Public Report

To:	Safety and Facilities Services Committee
From:	Adam Grant, Commissioner, Safety and Facilities Services Department
Report Number:	SF-24-24
Date of Report:	May 8, 2024
Date of Meeting:	May 13, 2024
Subject:	2024 Oshawa Executive Airport Action Plan
Ward:	Ward 2
File:	03-05

1.0 Purpose

The purpose of this report is to respond to Parts 1, 2 and 3 of a resolution passed by Council on October 25, 2021, as follows:

> 1. "That pursuant to Report ED-23-152 dated August 24, 2023, Economic and Development Services staff be directed to defer any land transactions at the Oshawa Executive Airport until a 2024 Airport Action Plan is adopted; and,
>
> 2. That Economic and Development Services staff be authorized to advise any prospective purchaser of land at the Oshawa Executive Airport of Item 1 above; and,
>
> 3. That Safety and Facilities Services staff be directed to prepare a 2024 Airport Action Plan for presentation to the Safety and Facilities Services Committee no later than the second quarter of 2024."

Attachment 1 is a copy of HM Aero report.

2.0 Recommendation

That the Safety and Facilities Services Committee recommend to City Council:

> That pursuant to SF-24-24 dated May 8, 2024, the 2024 Oshawa Executive Airport Action Plan be endorsed by Council.

3.0 Executive Summary

Not Applicable

4.0 Input From Other Sources

The following have been consulted in the preparation of this Report:

- Director, Corporate Comunications
- Director, Planning Services
- Director, Finance Services
- City Solicitor
- Airport Manager

5.0 Analysis

5.1 Background

At its meeting of March 29, 2021, City Council considered Report DS-21-44, a report of the then Commissioner of Development Services regarding the Draft Proposed 2021-2022 Oshawa Executive Airport Action Plan and passed the following resolution:

"That, pursuant to Report DS-21-44 dated March 3, 2021, Development Services staff be directed to obtain public input on the Draft Proposed 2021-2022 Oshawa Executive Airport Action Plan outlined in said Report, using the approach described in Section 5.14 of said Report, which will include holding a public meeting of the Development Services Committee."

On May 10, 2021, a public meeting was held with respect to the Plan. At the conclusion of the public meeting, the Development Services Committee adopted recommendations to refer the Plan and eight pieces of correspondence to staff for consideration in the future recommendation report on this matter.

A copy of DS-21-44, including the Draft Proposed 2021-2022 Oshawa Executive Airport Action Plan.

At its meeting of June 21, 2021, City Council considered Report DS-21-137, a report of the then Commissioner of Development Services regarding the Draft Proposed 2021-2022 Oshawa Executive Airport Action Plan and passed the following resolution:

"That pursuant to Memorandum DS-21-137 dated June 2, 2021, that Council endorse the 2021-2022 Oshawa Executive Airport Action Plan."

The 2021-2022 Oshawa Executive Airport Action Plan contained fourteen (14) action items related to the Oshawa Executive Airport as follows:

1. Continue to Advance an Appropriate Balance Between the Airport and the Residential Communities;
2. Continue to Defend the City's Interests in Legal Proceedings Involving Canadian Flight Academy Ltd;
3. Market the Airport as an Executive Airport;
4. Advance Opportunities to Restrict Flight Training Schools;

4A: Re-affirm for Transport Canada that the City of Oshawa is Formally Opposed to the Establishment of New Flight Training Schools at the Airport.
4B: Investigate an Amendment to Zoning By-law 60-94 to Limit the Number of Flight Training Schools at the Airport.

5. Complete Phase 2 of Air Quality and Noise Study;
6. Continue to Investigate Process to Establish New Noise Abatement Procedures and Restrictions;
7. Explore New Technologies and the Use of Unleaded Fuels;
8. Continue to Advocate With Transport Canada for Increased Enforcement of Safety;
9. Continue to Advocate With Federal and Local Elected Officials;
10. Initiate Review of Fees;
11. Update the 25 Year Capital Forecast through Annual Budget;
12. Continue to Advance Recommendations of the Independent K.P.M.G. Airport Audit;
13. 1997 Operating Agreement;
14. Continue to Advance Public Communications on Airport Matters.

5.2 Overview and Current Status

Action 1: Continue to Advance an Appropriate Balance Between the Airport and the Residential Communities

A common theme at the Town Hall and the virtual Workshops was the need to bring better balance of the operational aspects of the Airport with the quality of life of the residents in the surrounding community. The 2021-2022 Airport Action Plan and the 2024 Airport Action Plan will attempt to advance a better balance through the advancement of the Actions listed below.

Action 2: Continue to Defend the City's Interests in Legal Proceedings Involving Canadian Flight Academy Ltd.

The City is currently in litigation with Canadian Flight Academy Ltd. ("C.F.A."), one of two existing flight schools operating out of the Airport. Section 5.7 of DS-21-44 provides contextual details regarding this litigation. Development Services staff and the City Solicitor, in consultation with the City's Airport Manager, will continue to defend the City's interests in this regard, as directed by Council.

Action 3: Market the Airport as an Executive Airport

As noted in the City of Oshawa Economic Development Strategy ("O.E.D.S."), Oshawa's prime location coupled with a range of unique infrastructure assets provide the City a substantial competitive advantage within the G.T.H.A. Oshawa is one of few Canadian cities that boasts an airport, rail lines, a deep-water port and 400-series highways all within proximity to each other. This combination of transportation facilities provides importers and exporters in the City a multimodal competitive advantage. The Oshawa Executive Airport is a key component of that diverse mix of infrastructure; providing strategic growth opportunities aligned with executive air travel.

As noted in Section 5.13 of DS-21-44, part of the purpose of the 2015-2019 Airport Business Plan was to continue to strengthen the role of the Airport as an executive Airport and an economic asset to provide high quality aviation facilities that encourage economic growth and meet corporate aviation needs. It is appropriate to support and advance the role of the Airport as an executive Airport and an economic asset that is available to be used by the Oshawa and Durham business community. In this regard, marketing the executive function of the Airport and its operational ability to serve as an economic gateway for goods and services is a key action item that maintains and reinforces the City's ongoing strategic efforts.

Looking forward, staff will continue to work with the local business community, including the Greater Oshawa Chamber of Commerce, post-secondary institutions and major employers, to explore opportunities for corporate aviation growth at the Airport. As outlined in Section 2A of the O.E.D.S., key infrastructure optimization of assets such as the Oshawa Executive Airport represents a significant opportunity for the City.

Action 4: Advance Opportunities to Restrict Flight Training Schools

On October 15, 2019, City Council directed staff to, amongst other matters, specifically review issues concerning flight training with a view of reducing the amount of flight training aircraft traffic. Two key methods available to Council would be as follows:

Action 4A: Re-affirm for Transport Canada that the City of Oshawa is Formally Opposed to the Establishment of New Flight Training Schools at the Airport.

The City will continue to decline any requests for the issuance of new certificates related to flight training.

Action 4B: Investigate on Amendment to Zoning By-law 60-94 to Limit the Number of Flight Training Schools at the Airport.

Staff will investigate following the completion of legal proceedings with C.F.A.

Action 5: Complete Phase 2 of Air Quality and Noise Study

Phase 1 of the Air Quality and Noise Study for the Airport took place in 2019 and Phase 2 was initially delayed due to the restrictions caused by the COVID-19 pandemic. Phase two was subsequently completed in January 2022.

At its meeting of January 24, 2022, City Council considered Report DS-22-12, a report of the Commissioner of Development Services regarding the Oshawa Executive Airport Air Quality and Noise Study and passed the following resolution:

> "That, pursuant to Report DS-22-12 dated January 5, 2022, Development Services staff be directed to include the finalized Air Quality and Noise Study reports for Phases 1 and 2 of the study, as generally outlined in Report DS-22-12, as supplemental information in the City's forthcoming submission to Transport Canada

under the Advisory Circular AC-302-002 process for the establishment of new noise abatement procedures at the Oshawa Executive Airport."

The Air Quality and Noise Study reports for Phases 1 and 2 of the study were included in initial submission to Transport Canada under Action 6.

Action 6: Continue to Investigate Process to Establish New Noise Abatement Procedures and Restrictions

At its meeting of February 22, 2021, pursuant to Report DS-21-23 dated February 3, 2021, City Council authorized the then Commissioner of Development Services, in consultation with the City's Airport Manager, to advance the process prescribed in Advisory Circular 302-002 to request Transport Canada to establish a new noise abatement procedure at the Airport. Accordingly, staff undertook the process outlined in the Advisory Circular, including the engagement of a qualified consultant with familiarity of the requirements of the Advisory Circular process to assist staff in this regard.

At its meeting of March 28, 2022, City Council considered Report DS-22-67, a report of the then Commissioner of Development Services regarding the Draft Proposed Noise Abatement Procedures for the Oshawa Executive Airport and passed the following resolution:

1. "That, pursuant to Report DS-22-67 dated March 2, 2022, Council adopt the Proposed Noise Abatement Procedures for the Oshawa Executive Airport for the purposes of authorizing the Airport Manager to submit the Council-adopted Proposed Noise Abatement Procedures for the Oshawa Executive Airport and all supporting material to Transport Canada for their review, consideration and final approval as outlined in said Report in accordance with Transport Canada's Advisory Circular 302-002; and,
2. That the Mayor be authorized to send a letter on behalf of City Council to the Federal Minister of Transport to advise of the City's adoption of the Noise Abatement Procedures for the Oshawa Executive Airport and that the City looks forward to the Minister's support; and,
3. That copies of this Report and associated resolution be forwarded to all Oshawa and Whitby MPs and MPPs as well as to the Town of Whitby."

The report was submitted to Transport Canada on March 30, 2022 and items 2 and 3 were completed shortly thereafter. The Airport Manager subsequently received a request for additional information from Transport Canada 17 months after the original submission date. A response to Transport Canada will be prepared following the completion of legal proceedings with C.F.A.

Action 7: Explore New Technologies and the Use of Unleaded Fuels

On May 21, 2019, Council directed that the use of new technologies for aircraft noise reduction and the phase-out of the use of unleaded fuel be explored as part of the process to update the Airport Business Plan. As such, it is appropriate to determine the availability of noise reduction technologies and unleaded fuel options for aircraft.

HM Aero aviation consulting was retained to undertake an extensive industry review relating to new technologies and unleaded aviation fuel. The report included the following conclusions:

Aircraft Source Noise

1. The implementation of exhaust modifications approved as Supplemental Type Certificates (STC) on the flight training fleets based at the Airport represents the primary opportunity in the short term for the reduction of aircraft source noise.

2. Further review is required to identify the costs and benefits of these modifications. Consideration should be given to conducting outreach with Montreal Saint-Hubert Airport (Chabord exhaust modifications) and Embry-Riddle Aeronautical University (GOMOLZIG exhaust modifications) to explore their use in real world operations.

3. The potential adoption of exhaust modifications will be influenced by Transport Canada (STC) approval, the acquisition and installation costs of each system, and potentially the costs associated with additional aircraft maintenance. Implementation will likely require collaboration between the City, Airport Operator, and primary aircraft operators.

Unleaded Avgas Replacement Fuels

4. The Environmental Protection Agency (EPA) in the United States has determined that Tetra Ethyl Lead (TEL) emissions from aircraft cause or contribute to air pollution that may reasonably be anticipated to endanger public health.

5. Neighbourhood air quality studies commissioned by the City indicate that during the peak season for aircraft movements, monitoring identified low levels of all pollutants, and all measured levels were below the Ontario Ambient Air Quality Criteria, including airborne TEL.

6. Swift Fuels and GAMI have received STC approvals in the United States for their UL94 Unleaded Avgas and G100UL fuels, respectively, and work continues through the Piston engine Aviation Fuels Initiative (PAFI) and Eliminate Aviation Gasoline Lead Emissions (EAGLE) programs on drop-in unleaded replacement fuels.

7. UL94 Unleaded Avgas is already in use at numerous airports in the United States and has been adopted by the large-scale flight training departments of the University of North Dakota, Utah Valley University, and Purdue University. Given the suitability of UL94 Unleaded Avgas for lower performance flight training and general aviation aircraft that comprise the majority of the activity at the Airport, this may represent a short to medium-term opportunity for implementation.

8. Although UL94 Unleaded Avgas (soon to be joined by G100UL) is approved and in use in the United States, potential barriers to its implementation at Oshawa will include Transport Canada STC approval and the costs and logistics associated with new fuelling infrastructure, supply and distribution, and unit costs.

9. Reducing airborne TEL can be achieved through piston aircraft burning jet fuel, mogas, or lower quantities of avgas, such as the P2006T being integrated by Durham Flight Centre.

Electric Aircraft Propulsion

10. The consultant has idenitifed the potential benefits of electric aircraft may be considerable. Electric aircraft in circuit training could address one of the primary resident complaints regarding noise at the Airport, that being the repeated exposure to noise from high frequency overflights as circuits are conducted. Significant research, development, and regulatory maturation remains to be completed on certification requirements, charging infrastructure, and emergency preparedness, and future ion will be influenced by electric aircraft acquisition costs, performance, and mission suitability.

Attachment 1 is a copy of the complete HM Aero report.

Action 8: Continue to Advocate With Transport Canada for Increased Enforcement of Safety

At a special meeting of Council held on December 11, 2017, the Airport Manager was directed to send a letter to Transport Canada advising them that a number of neighbors have expressed concern with the height that aircraft are flying over their homes while landing and taking off at the Airport.

In correspondence dated February 21, 2018, Transport Canada responded to the Airport Manager on the matter of aircraft height restrictions operating at an Airport, noting that Transport Canada Civil Aviation Safety Inspectors will be visiting the Airport to observe circuit operations. A Transport Canada Inspector subsequently visited the Airport on September 6, 2018. The Inspector made observations from within the control tower and no irregularities were observed during the visit. City staff and the Airport Manager continue to advocate with Transport Canada for increased enforcement of safety and all safety concerns are immediately submitted to Transport Canada for consideration.

Action 9: Continue to Advocate With Federal and Local Elected Officials

Letters to the Federal Minister of Transport and Oshawa M.P.s and M.P.P.s were issued by the City pursuant to resolution DS-20-124 adopted by Council on October 26, 2020, requesting their support to address residents' concerns regarding noise, air quality and safety at the Airport. Given that there is now a new Federal Minister of Transport, it is appropriate that the City's request be re-sent by the Mayor, together with new details advising of Council's decision on February 22, 2021 to undertake the process identified by Transport Canada Aviation Advisory Circular 302-002 to establish noise abatement procedures and restrictions at the Airport. The Mayor re-sent the City's request as noted above.

Action 10: Initiate Review of Fees

The 2015-2019 Airport Business Plan included a review of Airport fees. It is appropriate to undertake a new review of fees at the Airport relative to the fees levied at other airports.This work was undertaken by the Airport Manager in consultation with city staff.

At its meeting of October 25, 2021, City Council considered Report FIN-21-91, a report of the Commissioner of Finance Services regarding the 2022 General Fees and Charges By-law Update and passed the following resolutions:

> "That as outlined in Report FIN-21-91 dated October 13, 2021, the changes to the General Fees and Charges By-law 13-2003 except the Airport Fees be approved and the amending General Fees and Charges By-law be passed which is generally shown in Attachment 1."
>
> "That Council adopt the recommendation contained in Item FIN-21-91 as it relates to Airport Fees."

Action 11: Update the 25 Year Capital Forecast through Annual Budget

The 2015-2019 Airport Business Plan included a 25 year capital forecast.The airport capital forecast is updated each year and is included in the City's capital management plan.

Action 12: Continue to Advance Recommendations of the Independent K.P.M.G. Airport Audit

Pursuant to Council's consideration of Report CNCL-20-66 dated May 20, 2020 regarding an independent Internal Audit of the Oshawa Executive Airport by K.P.M.G., five key recommendations were highlighted in the report and endorsed by Council as the general basis for improvements at the Airport (refer to Section 5.9 of DS-21-44). The City is presently engaged in an independent audit conducted by Deloitte. Upon completion, any recommendations will be integrated into the K.P.M.G. audit and incorporated to reflect changes by the end of Q4 of 2024. The City and Total Aviation and Airport Solutions Limited ("T.A.A.S.") will endeavour to amend the agreement once the audit is complete.

Action 13: 1997 Operating Agreement

On October 15, 2019, City Council adopted a motion (Item DS-19-183) directing staff to, among other matters, prepare an information report outlining the current status of the 1997 Operating Agreement for the Airport between the City and the Federal Government.

At its meeting of March 28, 2022, City Council considered Report DS-22-64, a report of the then Commissioner of Development Services regarding the 1997 Operating and Options Agreement for the Oshawa Executive Airport and passed the following resolution:

1. "That, pursuant to Report DS-22-64 dated March 2, 2022, the South Field and East Airport Accessible Trail lands as shown on Attachment 1 to said Report be deemed not necessary for the management, maintenance or operation of the Oshawa Executive Airport as an undertaking and as a result, Transport Canada be requested to amend the 1997 Operating and Option Agreement for the Oshawa Executive Airport to remove said lands from the area subject to the agreement; and,

2. That, pursuant to Report DS-22-64 dated March 2, 2022, the Mayor and Clerk be authorized to sign any necessary agreement required to give effect to Item 1 above; and,

3. That, pursuant to Report DS-22-64 dated March 2, 2022, staff be authorized, in consultation with the Airport Manager, to advance discussions with the appropriate representatives of the Federal Government with respect to various matters concerning the current framework and terms of the 1997 Operating and Option Agreement for the Oshawa Executive Airport, as generally outlined in Section 5.4 of said Report, and report back to the Development Services Committee on the results of those discussions."

Subsequent to March 28, 2022 and in consultation with Transport Canada, it was determined that the Thornton Rd. airport lands were also included in the 1997 Operating and Options Agreement and it is appropriate to consider the removal of these lands from the agreement. Staff will continue to investigate the removal of lands and will bring a report to Council in the future.

Action 14: Continue to Advance Public Communications on Airport Matters

Staff continue to advance opportunities to improve communications with the public on matters relating to the Airport as an ongoing practice. This includes a dedicated Airport News webpage and updating the Airport webpages and providing notification, as appropriate, of forthcoming reports on Airport matters. Additionally, community members and interested individuals are encouraged to subscribe to Airport News (Oshawa.ca/Subscribe) to receive email updates on Airport matters.

5.3 Oshawa Executive Airport Action Plan 2024

From the 14 action items outlined in Section 5.1, a total of 6 have been addressed. The outstanding items, as identified below, will carry forward to form the 2024 Oshawa Executive Airport Action Plan.

2024 Airport Action Plan

1. Continue to Advance an Appropriate Balance Between the Airport and the Residential Communities;
2. Continue to Defend the City's Interests in Legal Proceedings Involving Canadian Flight Academy Ltd;
3. Market the Airport as an Executive Airport;
4. Advance Opportunities to Restrict Flight Training Schools;

4A: Re-affirm for Transport Canada that the City of Oshawa is Formally Opposed to the Establishment of New Flight Training Schools at the Airport.
4B: Investigate an Amendment to Zoning By-law 60-94 to Limit the Number of Flight Training Schools at the Airport.

5. Continue to Investigate Process to Establish New Noise Abatement Procedures and Restrictions;
6. Continue to Advocate With Transport Canada for Increased Enforcement of Safety;
7. 1997 Operating Agreement.
8. Continue to Advance Recommendations of the Independent Audit.

6.0 Financial Implications

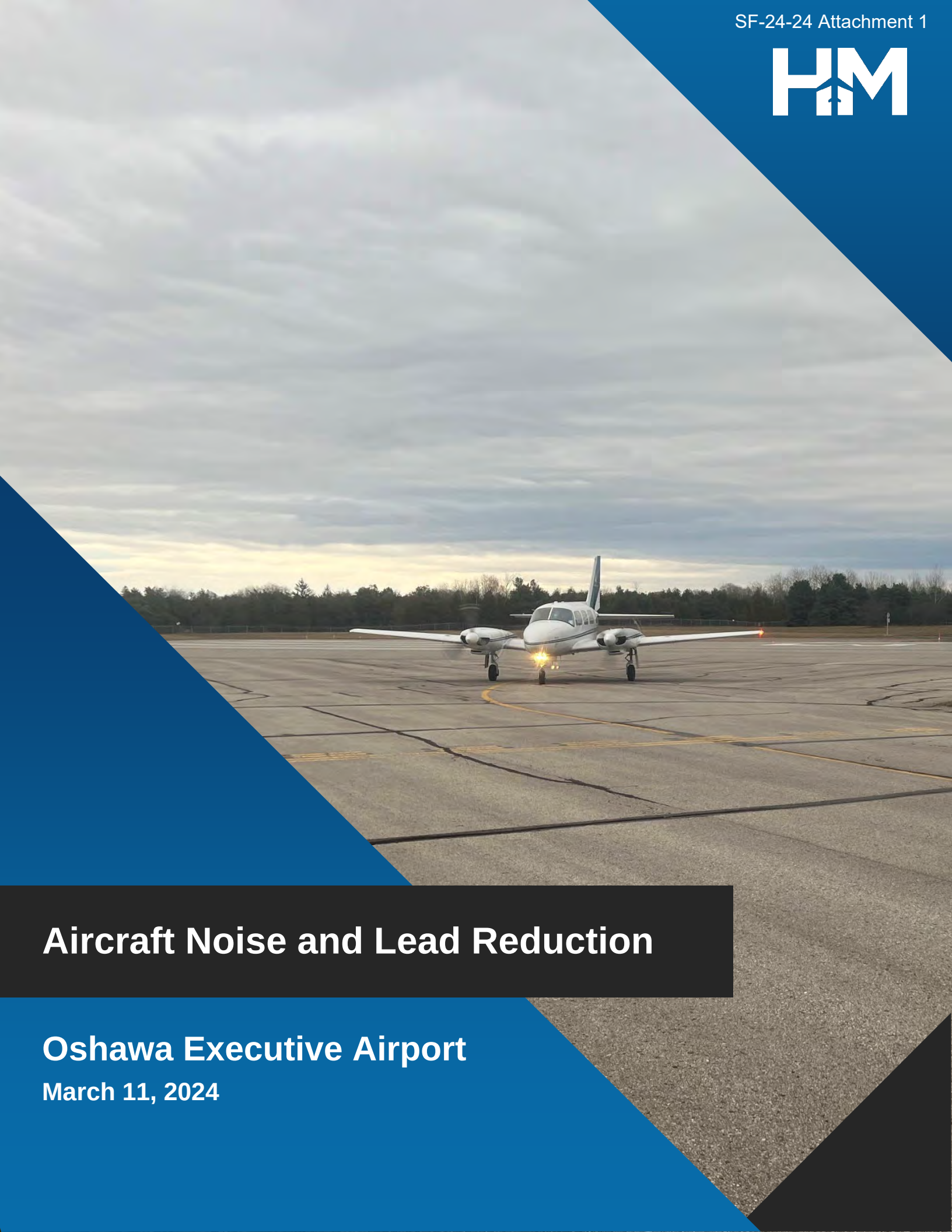
The estimated cost to remove certain lands from the 1997 Agreement is ±$12,000 and is primarily related to the cost of a property survey and appraisal of the lands.

7.0 Relationship to the Oshawa Strategic Plan

This report addresses the Oshawa Strategic Plan by responding to the goals of Economic Prosperity and Financial Stewardship, Environmental Responsibility and Accountable Leadership.

Adam Grant, Commissioner,
Safety and Facilities Services Department

SF-24-24 Attachment 1



Aircraft Noise and Lead Reduction

Oshawa Executive Airport

March 11, 2024

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1 INTRODUCTION

1.1 Background

Oshawa Executive Airport (the "Airport") is owned by the City of Oshawa (the "City") and operated by Total Aviation & Airport Solutions (the "Airport Operator"). A unique contextual factor that influences the operations and development of the Airport is the primarily residential land use context to the west, east, and south, with additional less extensive residential areas to the north. There are an estimated 14,000 residential dwellings in the immediate vicinity of the Airport that are exposed to the externalities of aircraft operations, including noise and the release of particulate matter from fuel combustion.

In recognition of the externalities of aircraft operations and their impacts to surrounding residents, the 2015-2019 Oshawa Executive Airport Business Plan included a commitment to ensure that the Airport is operated within the context of being a "Good Community Neighbour". The 2015-2019 Business Plan also established the goal that the Airport shall be:

> *"A leader in environmental stewardship including noise mitigation, wildlife management and energy conservation."*

With respect to aircraft noise, the International Civil Aviation Organization has adopted the Balanced Approach to Aircraft Noise Management that includes four principal elements:

1. **Reduction of Source Noise:** Limits on the noise of aircraft have been in place since the 1970s through Annex 16 of the Convention of International Civil Aviation. Transport Canada ensures compliance with applicable noise limits as part of the certification process for new aircraft.
2. **Land Use Planning:** Compatible land use planning involves appropriately separating noise-sensitive land uses, such as residential areas, from airports and associated aircraft noise. This involves delineating areas associated with current and anticipated future noise levels and enacting planning legislation that considers the sensitivity of each permitted use. In Canada, the Noise Exposure Forecast system is the primary means through which this planning is accomplished, implemented through municipal plans and bylaws.
3. **Noise Abatement Operational Procedures:** Changes that address the way aircraft are operated through the use of standardized procedures. Examples include noise preferential runways and avoiding overflights of noise-sensitive areas.
4. **Aircraft Type Operating Restrictions:** Prohibitions on the operation of select aircraft with high noise profiles.

The City has implemented several actions under the International Civil Aviation Organization's Balanced Approach to Aircraft Noise Management, including:

- The establishment of voluntary noise abatement procedures;
- The proposed establishment of mandatory noise abatement procedures under the authority of Canadian Aviation Regulation 602.105 pursuant to the process prescribed in Advisory Circular 302-002. These proposed procedures are currently before Transport Canada for the consideration of the federal government;
- The construction of three earthen berms to limit noise associated with ground operations;
- The preparation of Noise Exposure Forecast contours to guide land use planning; and
- The completion of noise and air quality monitoring studies in 2019 and 2021, discussed further in Section 3.1.

1.2 Objectives

The 2021-2022 Oshawa Executive Airport Action Plan further affirmed the City's commitment to being a Good Community Neighbour and included the following targeted actions with respect to noise and air quality management:

> ***Action 1: Continue to Advance an Appropriate Balance Between the Airport and the Residential Communities***
>
> *A common theme at the Town Hall and the virtual Workshops was the need to bring better balance of the operational aspects of the Airport with the quality of life of the residents in the surrounding community. The 2021-2022 Airport Action Plan will attempt to advance a better balance through the advancement of the Actions listed under Section 5.13 of this Report.*
>
> ***Action 7: Explore New Technologies and the Use of Unleaded Fuels***
>
> *On May 21, 2019, Council directed that the use of new technologies for aircraft noise reduction and the phase-out of the use of leaded fuel be explored as part of the process to update the Airport Business Plan. As such, it is appropriate to determine the availability of noise reduction technologies and unleaded fuel options for aircraft.*

The following Aircraft Noise and Lead Reduction Opportunities Synopsis (the "Report") has been prepared per Action 7 to:

1. Identify opportunities for aircraft source noise reduction;
2. Outline the efforts to develop alternatives to 100 Low Lead aviation fuel to achieve lead reduction or elimination;
3. Provide an overview of research, development, and certification activities with respect to electric aircraft propulsion; and
4. For each of the above-noted noise and air quality management opportunities, identify implementation considerations that will influence their future use at the Airport.

Given the predominance of single and twin piston-engine fixed-wing aircraft used in general aviation and flight training roles at the Airport, this Report is primarily focussed on opportunities for these aircraft fleets under the four synopsis objectives. Opportunities to address noise and air quality concerns from larger single and twin-engine fixed and rotary-wing turboprop and turbofan aircraft used in corporate, commercial, and emergency response roles are not identified as part of this Report.

2 AIRCRAFT SOURCE NOISE REDUCTION

Opportunities for the flight training and general aviation aircraft fleets used at the Airport to be retrofitted to achieve source noise reduction were reviewed, including exhaust modifications offered by European companies Chabord, GOMOLZIG, Liese / Bitz GmbH, and Mecanair. A preliminary review of opportunities to reduce the noise associated with propellers was completed; however, approved retrofits for the aircraft fleets most commonly used at the Airport were not identified. As new aircraft models enter the market with alternative propulsion sources (e.g., the Pipistrel Velis Electro discussed in Section 4.2.1), alternative propeller designs with lower noise profiles are anticipated to become more widely used. It is noted that Embry-Riddle Aeronautical University is reportedly conducting research on quieter propeller options for its single-engine Cessna flight training fleets, although results or implementation plans have not been made publicly available.

2.1 Chabord Exhaust Modifications

French company Chabord received Supplemental Type Certificate (STC)[1] approval from Transport Canada in 2017 for three exhaust modification systems for the single-engine Cessna fleets predominantly used in flight training at the Airport: Cessna 150 / Continental O-200; Cessna 152 / Lycoming O-235-L2C; and Cessna 172 / Lycoming IO-360-L2A. Chabord advertises that the systems decrease noise by 4 to 11 dB. The company also advertises that its systems increase climb rates by 14%, reduce fuel consumption by 8%, and decrease engine vibrations.

The Chabord exhaust modifications have been installed on the fleets of four Flight Training Units (FTUs) based at Montreal Saint-Hubert Airport. Data is not publicly available on the impacts of the exhaust retrofits in Saint-Hubert on noise levels.

2.2 GOMOLZIG Aircraft Services Exhaust Modifications

German company GOMOLZIG Aircraft Services has developed Quiet Flight, a muffler system designed to reduce the noise levels of general aviation aircraft. GOMOLZIG indicates that it holds an EASA STC for the Cessna 172S and numerous Cessna 182 models. The company's website also advertises Quiet Flight packages for the Cessna 150, 152, and 172.

GOMOLZIG advertises a 7-10 dB(A) reduction in aircraft noise with its system. This system has been implemented by Embry-Riddle Aeronautical University on its fleet of Cessna 172 aircraft at its Daytona Beach campus. Through testing by Embry-Riddle, it was found that the Quiet Flight system reduced Cessna 172 noise levels from 75 dB to 70 dB. The entire Daytona Beach fleet of 41 aircraft were retrofitted at an approximate total cost of $250,000 USD (approximately $6,100 USD per aircraft).

2.3 Liese / Bitz GmbH Exhaust Modifications

German company Liese, now owned by Bitz GmbH, advertises exhaust modification systems for the Cessna 150 and 172 series of aircraft. The mean noise level for the Cessna 150M with the modifications installed is 66.1 dB(A) and 70.1 dB(A) for the Cessna 172N. The systems offered by Liese hold EASA STCs. Limited information is available on the use of these systems internationally and whether Transport Canada STCs have been granted. Information on installation costs and operating requirements have not been found.

[1] A Supplemental Type Certificate is a document issued by Transport Canada to approve a change to the type design of an aeronautical product or products.

2.4 Mecanair Exhaust Modifications

Swiss company Mecanair has developed approved STCs for the Cessna 152 and 172 series of aircraft. The manufacturer advertises that *"These reduce the noise pollution by several dB…"* although a reduction metric is not provided. Limited information is available on the use of Mecanair's system, installation costs, operating requirements, and its approval status in Canada.

2.5 Implementation Considerations

The use of retrofitted source noise reduction technologies on aircraft based at the Airport to address noise concerns is influenced by the following implementation considerations:

- **Noise Impacts:** Further research is required to better understand the noise impacts from the use of the technologies described above, which will influence whether one or more options are worth pursuing from a benefits perspective. Previous trials at the Airport indicated that these systems appeared to change the pitch of the sound emitted from aircraft engines, rather than reducing overall noise levels.
- **Certification:** Only the Chabord exhaust modification has received STC approval from Transport Canada. The use of retrofits from other manufacturers will require STC approval.
- **Acquisition Costs:** FTUs seeking to retrofit their fleets with source noise reduction technologies will encounter costs associated with product acquisition and installation. The costs associated with the Chabord exhaust modification system, for example, were approximately $3,900 USD in 2012. The GOMOLZIG costs per aircraft for Embry-Riddle Aeronautical University were estimated at $6,100 USD.
- **Additional Maintenance Requirements:** Operators may encounter additional maintenance requirements for the inspection, repair, and replacement of exhaust modifications. The Chabord exhaust, for example, must be removed every 60 hours to replace the sound proofing material. The exhaust is either 1) sent to the company's facilities in France for disassembly, inspection, and replacement of the sound proofing; or 2) a sound proofing replacement kit is ordered from the manufacturer and installed by a local Aircraft Maintenance Engineer.

3 AIRBORNE LEAD REDUCTION

100 Low Lead aviation fuel (100LL or “avgas”) is used by the single and twin piston-engine aircraft operating at the Airport in general aviation and flight training roles. Avgas production includes the addition of Tetraethyl Lead (TEL) to boost octane and limit detonation in piston aircraft engines. With regulatory changes and the significantly reduced use of TEL in other fuel products (e.g., automotive fuel), avgas is now the only leaded fuel that remains in large-scale production.

Airborne lead poses risks to human and environmental health. Given the proximity of residential land uses to the Airport, the dispersion of lead from the combustion of avgas is therefore an area of concern. Profiled herein is a summary of the efforts to develop a drop-in[2] unleaded replacement for avgas underway in the United States and Canada and a discussion of potential implementation considerations applicable to the Airport.

3.1 City of Oshawa Airport Air Quality Monitoring

As noted in Section 1.1, the City commissioned air quality studies in 2019 and 2021. In the 2019 air quality study[3], four high-volume air sampling monitoring units were installed near each runway threshold, with data collection occurring between July 4, 2019 and September 22, 2019. The report notes that the selected locations were expected to have the greatest concentration of aircraft related pollutants. The study did not identify any exceedances of the Ontario Ambient Air Quality Criteria, and the report notes that the monitoring showed very low levels of all pollutants. Significant differences between the four stations (i.e., four runways) were not identified, suggesting that the greatest impact on air quality was from ambient background levels / concentrations. The average concentration of airborne lead (0.011 µg/m³) was noted to be less than the 2001 measurement by the Ministry of the Environment, Conservation and Parks, although more recent data was not noted to be available for comparison.

The 2021 air quality study[4] involved the installation of five air quality monitoring units at locations under flight paths in the residential neighbourhoods surrounding the Airport (Bermuda Park, Deer Valley Park, Marigold Avenue, Somerville Street, and Woodlea Crescent). Air pollutant concentrations at these five locations were deemed by the consultant to be representative of the impacts experienced in the surrounding community. Monitoring occurred between July 8, 2021 and September 10, 2021. As with the 2019 study, the 2021 study did not identify any exceedances of the Ontario Ambient Air Quality Criteria, and the average concentration of airborne lead (0.002 µg/m³) was noted to be less than the 2001 measurement by the Ministry of the Environment, Conservation and Parks. Therefore, the consultants indicated through the 2021 air quality study that during the peak summer season for aircraft movements, monitoring identified low levels of all pollutants, and all measured levels were below the Ontario Ambient Air Quality Criteria.

[2] A drop-in fuel is one that can be used with no permanent modifications or retrofits to aircraft systems.
[3] RWDI Consulting Engineers and Scientists. (2020, October 28). Oshawa Executive Airport Air Quality Monitoring, Oshawa, Ontario – Ambient Monitoring (RWDI #1903663).
[4] RWDI Consulting Engineers and Scientists. (2022, January 2). Oshawa Executive Airport, Oshawa, Ontario – Ambient Air Quality Monitoring (RWDI #2104007).

3.2 United States Unleaded Avgas Replacement Efforts

3.2.1 Unleaded Avgas Transition Aviation Rulemaking Committee

The Unleaded Avgas Transition Aviation Rulemaking Committee (UAT ARC) charter was signed by the Federal Aviation Administration (FAA) in January 2011 to investigate the issues associated with transitioning to an unleaded replacement for avgas and prepare recommendations for overcoming these obstacles. Represented on the UAT ARC were representatives from the government; aircraft manufacturers; aircraft operator groups; and fuel developers, producers, and distributors.

The final report of the UAT ARC was issued in February 2012, culminating in five main recommendations:

1. The creation of the Fuel Development Roadmap – Avgas Readiness Levels, a series of milestones in the aviation fuel development process, including the identification of the information needed to support the assessment of candidate replacement fuels;
2. That potential unleaded fuels be evaluated in a standardized manner at the FAA William J. Hughes Technical Center with government and industry involvement;
3. The establishment of a solicitation and selection process for a centralized fuel testing program;
4. That an FAA centralized certification office be established and resourced; and
5. The establishment of the Piston Aviation Fuels Initiative, discussed further in Section 3.2.2.

The UAT ARC therefore culminated in a roadmap identifying the critical elements that would be required to support the development and certification of unleaded replacement fuels.

3.2.2 Piston Aviation Fuels Initiative

The Piston Aviation Fuels Initiative (PAFI) was launched in 2012 as one of the recommendations of UAT ARC as a collaborative government-industry effort to develop and deploy unleaded replacements for avgas with the least impact on the existing piston-engine aircraft fleet. At a high level, PAFI was intended to serve as a process for the identification, evaluation, and deployment of the highest potential unleaded avgas replacement fuels and to support fleetwide authorization by the FAA. PAFI included a two-phase testing program:

1. **Phase 1** testing was designed to assess candidate fuels for high-impact issues in production, distribution, and operation prior to significant investments in pursuing approval. This phase included the evaluation of the chemistry of candidate fuels and suitability for their intended purpose; assessing emission and toxicology properties; evaluating production and distribution abilities; and verifying whether fuels will perform in the existing fleet of engines and aircraft.
2. **Phase 2** testing was completed on successful Phase 1 candidate fuels through an engine and aircraft flight testing program.

Major PAFI milestones have included:

- **June 2013:** The FAA invites candidate manufacturers to submit fuels to be assessed;
- **July 2014:** A total of 17 candidate replacement fuels from 6 proponents were submitted
- **September 2014:** 4 candidate fuels from 3 proponents (Shell – 1, TOTAL – 1, Swift Fuels – 2) were selected for the Phase 1 test program;
- **March 2015:** Phase 1 laboratory and engine testing begins; and
- **March 2016:** The FAA selects Shell and Swift Fuels to begin Phase 2 testing.

The objective was that PAFI would culminate in the completion of Phase 2 testing and the selection of one or more unleaded replacement fuels in 2018. However, the comparative differences between the Phase 1 and 2 PAFI fuels and avgas resulted in the identification of issues needing resolution, requiring that ground and flight testing be paused. Swift Fuels withdrew its candidate fuel from PAFI Phase 2 in August 2018 to pursue approval outside of the program (Section 3.2.5). In July 2019, it was announced that Shell's candidate fuel had been deemed unsuccessful by the FAA. Work under PAFI is continuing as part of the Eliminate Aviation Gasoline Lead Emissions program described in Section 3.2.3 and new candidate fuels have been invited to the process. This includes partnerships between Afton Chemical / Philips 66 and LyondellBasell / VP Racing, each of which have developed high-octane avgas replacements (Section 3.2.5).

3.2.3 Eliminate Aviation Gasoline Lead Emissions

In February 2022, the Eliminate Aviation Gasoline Lead Emissions (EAGLE) program was announced by the FAA as a new government-industry partnership to introduce unleaded avgas replacement fuels. The program is designed to leverage government-industry relationships developed through PAFI, with PAFI integrated as one of the four pillars of EAGLE. EAGLE is intended to work towards the transition to lead-free aviation fuels for piston-engine aircraft by the end of 2030 through four focus areas:

1. Regulatory and Policy (FAA-led);
2. Unleaded Fuel Testing and Qualification (FAA-led);
3. Research & Development (industry-led); and
4. Business Infrastructure and Implementation (industry-led).

3.2.4 Environmental Protection Agency Endangerment Finding

Following several years of investigation, in October 2023 the U.S. Environmental Protection Agency (EPA) released its final determination that lead emissions from aircraft engines cause or contribute to air pollution that may reasonably be anticipated to endanger public health and welfare. The EPA notes that scientific evidence demonstrates that low levels of lead in children's blood can have harmful effects on cognitive function, including reduced IQ and decreased academic performance. The EPA also states that there is no evidence of a threshold below which there are no harmful effects on cognition in children from lead exposure, and that piston-engine aircraft are the largest single source of airborne lead emissions in the United States, contributing 70% of the lead entering the air annually.

The October 2023 endangerment finding does not:

- Impose restrictions on the use or availability of avgas;
- Establish new control measures regarding aircraft lead emissions; or
- Impose requirements on anyone other than EPA and the FAA.

The EPA now has a duty to propose regulatory standards for aircraft lead emissions, and the FAA is required to prescribe standards for the composition or chemical and physical properties of aircraft fuel to control or eliminate lead emissions. The future action required of the EPA and FAA, including the development of regulations for an unleaded avgas replacement, could take multiple years.

3.2.5 Adoption of Unleaded Avgas Replacement Fuels

Table 3.1 summarizes the status, as of March 2024, of the adoption of unleaded avgas replacement fuels by four manufacturers.

Table 3.1 - Unleaded Avgas Replacement Adoption Summary

Manufacturer	Fuel	Approval Status	Usage
Swift Fuels	94UL – 94 Octane	U.S. STC approval received for select aircraft and engines Not approved by Transport Canada	Available at over 30 airports in the United States and in use by 3 university flight programs Suitable for smaller single and twin-engine aircraft with low compression engines
	100R – 100 Octane	Pursuing STC approval	
General Aviation Modifications Inc.	G100UL – 100 Octane	U.S. fleetwide STC approval received Not approved by Transport Canada	Not in widespread use, initial deployment in California expected in 2024
LyondellBasell / VP Racing	UL100E – 100 Octane	Proceeding through PAFI process, moving into full-scale testing in 10 engines and 8 aircraft	
Afton Chemical / Philips 66	100M – 100 Octane	Proceeding through PAFI process, testing paused in January 2024 due to issues encountered	

Swift Fuels

Swift Fuels has developed a 94-octane unleaded fuel (UL94) that can be used in about half to two thirds of the piston-engine aircraft fleet and is limited to lower performance aircraft (e.g., smaller single and twin-engine aircraft used in flight training, general aviation, and other commercial purposes). Swift's UL94 product shares the same basic chemistry as 100LL with the difference being that TEL is not included as an additive.

Swift Fuels has received STC approval from the FAA for its UL94 fuel, and eligible aircraft owners can purchase the STC from the company for $100 USD. The STC is limited to the addition of fuelling information placards and involves no modifications to aircraft systems. Over 30 airports and Fixed-Base Operators in the United States have UL94 available for purchase, in addition to numerous private users. Three university flight training programs have adopted UL94 in their fleets: the University of North Dakota, Utah Valley University, and Purdue University. UL94 can commingle with avgas; however, separate fuel storage facilities are required at airports to prevent misfuelling for higher performance aircraft. The Swift Fuels UL94 STC is not currently authorized by Transport Canada.

While Swift Fuels' UL94 has been expanding in its use in the United States, in February 2024 the University of North Dakota announced that it would be switching back to 100LL due to valve-related problems with engines using UL94 after three months of exclusive use. Work is underway at the time of this Report's preparation by the University of North Dakota, Swift Fuels, and the engine manufacturer to identify specific causes of damage and identify a path forward.

Swift Fuels is also developing and testing a higher octane 100R unleaded fuel for aircraft that cannot use the lower octane UL94 fuel.

General Aviation Modifications Inc.

General Aviation Modifications Inc. (GAMI) has developed a 100-octane unleaded fuel (G100UL). Unlike the Swift Fuels UL94 product, the GAMI G100UL fuel has received FAA STC approval for virtually all piston-engine aircraft, positioning the product as a drop-in replacement for avgas. STC approval was initially granted by the FAA in July 2021 for lower-compression engine and airframe combinations. Full-scale fleet approval was granted in September 2022, covering every spark ignition piston engine and every airframe using a spark ignition piston engine in the FAA's Type Certificate database. The G100UL STC is not currently authorized by Transport Canada.

Sales of G100UL are planned to begin in California in 2024. Wide-scale commercial adoption may be a protracted process due to the small size of GAMI as a company, the process associated with spooling up production, and the limited arrangements to-date with major fuel distributors.

LyondellBasell / VP Racing

Testing by LyondellBasell / VP Racing continues as part of PAFI and EAGLE, and in November 2023 it was announced that their candidate fuel had passed initial durability testing and was moving into the next phase of testing, involving engine and airframe testing with 8 aircraft and 10 engines. This phase of testing is expected to take 12 to 18 months.

Afton Chemical / Philips 66

Afton Chemical / Philips 66 is proceeding through the PAFI / EAGLE process for a 100-octane unleaded fuel. In January 2024, the Afton Chemical / Philips 66 partnership announced that their unleaded avgas evaluation process has been paused due to issues encountered during testing.

3.3 Canadian Unleaded Avgas Replacement Efforts

Avgas is exempted in Canada from regulatory requirements pertaining to the use of lead until a suitable unleaded replacement fuel is found, with the recognition of the widespread use of piston-engine aircraft reliant on avgas in numerous critical capacities. The primary developments with respect to the adoption of unleaded avgas replacement fuels in Canada are summarized as follows:

- **Piston Aviation Fuels Initiative:** The National Research Council Canada (NRC) is a member of the PAFI Technical Advisory Committee through the sponsorship of Transport Canada and Environment and Climate Change Canada. The NRC is involved from an information-gathering and research capacity – the organization isn't directly involved in developing unleaded fuels but participates to maximize its awareness and knowledge. The NRC's involvement in supporting the research on unleaded aviation fuels through PAFI has included:
    - Developing its Testbed for Aviation Piston Engine Research (TAPER) at its Research Altitude Test Facility. TAPER has been used to test unleaded fuels in simulated atmospheric environments and understand engine performance, operability, and emissions. The fuel-injected and turbocharged Continental TSIO-520VB engine was used in the TAPER unit as one of the worst-case engines for detonation at altitude. As part of PAFI, TAPER was used to test avgas and two candidate unleaded fuels by Swift Fuels and Shell; and
    - Supporting fuel research in-flight with its Harvard Mk IV testbed aircraft, the only radial engine aircraft in the PAFI fleet. Flight testing was planned as part of PAFI in 2017-2018.
- **Eliminate Aviation Gasoline Lead Emissions:** Representatives from the Government of Canada and NRC attended the March 2022 stakeholder briefing on EAGLE. No further involvement has been announced regarding the participation of the Government of Canada and / or NRC in EAGLE efforts beyond information gathering and awareness.

Future involvement by the NRC in unleaded fuel testing under PAFI and EAGLE is subject to the allocation of funding and the provision of a mandate by the Government of Canada, likely through Transport Canada, Health Canada, and / or Environment and Climate Change Canada. Public announcements have also not been made of the Government of Canada's internal research or strategy, if any, on unleaded fuels.

3.4 Alternative Fuels and Reduced Fuel Consumption

Piston engine aircraft that use avgas represent the largest proportion of general aviation and flight training aircraft based at the Airport, including aircraft types such as the Cessna 150 / 152, Cessna 170 / 172, and Piper PA-28. Until unleaded avgas replacement fuels become commercially available and viable for the Airport's users, an additional opportunity for the reduction of airborne TEL emissions is the replacement of legacy fleets with new aircraft that have lower avgas consumption levels or that use fuels other than avgas, such as Jet A-1 ("jet fuel") and 93-octane mogas. Avgas has a maximum of 0.56 g of TEL per litre (2.12 g per U.S. gallon); accordingly, decreasing the amount of avgas consumed through the use of jet fuel, mogas, or more fuel efficient engines has a corresponding impact on TEL emissions.

New (factory built) aircraft are being introduced that burn jet fuel instead of avgas, with the advantage being that TEL is not included in jet fuel. Due to the widespread availability of avgas in Canada and the United States, jet fuel powered piston engine aircraft have seen limited adoption, although the European market is seeing increased adoption with decreased avgas availability. Examples of new piston engine aircraft being produced for general aviation and flight training purposes include the:

- Single-engine, four-seat Diamond DA40 NG, Piper Archer DX, and Tecnam P2010;
- Single-engine, five-seat Diamond DA50 RG; and
- Twin-engine Diamond DA42 (four-seat) and DA62 (seven-seat).

Aircraft capable of burning jet fuel are also candidates for Sustainable Aviation Fuel (SAF) use in the future. SAF is a liquid fuel that reduces carbon dioxide emissions by up to 80% compared to standard fuels and can be produced from sources such as waste oil and fats, green and municipal waste, and non-food crops. Leading SAF fuel candidates are designed to be operationally equivalent to jet fuel, making SAF a drop-in replacement for jet fuel.

New general aviation and flight training piston engine aircraft are also being produced that achieve TEL reductions through reduced avgas consumption. Durham Flight Centre, one of two FTUs located at the Airport, is in the process of integrating the twin-engine Tecnam P2006T into its fleet for multi-engine training as a replacement for the Piper PA-23-250 Aztec. The P2006T has an advertised fuel consumption of 9 gallons (34 litres) per hour, versus the 28 gallons (106 litres) per hour of the Piper PA-23-250 currently used for multi-engine training[5]. This represents a reduction in the amount of TEL emitted per hour of 40.32 g, or a decrease of 68%. Durham Flight Centre intends to operate the P2006T using 93-octane mogas, a vehicle fuel that is approved for use in select piston engine aircraft instead of avgas. As mogas is unleaded, this will further contribute to airborne TEL reductions at and in the vicinity of the Airport.

[5] Tecnam P2006T fuel burn is as advertised by Tecnam. Piper PA-23-250 fuel burn is as reported by the Aircraft Owners and Pilots Association at 75% power in standard conditions.

3.5 Implementation Considerations

The future use of unleaded avgas replacement fuels at the Airport to address air quality concerns is influenced by the following implementation considerations:

- **Certification:** Transport Canada has not yet recognized the STCs granted by the FAA for the two unleaded avgas replacement fuels on the market (Swift Fuels UL94 and GAMI G100UL). Canadian STC approval will be required prior to the adoption of either or both fuels at Oshawa. Further, a timeline does not exist for the potential American approval of one or more drop-in unleaded fuels through the PAFI and EAGLE processes which would also require Canadian authorization.
- **Fuel Supply and Distribution:** UL94 and G100UL are both retailed by non-integrated fuel producers and do not benefit from the robust supply and distribution networks in place for avgas and jet fuel. Further investigation will be required with Swift Fuels and GAMI on the considerations associated with the supply of unleaded fuels from the production facilities of both companies to Oshawa. This challenge may be exacerbated if other airports in southern Ontario do not initially participate in the sale of unleaded fuels, positioning Oshawa as a sole cross-border market for Swift or GAMI and potentially influencing future agreements.
- **Fuelling Infrastructure:** If UL94 is to be offered for general sale by the Airport Operator or private retailers at the Airport, an additional fuel storage tank(s) will be required to complement existing avgas and jet fuel tanks to prevent mixing, as UL94 is not a drop-in replacement. This may also require an additional fuel bowser(s) and into-plane fuelling infrastructure. Each additional piece of fuelling infrastructure comes with associated capital and operating costs, a well as training for line crew and preventative measures to limit misfuelling. As G100UL is a drop-in fuel, separate fuelling infrastructure would not be required.
- **Fuel Cost:** It is anticipated that UL94 and G100UL may be more expensive on a per litre basis compared to avgas, raising aircraft operator costs.
- **Replacement Aircraft Costs:** The introduction of general aviation and flight training piston engine aircraft that use jet fuel or burn reduced quantities of avgas poses a challenge in terms of their purchasing costs versus the continued operation of legacy aircraft fleets.

4 ELECTRIC AIRCRAFT PROPULSION

The use of aircraft with electric propulsion represents an opportunity to reduce noise levels, greenhouse gas emissions, and TEL emissions associated with the current fleets of piston-engine aircraft. Given the capabilities of current electric aircraft, the expected path of technological maturation, and limitations such as battery power density, it is anticipated that the early adoption of electric aircraft will be seen in smaller single-engine flight training, other commercial, and general aviation aircraft fleets. As of March 2024, there are no certified electric aircraft in Canada. Significant work is underway by various organizations and manufacturers to advance this form of propulsion towards adoption.

4.1 Developments by Organization

4.1.1 Transport Canada

Light Sport Aircraft Flight Training Study

In November 2022, Transport Canada issued a call for proposals from FTUs interested in participating in operational trials to assess the use of Light Sport Aircraft (LSA)[6] in the flight training environment. Section 406.32 of the Canadian Aviation Regulations limits FTUs to the use of aircraft that have been issued a Certificate of Airworthiness. Transport Canada's objective through this study is to determine whether the type of training aircraft used by flight schools can be broadened to include those for which a European Union Aviation Safety Agency Certification Specifications – LSA type certificate and Special Certificate of Airworthiness – Limited[7] have been issued.

Although the focus of this program is to evaluate the use of LSA in flight training more broadly, this program includes the assessment of electrically propelled LSA. The Pipistrel Velis Electro (Virus SW 128) is the sole electric LSA currently being considered for an exemption to Section 406.32 as part of this study. The study will consider the suitability of these aircraft in flight training operations.

At the time of this Report's preparation, two FTUs have integrated the Pipistrel Velis Electro in their fleets under Specific Certificates of Airworthiness – Limited: Waterloo-Wellington Flight Centre and Sealand Flight. Developments by both entities are discussed further below.

This program is expected to result in progress in the development of the regulatory environment needed to facilitate electric propulsion in flight training aircraft, in absence of such standards today. This may also assist in better understanding the benefits of electric aircraft as far as their externalities are concerned, including noise and air pollution, and will help both government and industry better grasp their suitability for making progress on these objectives.

Certification

Transport Canada will be the entity responsible for developing the certification environment for electric aircraft propulsion, and as noted previously has been engaged with entities such as the NRC and Harbour Air in this respect.

[6] Using the definition established by the European Union Aviation Safety Agency, LSA are simple two-seat aircraft with a maximum take-off weight of 600 kg. LSA are generally subject to less stringent regulatory requirements.
[7] An aircraft eligible for a Special Certificate of Airworthiness - Limited is an aircraft which has been serially and commercially manufactured to a distinct and definable type description; and is not of a model for which a type certificate has been issued or accepted by Transport Canada, or for which an application for type approval has been submitted to Transport Canada.

4.1.2 National Research Council Canada

In 2019, the NRC's Aerospace Research Centre partnered with the Energy, Mining, and Environment Research Centre, Design and Fabrication Services, and Construction Research Centre to convert a Cessna 337 to hybrid electric power through its Hybrid Electric Aircraft Testbed (HEAT) program. The HEAT initiative is part of the NRC's broader Low Emission Aviation Program. The NRC's Cessna 337 has had its rear piston engine removed and replaced with an electric motor, battery, and supporting systems. This aircraft is being used by the NRC and their partners to explore the requirements and feasibility of electric aviation, with the hybrid propulsion approach used offering an improved platform given the limited usable range of existing all-electric aircraft.

The first hybrid-electric flight of the HEAT Cessna 337 occurred in February 2021, and as of early April 2022 five test flights had been completed with the longest being 32 minutes. The data being collected through the HEAT program is being shared with Transport Canada to assist in developing the certification structure for future electric aircraft.

4.1.3 Waterloo-Wellington Flight Centre

In June 2021, the Waterloo Institute for Sustainable Aeronautics (WISA) was formed under the University of Waterloo with the mission *"To be the world's leading hub for sustainable aeronautical research, technology, and education."* WISA builds on the University of Waterloo's post-secondary professional pilot training completed with the Waterloo-Wellington Flight Centre (WWFC).

In November 2022, the University of Waterloo and WWFC jointly announced the delivery of the first Pipistrel Velis Electro in Canada. Together, WISA and WWFC intend to use their Velis Electro to support fulsome research into the considerations associated with introducing electric aircraft to flight training operations. This partnership is unique in that it will combine the academic and research strengths of WISA / the University of Waterloo with the flight training and operational experience of WWFC. A second Pipistrel Velis Electro has recently been delivered to WWFC.

WWFC is part of the above-noted Transport Canada trial program for electric LSA in a flight training environment. Through online updates issued by WISA, the following preliminary insights have been made based on testing to-date with the Velis Electro:

- Findings released in January 2024 following acoustic testing indicated that the Velis Electro has reduced noise levels during the takeoff and landing phases of flight when compared to conventional aircraft. A testing station installed at the end of a runway under a departure path indicated that three Velis Electro flights had a typical sound level of 20-22 dB, while overflights by piston engine Cessna aircraft had a typical sound level of 50 dB;
- Testing in cooler weather had a small impact on battery discharge rates, reducing flight endurance by a couple of minutes. However, battery charging at lower temperatures increased the length of time required for charging, necessitating the use of a battery pre-heater; and
- Through testing completed over 65 traffic circuits conducted during summer months, 5 to 7 circuits were typically completed per flight with an average flight time of 54 minutes and average airtime of 40 minutes.

4.1.4 Sealand Flight

In February 2024, Campbell River-based Sealand Flight received its first Pipistrel Velis Electro for flight training purposes. Charging infrastructure is being developed at the FTU's bases in Courtenay, Powell River, and Qualicum Beach, and the first flight of the aircraft is planned for March 2024. Sealand Flight is participating in the aforementioned Transport Canada research project; in combination with the testing being completed by WISA and WWFC, these efforts should contribute to the industry understanding of the use of electric aircraft in flight training.

4.1.5 Harbour Air

British Columbia-based Harbour Air in 2019 announced a partnership with Washington-based magniX, to retrofit a DHC-2 Beaver as a fully electric commercial aircraft. The overarching goal of the operator is to convert its entire fleet of over 40 aircraft to electric propulsion. The first flight of Harbour Air's ePlane occurred in December 2019. Progress since that point as of April 2023 has included:

- The completion of over 70 test flights;
- The first point to point flight from Vancouver to Victoria in August 2022;
- The commencement of work on the second prototype as its certification aircraft (ePlane 2.0);
- The selection of a four-blade Hartzell composite propeller to improve performance and reduce noise; and
- The commencement of work with Transport Canada to establish the path towards certification of its ePlane, as well as the FAA and EASA for Harbour Airport's project partners.

In an update shared by Harbour Air in April 2023, the following next steps were identified:

- Installing a new electric propulsion unit to meet higher reliability requirements;
- The completion of a ground running certification prototype;
- The first flight of ePlane 2.0, planned for 2024; and
- Certification of the battery components and new propulsion unit in mid 2025.

4.2 Developments by Manufacturer

A review is provided of the activities of Original Equipment Manufacturers that are leading efforts in the research and development of flight training and general aviation category electric aircraft: Pipistrel, Diamond Aircraft, Piper Aircraft, and Bye Aerospace. This excludes the activities of companies that are pursuing the electrification of larger regional and Vertical Takeoff and Landing aircraft, such as Heart Aerospace and Joby Aviation.

4.2.1 Pipistrel

Pipistrel is a Slovenian-based light aircraft manufacturer that was established in 1989. Pipistrel is one of the leading researchers and manufacturers of electric aircraft, with examples including the Alpha Electro, Apis Electro, Taurus Electro, Taurus G4, WATTsUP, and Velis Electro. The Alpha Electro is certified by Transport Canada in the advanced ultralight category, and the Velis Electro is certified by EASA. The Velis Electro was granted an LSA airworthiness exemption by the FAA in March 2024, allowing FTUs in the United States to operate the aircraft as part of their training programs.

A single Pipistrel Alpha Electro is registered to an owner in British Columbia, and Velis Electros have been delivered to WWFC / WISA and Sealand Flight. Early steps have been taken to introduce electric aircraft produced by Pipistrel in the flight training environment. Green Aerolease in France has ordered 50 Velis Electro aircraft that will in turn be leased to various FTUs, and Green Airside of the UK has ordered 50 aircraft for a similar implementation strategy. The Green Flight Academy, based in Sweden, has a fleet of 3 Velis Electros that is used as part of recreational and professional pilot training; the Velis Electro is used for approximately 30% of student hours, with the remaining hours flown using traditional piston-engine aircraft.

In 2022, Pipistrel was acquired by leading US aircraft manufacturing company Textron and will be operated under Textron eAviation. This acquisition is expected to accelerate the pace of electric aircraft research and development by providing Pipistrel with access to the broader resources and expertise of Textron.

4.2.2 Diamond Aircraft

Diamond Aircraft is pursuing the development and certification of the eDA40, an electric propulsion derivative of the four-seat DA40. The eDA40 is being specifically marketed for circuit training given the limitations of battery endurance. Diamond advertises a fast-charging system that will reportedly be capable of turning around a depleted aircraft in under 20 minutes with a flight time of up to 90 minutes. The first flight of the eDA40 was completed in July 2023 and at that time, certification was expected at the end of 2023 or beginning of 2024. To-date, certification has not yet been received.

4.2.3 Piper Aircraft

In July 2022, CAE and Piper Aircraft jointly announced a partnership to develop an STC for the conversion of the Piper PA28-181 to electric propulsion, as well as the development of a new electric powered version of the aircraft. The electrification STC is part of Project Resilience, a $1B innovation funding partnership between CAE, the Government of Canada, and the Government of Quebec. Limited information on the status of the electrified Piper PA28-181 program has been made available since its announcement in August 2022, and no timelines are available for its entry into service.

4.2.4 Bye Aerospace

Bye Aerospace has been pursuing its eFlyer program since 2014 to bring a two-seat eFlyer 2 and four-seat eFlyer 4 to the market as certified aircraft. The eFlyer 2 is the platform intended for use in flight training operations. The company advertises a three-hour endurance for the aircraft and lists the eFlyer 2 at a base price of $489,000 USD. Flight testing is underway, and Bye Aerospace filed its application to the FAA for certification as a “Normal Category” electric aircraft in April 2018 under FAA Part 23. Certification as of January 2024 is estimated to occur in 2025.

British Columbia-based Elibird aero has placed deposits on two eFlyer 2 aircraft that it intends to use for flight training in the Lower Mainland. As of January 2024, Bye Aerospace has received orders for 889 eFlyer 2 and eFlyer 4 aircraft, with an estimated value of $570M.

4.3 Implementation Considerations

The use of electric aircraft in flight training and general aviation operations at the Airport will be subject to the following implementation considerations:

- **Noise Impacts:** Further research is expected to be required on the noise impacts of electric aircraft. While electric propulsion addresses combustion noise, noise will continue to be generated by the rotation of the propeller and the movement of air over the airframe.
- **Certification:** All aircraft used in flight training operations will require certification and approval by Transport Canada, or a regulatory exemption. Currently, the Pipistrel Alpha Electro is the sole electric aircraft certified in Canada – however, it is under the advanced ultralight category. While research activities involving both government and industry are ongoing, a clear path for the certification of this nascent technology or regulatory standards has not been established.
- **Acquisition Costs:** FTUs seeking to integrate electric aircraft in their fleets must contend with the capital costs associated with their acquisition and operational start-up. This includes the airframe and supporting infrastructure acquisition costs (e.g., the acquisition costs for the WISA / WWFC Pipistrel Velis Electro were approximately $290,000), Certified Flight Instructor and Aircraft Maintenance Engineer training, and spare parts.

- **Performance / Mission Suitability:** Based on the performance of in-service aircraft such as the Pipistrel Velis Electro and battery energy density limitations, it is expected that the early use of electric aircraft in the flight training context will be limited to circuit training and potentially upper air work. Further data will be required on battery recharging times and how the turnaround of depleted aircraft fits in the flight training context where aircraft utilization is targeted to be maximized.
- **Charging Infrastructure:** FTUs will need to retrofit their facilities with the requisite charging infrastructure. This may include in-hangar charging facilities and on-apron infrastructure for charging between flight training missions. Pipistrel's Velis Electro charger, for example, is designed for a 400-volt AC input, a non-standard voltage in North America. Where 600-volt infrastructure is in place, a stepdown charger to 400 volts would be required. Standardized requirements for voltage and chargers have also not been developed for consistency between manufacturers. This may serve as a challenge if the decision is made to install charging facilities for itinerant aircraft, given that multiple electric aircraft types with different charging needs may foreseeably visit the Airport.
- **Emergency Preparedness:** It is anticipated that the widespread adoption of electric aircraft at the Airport will require updates to Aircraft Rescue and Firefighting procedures, given the unique fire characteristics of lithium-ion batteries. This may require specialized differences training for emergency responders and updates to the Airport's Emergency Response Plan.

5 CONCLUSIONS

Aircraft Source Noise

1. The implementation of exhaust modifications approved as STCs on the flight training fleets based at the Airport represents the primary opportunity in the short term for the reduction of aircraft source noise.
2. Further review is required to identify the costs and benefits of these modifications. Consideration should be given to conducting outreach with Montreal Saint-Hubert Airport (Chabord exhaust modifications) and Embry-Riddle Aeronautical University (GOMOLZIG exhaust modifications) to explore their use in real world operations.
3. The potential adoption of exhaust modifications will be influenced by Transport Canada STC approval, the acquisition and installation costs of each system, and potentially the costs associated with additional aircraft maintenance. Implementation will likely require collaboration between the City, Airport Operator, and primary aircraft operators.

Unleaded Avgas Replacement Fuels

4. The EPA in the United States has determined that TEL emissions from aircraft cause or contribute to air pollution that may reasonably be anticipated to endanger public health.
5. Neighbourhood air quality studies commissioned by the City indicate that during the peak season for aircraft movements, monitoring identified low levels of all pollutants, and all measured levels were below the Ontario Ambient Air Quality Criteria, including airborne TEL.
6. Swift Fuels and GAMI have received STC approvals in the United States for their UL94 and G100UL fuels, respectively, and work continues through the PAFI and EAGLE programs on drop-in unleaded replacement fuels.
7. UL94 is already in use at numerous airports in the United States and has been adopted by the large-scale flight training departments of the University of North Dakota, Utah Valley University, and Purdue University. Given the suitability of UL94 for lower performance flight training and general aviation aircraft that comprise the majority of the activity at the Airport, this may represent a short to medium-term opportunity for implementation.
8. Although UL94 (soon to be joined by G100UL) is approved and in use in the United States, potential barriers to its implementation at Oshawa will include Transport Canada STC approval and the costs and logistics associated with new fuelling infrastructure, supply and distribution, and unit costs.
9. Reducing airborne TEL can be achieved through piston aircraft burning jet fuel, mogas, or lower quantities of avgas, such as the P2006T being integrated by Durham Flight Centre.

Electric Aircraft Propulsion

10. The potential benefits of electric aircraft may be considerable. The Pipistrel Velis Electro has a stated noise level of 60 dB versus the 70 dB of current piston-engine aircraft such as the Cessna 172, representing an improvement given the concentration of noise-sensitive land uses in the vicinity of the Airport. The early use case of electric aircraft in circuit training also addresses one of the primary resident concerns regarding noise at the Airport, that being the repeated exposure to noise from high frequency overflights as circuits are conducted.
11. Significant research, development, and regulatory maturation remains to be completed on certification requirements, charging infrastructure, and emergency preparedness, and future adoption will be influenced by electric aircraft acquisition costs, performance, and mission suitability.

#209-532 Montreal Road
Ottawa, ON K1K 4R4
hmaero.ca