Air Quality Study & Human Health Risk Assessment

GTAA

Toronto Pearson
International Airport | Aéroport International

Overview

Toronto Pearson is Canada's largest airport - in 2015, Toronto Pearson welcomed more than 40 million passengers and that number is forecasted to grow to 65 million passengers by 2033.

Toronto Pearson is also a significant employer and generator of economic activity for the country and local communities. Additional job growth and economic activity will continue to be fueled by Toronto Pearson's growth.

Of course, this potential growth must be managed in a responsible and sustainable manner.

The GTAA takes the obligation to manage growth sustainably very seriously – which includes the continuous improvement of our environmental programs and a commitment to understand our impacts so we can develop and collaborate on the programs to mitigate them.

One way we can deliver on this commitment is through studies like the 2015 Air Quality and Human Health Risk Assessment Study

What is an Air Quality (AQ) Study and Human Health Risk Assessment (HHRA)?

- **An AQ study is one of the ways we can understand the impact of our operations. It assesses the air quality in a defined area.**

- **An HHRA aims to understand the potential for any adverse health effects for those who live, work and play in the vicinity of a defined area from exposure to its emissions.**

Why do an AQ Study + HHRA now?

- **The previous study, undertaken in 2004, forecast out to 2015.**
  - Since the last study, passenger traffic has increased and the airport and aircraft are now more efficient.
- **With these changes, it is the right time to update the previous work**
- **The GTAA has completed work to conduct an AQ Study and HHRA that will forecast out 2032.**

How we did our AQ Study and HHRA?

Phase 1	**Understand which chemicals are present on airport property** *Develop airport emissions inventories for 2011, 2022, 2032*	Golder Associates
Phase 2	**Understand which chemicals are present in area surrounding the airport** *Off-site emissions inventory*	Golder Associates
Phase 3	**Combine Phase 1 and 2 to Understand the overall composition of air within the region** *Emissions and Dispersion Modeling System (EDMS)*	Golder Associates
Phase 4	**Determine possibility of any potential health risks for those who live, work and play in the airport region** *Human Health Risk Assessment*	intrinsik SCIENCE INTEGRITY KNOWLEDGE

The Industry and Community Voice was part of the process

In support of the study, the GTAA formed a Community Advisory Committee as a mechanism to seek input from industry and community stakeholders.

Objective of the Committee: Provide advice and expertise to the GTAA Air Quality Study to ensure that industry best practices are being met.

- Provide an opportunity for the general community to receive information, ask question and engage in dialogue concerning scientific and technical concepts necessary for informed discussion.
- Included CENAC, residents from the 7.5 km (there was a public call) and reps from the Boards of Health, etc.

Glossary

Emissions: the chemicals released into the air from combustible engines (automobiles, factories, aircraft, machinery etc.)

Inventory: a list of sources and substances they emit to the air within a specific area.

Monitoring: measurement of chemicals present in atmosphere.

Dispersion: The scattering or diffusion of a pollutant in the air after release from a source.

Modelling: a mathematical simulation of emissions as they are transported throughout the atmosphere.

Emissions and Dispersion Modeling System (EDMS): The Federal Aviation Administration's model designed to assess the air quality impacts of proposed airport development projects.

Chemicals of Concern: specific chemicals that are identified for evaluation in the risk assessment process.

Maximum point of impingement (MPOI): the (non-static) location at which specified chemicals are most concentrated within a certain time period.

Incremental Lifetime Cancer Risk (ILCR): the estimated increased risk for cancer that occurs over an assumed average lifespan.

Overall Results

Things to Consider

Methods and assumptions used in the assessment were designed to be highly cautious, with a tendency to over-estimate potential health risks. These conservative exposure assumptions are not representative of the general population.

Highly unlikely scenarios:

- assumed humans would have the highest level of exposure (24 hours/day, 365 days/year)
- assumed humans in residential areas were born in the study domain and lived in the same location their entire lives.
- assumed humans in industrial area remained at the maximum point of impingement (MPOI), which is not a static point

Highly conservative benchmarks and estimates:

- applied highly conservative estimates to animal laboratory testing due to lack of human exposure data for some instances in which exceedances occurred. eg. Actual exposure limit was 17,000 lower than limit used in laboratory study
- always used most conservative acceptable level of risk benchmark. eg. Regulatory agencies typically use Incremental Lifetime Cancer Risk (ILCR) levels between 1-in-100,000 (Health Canada) and 1-in-1,000,000. This HHRA used 1-in-1,000,000 (Ministry of the Environment and Climate Change).

Results

General population is not likely at risk of adverse health effects due to Toronto Pearson's operations, based on the highly-conservative nature of the assessment and the infrequency of any exceedances.

Most chemicals do not pose any unacceptable risks to human health even with conservative assumptions

Elevated risk levels were predicted from 4 of the 27 COCs in air at commercial and residential locations, however exceedances for these chemicals were either based on highly intermittent events or on highly conservative exposure assumptions that are likely not representative of the general population

Deposition of chemicals from operations at Toronto Pearson showed no unacceptable risks ((*i.e.*, soil, dust, home, garden grown produce, and breast milk ingestion by infants)

Next Steps

GTAA will be developing a comprehensive air quality strategy with three key areas of focus:

- Leverage the relationship developed with the agencies that were part of Community Advisory Group and others
- Update and improve the air quality monitoring capability at Toronto Pearson
- Continue to influence changes that will improve local air quality for the workers of Toronto Pearson and our neighbours

Objectives and Approach

Phases 1-3: Objectives and Approach

Phase One: Airport Emissions Inventory

Objective: Determine sources of chemicals which are present on airport property as a result of emissions from Toronto Pearson at the current time and the projected future (2011, 2022, 2023)

APPROACH

Obtain and analyze data on existing operations:

- Examples: GIS Images; Aircrafts counts; Fleet makeup; Operational equipment; Take-offs and landings

Phase Two: Regional Emissions Inventory

Objective: Using best available information determine sources of chemicals which are present in a 7.5km radius of the airport property excluding emissions at Toronto Pearson at the current time and the projected future (2011, 2022, 2023

APPROACH

Use most recent, reliable data available

- Ontario Ministry of the Environment
- Environment Canada

Compare data to that of the Region of Peel for quality assurance

Calculate emission based on individual grid cells

- Use GIS technology to map
- Each modelled based on with unique facilities, operations or landuse

Phase Three: Emissions and Dispersion Modeling System (EDMS) and Area modeling

Objective: To understand the overall composition of area within the airport region at the current time and the projected future (2011, 2022, 2023) in three scenarios:

1. Airport alone (no regional emissions)
2. Region alone (no airport emissions)
3. Airport and region emission combined

APPROACH

Use meteorological data from Environment Canada Meteorological Station at Toronto Pearson

Use best-in-class modelling systems

- U.S. Federal Aviation Authority's (FAA's) Emissions and Dispersion Modelling System
- U.S. Environmental Protection Agency's MOtor Vehicle Emission Simulator (MOVES)

Compare our results to local stations within the region to see if result can be correlated

Show change in airport contributions to local air quality with distance from the airport

Phase 1-3: What We Learned

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Majority of emissions inside the 7.5 km radius are from regional sources (not Toronto Pearson)

- Why 7.5 km? This is international standard in EDMS but at this distance aircraft are above 3000 feet. At this point, aircraft emissions are difficult to model and concentrations are minimal due to dispersion.
- Regional sources may include roads and highways, industry, commercial establishments etc.

Estimated emissions for the airport are anticipated to increase due to the airport's growth, however will be partially offset by advances in aircraft technology

Predicted future emissions are below current guidelines for airport alone (all scenarios)

Phases 1-3: What We Learned

Table 1: Summary of Annual Regional Emissions by Source Group

Contaminant	Emissions (tonnes/year)							
	Agricultural[1]	Construction	Road/Rail[2]	Off Road Transportation	Air Traffic	Residential[3]	Industrial	TOTAL
NO_X	—	—	1,036	4,640	1,180	3,748	1,357	11,960
SO_2	—	—	30	180	119	1,186	—	1,516
CO	—	—	3,020	59,051	3,153	9,805	8,726	83,755
PM_{10}	65,185	2,288	5,448	371	18	2,458	802	76,573
$PM_{2.5}$	10,185	429	1,284	357	18	1,945	—	14,219
VOC	—	—	199	2,550	875	18,337	—	21,962

Notes:

1 Includes biogenic (agricultural emissions, fallow land, treed areas, etc.) emissions as well as farm operations (tilling/plowing, etc.)

2 Includes freeways, expressway/highways, ramps, arterial roads (Zheng, 2012) and rail lines

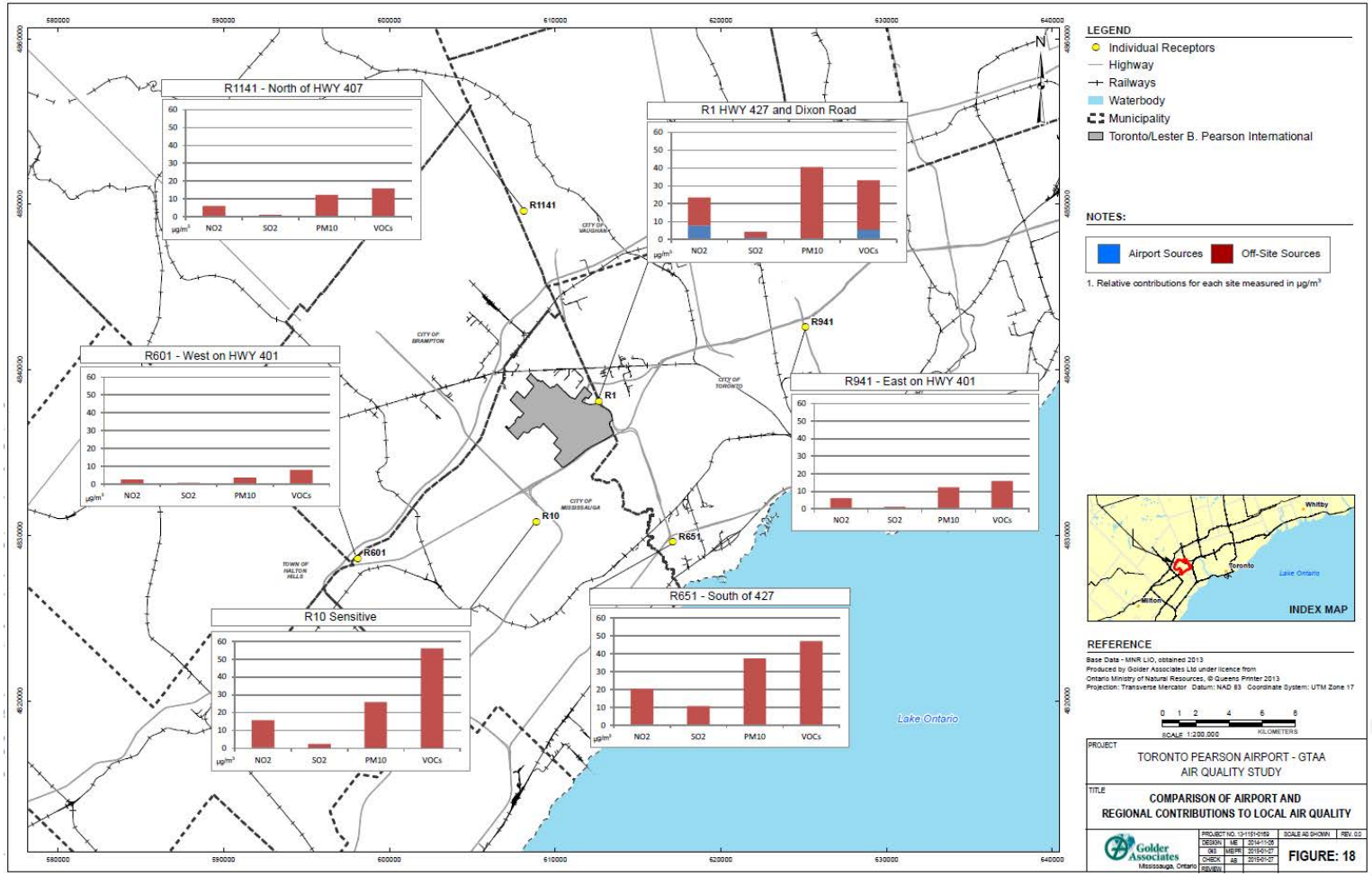
3 Includes residential traffic, heating (oil, gas) and wood burning

Table 2: Recommended Regional Emissions for Inclusion in the Assessment

Contaminant	Emissions (tonnes/year)					
	Construction	Road/Rail	Air Traffic	Residential	Industrial	TOTAL
NO_X	—	1,036	1,180	3,748	1,357	7,321
SO_2	—	30	119	1,186	—	1,335
CO	—	3,020	3,153	9,805	8,726	24,704
PM_{10}	2,288	5,448	18	2,458	802	11,014
$PM_{2.5}$	429	1,284	18	1,945	—	3,676
VOC	—	199	875	18,337	—	19,411

Phases 1-3: What We Learned

Relative Contributions



Phase Four: Human Health Risk Assessment (HHRA)

Objective: To understand the potential for any adverse health effects for those who live, work and play in the vicinity of Toronto Pearson from exposure to its emissions at the current time and the projected future (2011, 2022, 2023)

Phase Four: Approach

Use data obtained from Phases 1-3

Identify chemicals of concern (COCs) to humans based on relative abundance and toxicological considerations

Consider numerous exposure pathways

- Inhalation, ingestion (eg.food, soil, breast milk), skin exposure

Use widely accepted risk assessment methodologies endorsed by regulatory agencies, including: Ontario Ministry of the Environment and Climate Change, Health Canada and the United States Environmental Protection Agency.

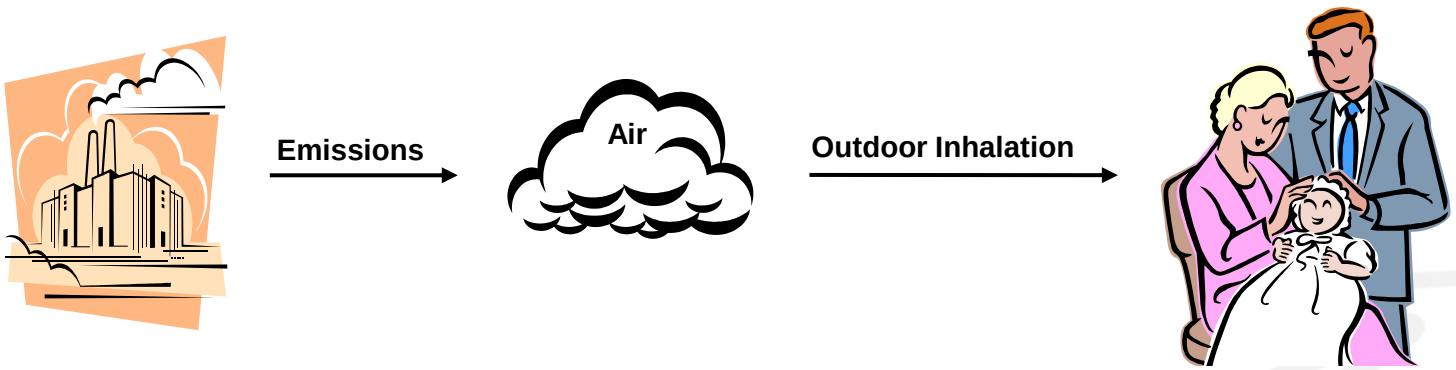
Analyze three scenarios:

- **Baseline Case:** assessment of existing and estimated background conditions in the absence of Toronto Pearson
- **Airport Alone Case:** assessment of estimated emissions from Toronto Pearson alone
- **Cumulative Effects Case:** assessment of the cumulative effects of the Baseline Case *plus* the Airport Alone Case for each year (2011, 2022, 2032)

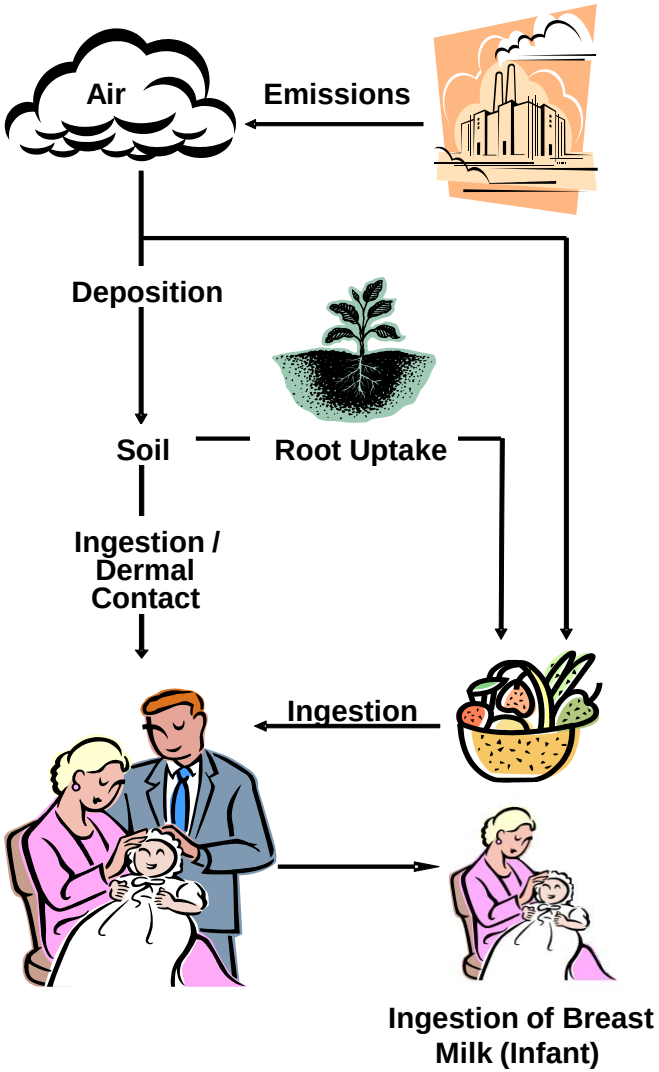
Phase Four: Approach - Exposure Assessment

Inhalation Assessment:

- Estimated inhalation of vapour and particulate concentrations was studied in two scenarios:
  - Short-term (acute): Maximum 1-hour and 24-hour concentrations
  - Long-term (chronic): Annual time-weighted average concentration



Phase Four: Approach - Exposure Assessment



Multi-media Assessment:

- Air Quality study data used to predict chemical concentrations in:
  - Soil/dust (*via* atmospheric deposition)
  - Home-grown produce (*via* atmospheric deposition, vapour uptake, and root uptake)
  - Breast milk (*via* mother's chemical intake)
- The total estimated daily intake of chemicals by individuals from direct and indirect exposure routes were calculated using ingestion rates and physical characteristics

Phase Four: Results

General population is not likely at risk of adverse health effects due to infrequency of exceedances and the highly-conservative nature of the assessment

Most chemicals do not pose any unacceptable risks to human health despite conservative assumptions

Elevated risk levels were predicted from 4 of the 27 COCs in air at commercial and residential locations, however exceedances for these chemicals were either based on highly intermittent events or on highly conservative exposure assumptions that are likely not representative of the general population

Year 2032 represents the expected period with the greatest amount of air traffic volume and air impact

Deposition of chemicals from operations at Toronto Pearson showed no unacceptable risks ((*i.e.*, soil, dust, home, garden grown produce, and breast milk ingestion by infants)

How Do The Results Compare Against The 2003 HHRA?

The results from the current HHRA and the 2003 HHRA are largely the same

- Most chemicals do not pose any elevated risks to human health despite conservative assumptions
- Occasional incidences where concentrations exceed short-term benchmarks
- Additional elevated long-term risk predictions were predicted resulting from the use of more conservative TRVs
  - Acrolein long-term TRV is 20-fold more conservative
  - Benzene cancer TRV is 4-fold more conservative
  - Formaldehyde cancer TRV is 31,000-fold more conservative

Next Steps

GTAA will be developing a comprehensive air quality strategy with three key areas of focus:

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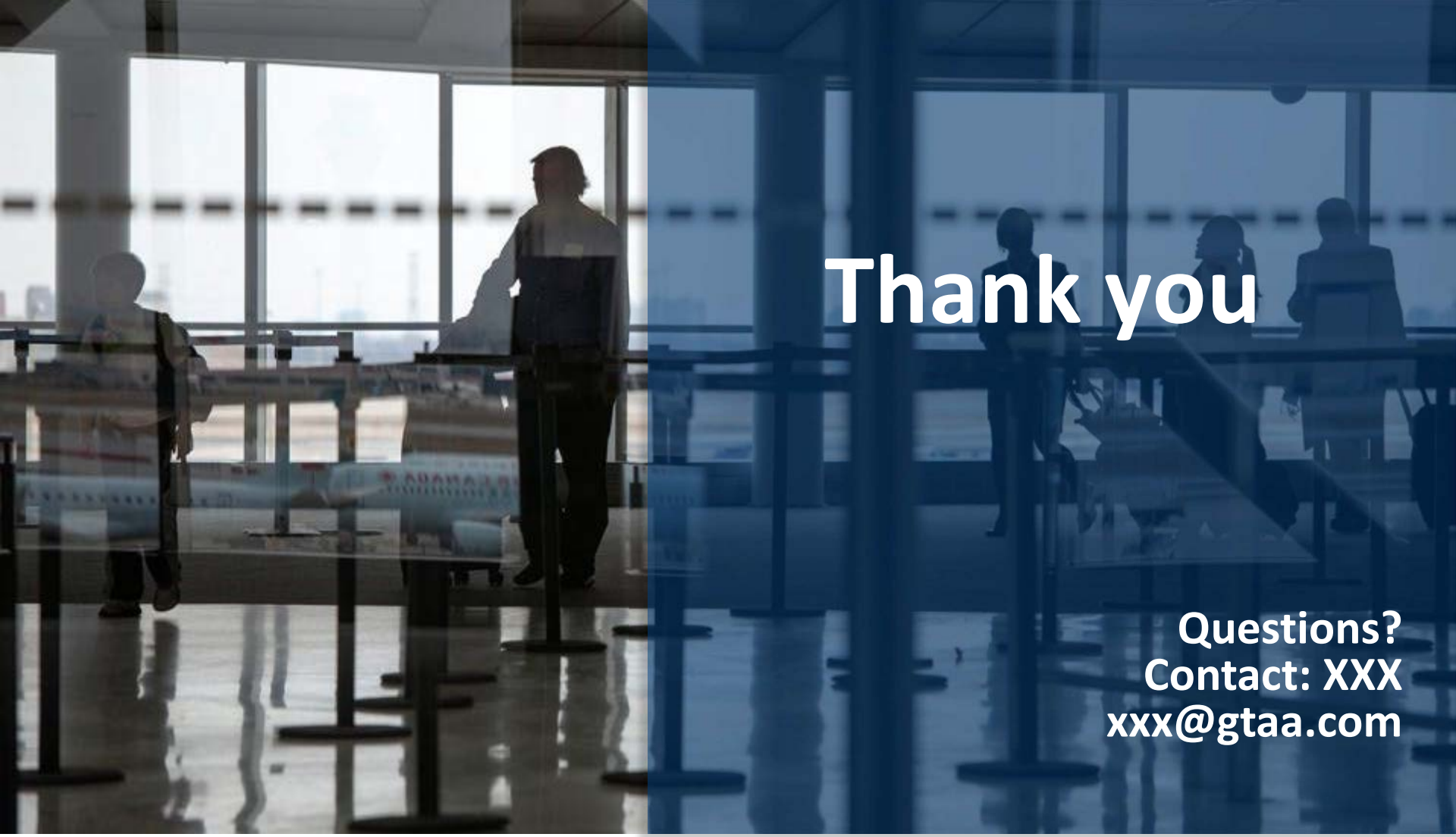

Thank you

Questions?
Contact: XXX
xxx@gtaa.com

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