new runway is part of a $2.4 billion airport expansion program. The PRP will cost $460 million and create 890 construction jobs. Operation of the runway will enable the creation of a further 3,746 jobs. Economic modelling indicates that the PRP will enable $240 million per year in additional visitor spending.

Overall, the PRP will result in a net beneficial effect on community well-being. It is anticipated that people are likely to continue to feel healthy, safe, and satisfied living in their communities during PRP construction and operation. The PRP and its enabled development is expected to improve the state of the community assets possessed by local and regional



Example of predicted noise contours with the parallel runway operational

communities and will support their residents, organizations, and institutions in achieving their maximum potential.

Accommodating the additional aircraft movements without building the new runway would result in noise effects on people currently not affected. In 2015, with the PRP in operation, 86,000 people would experience less noticeable noise as a result of the new runway and no individuals would experience an increase in noise. Most people subject to high probabilities of sleep disturbance if the new runway is not built will experience lower probabilities when it is built. Many people experiencing lower probabilities of sleep disturbance without the new runway may see a small increase. Building the new runway will result in an overall decrease in the probability of sleep disturbance in communities near the airport.

Sustainable Operations: Storm and rain water recycling

With respect to community well-being, the Authority's commitments to sustainability were considered in the planning and design of the PRP by:

- Ensuring that on-site health and safety facilities and services are available for workplace accidents and injuries, and that acceptable response times to the east airfield are maintained
- Timing of the construction phase during a period of time where there exists excess labour supply in Alberta and the commencement of operations in time to adequately service the anticipated growth in visitation to the Calgary area
- Maximum utilization of excavated material at YYC, concrete and asphalt recycling on airport lands, and the reuse and recycling of salvaged materials

4.5 Meeting and exceeding owner's/ client's needs

AECOM exceeded all project goals and objectives and the EA was successfully delivered to the client ahead of schedule and significantly under budget, which is almost unheard of for a major, complex environmental approval process. Upon request from the client, the original schedule was successfully accelerated by the project team and the EA was approved six months ahead of the original schedule. This ambitious goal was achieved by proficient project management, risk management, and a collaborative effort from the entire multi-discipline team. As such, construction activities commenced several months ahead of schedule. The PRP opened new areas for organic growth to AECOM, who continues to be a major partner of the Authority on the wider Airport Development Program. Along with the International Facilities Project (IFP) at YYC (also being completed by AECOM), the combined program will be the largest construction project in Calgary's history.

The project exceeded commercial targets, with an overall delivered revenue of $4.8 million USD, $800,000 lower than the total revenue as sold. With a capital value of $500 million, the project was ranked number 57 in ReNew Canada magazine's Top 100 Projects 2011 and received an Award of Merit at the 2012 Consulting Engineers of Alberta Showcase Awards.

Management of Risk

As part of the project, an assessment of various alternatives to the PRP and means of carrying it out were undertaken. Cost effectiveness, practicality, environment, and socio-economic effects were considered in examining and assessing all alternatives to the PRP that were considered to minimize any risk to the client and the environment.

A series of risk management workshops were held with the client (YYC). The initial workshops were mostly concerned with risks to project schedule and cost related to the lack of a formal regulatory process (Canadian Airport Authorities are not currently subject to the CEAA). Those risk workshops led to formulation of risk management measures to remove the potential for delays arising from regulatory uncertainties and the measures were successful. Risks arising from environmental, social, and economic effects of the project were also discussed in workshops and strategies for dealing with them were developed. Surface transportation, noise, land use, and treatment of wetlands were the most important areas of risk examined at the workshops.

Summary

The assessment concludes that building the new runway is the most sustainable way to meet the increasing demand for service at YYC. The Authority has embraced sustainable development as an important aspect of its business. Building a new parallel runway at YYC will enable the airport to meet increasing demand for service to 2025 and beyond. Examination of alternatives shows that adding the new runway is the most sustainable way of meeting the demand. The current land use regulations in the vicinity of the YYC anticipated the addition of a parallel runway and as a result, there will be no changes to existing land use designations and less effect on land use, communities, and residents when compared to other new runway projects at major North American airports. Construction of the new runway is not expected to significantly affect property values or traditional land use.

The net effect of building the new runway will be overwhelmingly positive and the assessment concludes that building the new runway is the most sustainable means of meeting increasing demand for service at YYC. Building the new runway will also result in an overall decrease in the probability of sleep disturbance in communities near the airport.

Taking into consideration the unique nature of this self directed EA and the tremendous benefits to society brought about by this project, it is our belief that this submission shows that AECOM has demonstrated excellence in the Environment Category.