

APPENDIX D

Air Quality Analysis

- **Appendix D1** – Puget Sound Clean Air Agency Correspondence
- **Appendix D2** – Air Quality and Greenhouse Gas Assessment Methodology Protocol

Appendix D-1
Puget Sound Clean Air Agency
Correspondence

Chris Easter

From: Kathy Strange <KathyS@pscleanair.org>
Sent: Monday, July 9, 2018 5:06 PM
To: Cayla Morgan
Cc: Autumn Ward; Chris Easter
Subject: RE: draft protocol

Hi Cayla,

Thanks for your patience with my delayed response – was out of the office last week.

Yes, no revisions requested from our end.

Thank you,
Kathy

Kathy Himes Strange, P.E., M.S.

Manager, Technical Analysis

206.689.4095 | Toll free 800.552.3565 | KathyS@pscleanair.org

1904 Third Avenue, Suite 105 | Seattle, WA 98101



Clean healthy air for everyone, everywhere, all the time.

From: Cayla.Morgan@faa.gov [mailto:Cayla.Morgan@faa.gov]
Sent: Monday, July 09, 2018 12:29 PM
To: Kathy Strange
Cc: AWard@esassoc.com; CEaster@esassoc.com
Subject: FW: draft protocol?

Hi Kathy,

I am so sorry to bug but want to make sure that there isn't anything else your agency would like us to revise in the protocol before we move forward.

Thanks,

Cayla D. Morgan
Environmental Protection Specialist
Seattle Airports District Office
206-231-4130

My new address is: 2200 S. 216th Street, Des Moines, WA. 98198

From: Morgan, Cayla (FAA)
Sent: Monday, July 02, 2018 9:48 AM
To: 'Kathy Strange' <KathyS@pscleanair.org>
Subject: RE: draft protcol?

Thanks Kathy. Is there anything that you would like us to revise or should we move forward?

Cayla D. Morgan
Environmental Protection Specialist
Seattle Airports District Office
206-231-4130

My new address is: 2200 S. 216th Street, Des Moines, WA. 98198

From: Kathy Strange <KathyS@pscleanair.org>
Sent: Saturday, June 30, 2018 7:57 AM
To: Morgan, Cayla (FAA) <Cayla.Morgan@faa.gov>
Subject: RE: draft protcol?

Hi Cayla,

The Agency doesn't have any substantive comments on the draft protocol. Thank you for the opportunity to review.

Thank you,
Kathy

Kathy Himes Strange, P.E., M.S.

Manager, Technical Analysis
206.689.4095 | Toll free 800.552.3565 | KathyS@pscleanair.org
1904 Third Avenue, Suite 105 | Seattle, WA 98101



Clean healthy air for everyone, everywhere, all the time.

From: Cayla.Morgan@faa.gov [<mailto:Cayla.Morgan@faa.gov>]
Sent: Monday, June 25, 2018 3:34 PM
To: Kathy Strange
Subject: RE: draft protcol?

Hi Kathy,

Let me know if this doesn't come through for you.

Thanks,

Cayla D. Morgan
Environmental Protection Specialist
Seattle Airports District Office
206-231-4130

My new address is: 2200 S. 216th Street, Des Moines, WA. 98198

From: Kathy Strange [<mailto:KathyS@psc Clean Air.org>]
Sent: Monday, June 25, 2018 3:02 PM
To: Morgan, Cayla (FAA) <Cayla.Morgan@faa.gov>
Subject: draft protocol?

Hi Cayla,

Apologies, I think you sent on the draft protocol last week, but I can't seem to find it in my inbox. Could you please re-send?

Also, can you please let me know when you need any input from PSCAA?

Thanks,
Kathy

Kathy Himes Strange, P.E., M.S.
Manager, Technical Analysis
206.689.4095 | Toll free 800.552.3565 | KathyS@psc Clean Air.org
1904 Third Avenue, Suite 105 | Seattle, WA 98101



Clean healthy air for everyone, everywhere, all the time.

From: Cayla.Morgan@faa.gov [<mailto:Cayla.Morgan@faa.gov>]
Sent: Monday, June 18, 2018 1:52 PM
To: Kathy Strange
Cc: Janell.Barrilleaux@faa.gov; Patricia.Deem@faa.gov; Pepple.Karl@epa.gov; kmcgourty@psrc.org
Subject: RE: Confirmation of Maintenance status

Kathy,

Thank you very much for your quick response to this matter. We will send you a draft protocol soon.

Cayla D. Morgan
Environmental Protection Specialist
Seattle Airports District Office
206-231-4130

My new address is: 2200 S. 216th Street, Des Moines, WA. 98198

From: Kathy Strange [<mailto:KathyS@pscleanair.org>]
Sent: Monday, June 18, 2018 1:20 PM
To: Morgan, Cayla (FAA) <Cayla.Morgan@faa.gov>
Cc: Barrilleaux, Janell (FAA) <Janell.Barrilleaux@faa.gov>; Deem, Patricia (FAA) <Patricia.Deem@faa.gov>; Karl Pepple (Pepple.Karl@epa.gov) (Pepple.Karl@epa.gov) <Pepple.Karl@epa.gov>; kmcgourty psrc.org <kmcgourty@psrc.org>
Subject: RE: Confirmation of Maintenance status

Hello Cayla and colleagues,

Thank you for coming to our office last week to discuss the Paine Field project. I confirmed with my EPA colleague that transportation and general conformity are not required. For transportation conformity, see [40 CFR 93.102\(b\)\(4\)](#):

(4) The provisions of this subpart apply to maintenance areas through the last year of a maintenance area's approved CAA section 175A(b) maintenance plan, unless the applicable implementation plan specifies that the provisions of this subpart shall apply for more than 20 years.

My understanding is that the same concept applies to general conformity: no general conformity after conclusion of the maintenance period unless the state commits to doing that longer in the SIP.

I also checked in with a colleague at Puget Sound Regional Council and she concurred.

Another helpful resource is this [Washington State Department of Ecology map](#) – when you click on the areas it shows the end of the 20-year maintenance periods: 10/11/2016 and 11/25/2016 for carbon monoxide and ozone, respectively. It also lists them below on the page in the “past maintenance areas” list.

Please let me know if you have additional questions. We look forward to seeing the protocol when developed,
Kathy

Kathy Himes Strange, P.E., M.S.

Manager, Technical Analysis

206.689.4095 | Toll free 800.552.3565 | KathyS@pscleanair.org

1904 Third Avenue, Suite 105 | Seattle, WA 98101



Clean healthy air for everyone, everywhere, all the time.

From: Cayla.Morgan@faa.gov [<mailto:Cayla.Morgan@faa.gov>]

Sent: Monday, June 18, 2018 10:17 AM

To: Kathy Strange

Cc: Janell.Barrilleaux@faa.gov; Patricia.Deem@faa.gov

Subject: Confirmation of Maintenance status

Hi Kathy,

I am checking in with you to see what you have found out from EPA on the maintenance status for Snohomish County as it relates to the proposed commercial service Supplemental EA at Paine Field.

Thanks,

Cayla D. Morgan
Environmental Protection Specialist
Seattle Airports District Office
206-231-4130

My new address is: **2200 S. 216th Street, Des Moines, WA. 98198**

Appendix D-2
Air Quality and Greenhouse Gas
Assessment Methodology Protocol



180 Grand Avenue
Suite 1050
Oakland, CA 94612
510.839.5066 phone
510.839.5825 fax

www.esassoc.com

memorandum

date June 20, 2018

to Cayla Morgan, Federal Aviation Administration

cc Puget Sound Clean Air Agency

from Chris Easter, Air Quality Director, Environmental Science Associates

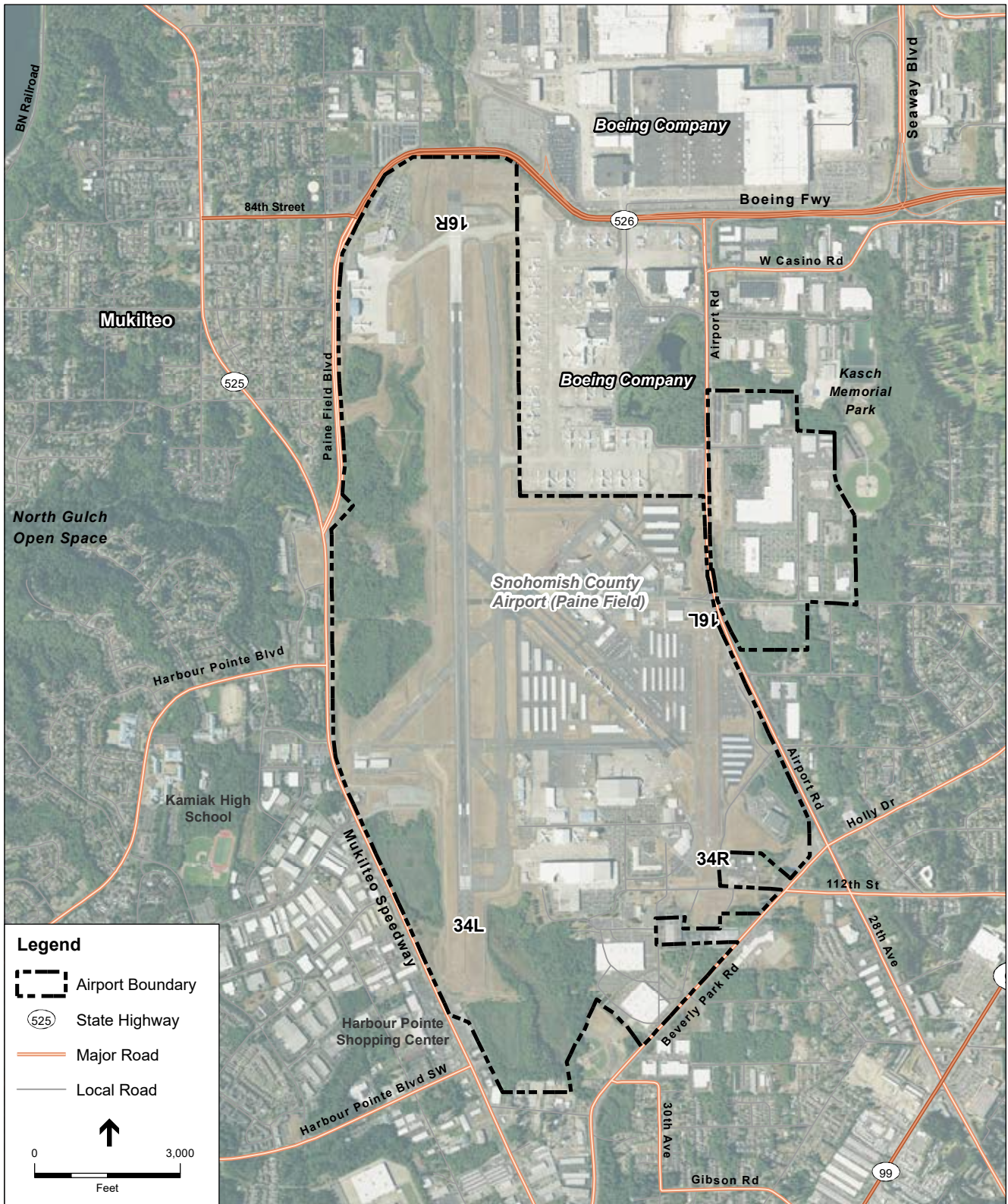
subject Draft Air Quality and Greenhouse Gas (GHG) Assessment Methodology Protocol for the Supplemental Environmental Assessment for Operations Specifications Amendments and an Amendment to a 14 CFR Part 139 Certification to Allow Alaska Airlines, United Airlines, and Southwest Airlines Service to Snohomish County Airport/Paine Field

1.0 Introduction

This document presents the methods that will be employed to assess the air quality and greenhouse gas (GHG) impacts for the Supplemental Environmental Assessment being prepared for the Snohomish County Airport/Paine Field (PAE) and the Federal Aviation Administration's (FAA's) Conformity Analysis hereafter referred to as the "PAE Supplemental EA." The proposed initiation of scheduled commercial passenger service at Paine Field requires decisions and approvals by the FAA, which constitute federal actions subject to review under the *National Environmental Policy Act* (NEPA). Alaska Airlines, United Airlines, Inc., and Southwest Airlines Company (collectively referred to herein as the "Airlines") have submitted requests to the FAA to amend each airline's Operations Specifications to conduct scheduled commercial airline service at PAE. The PAE Supplemental EA will be prepared in accordance with the President's Council on Environmental Regulations (CEQ) Title 40 CFR §§ 1500-1508 and guidance contained in FAA *Order 1050.1F, Environmental Impacts: Policies and Procedures*, FAA *Order 5050.4B NEPA Implementing Instructions for Airport Actions*, and FAA's *1050.1F Desk Reference*. This memorandum includes ESA's approach to estimating criteria air pollutant and GHG emissions for existing conditions, the No-Action Alternative, and the Proposed Action.

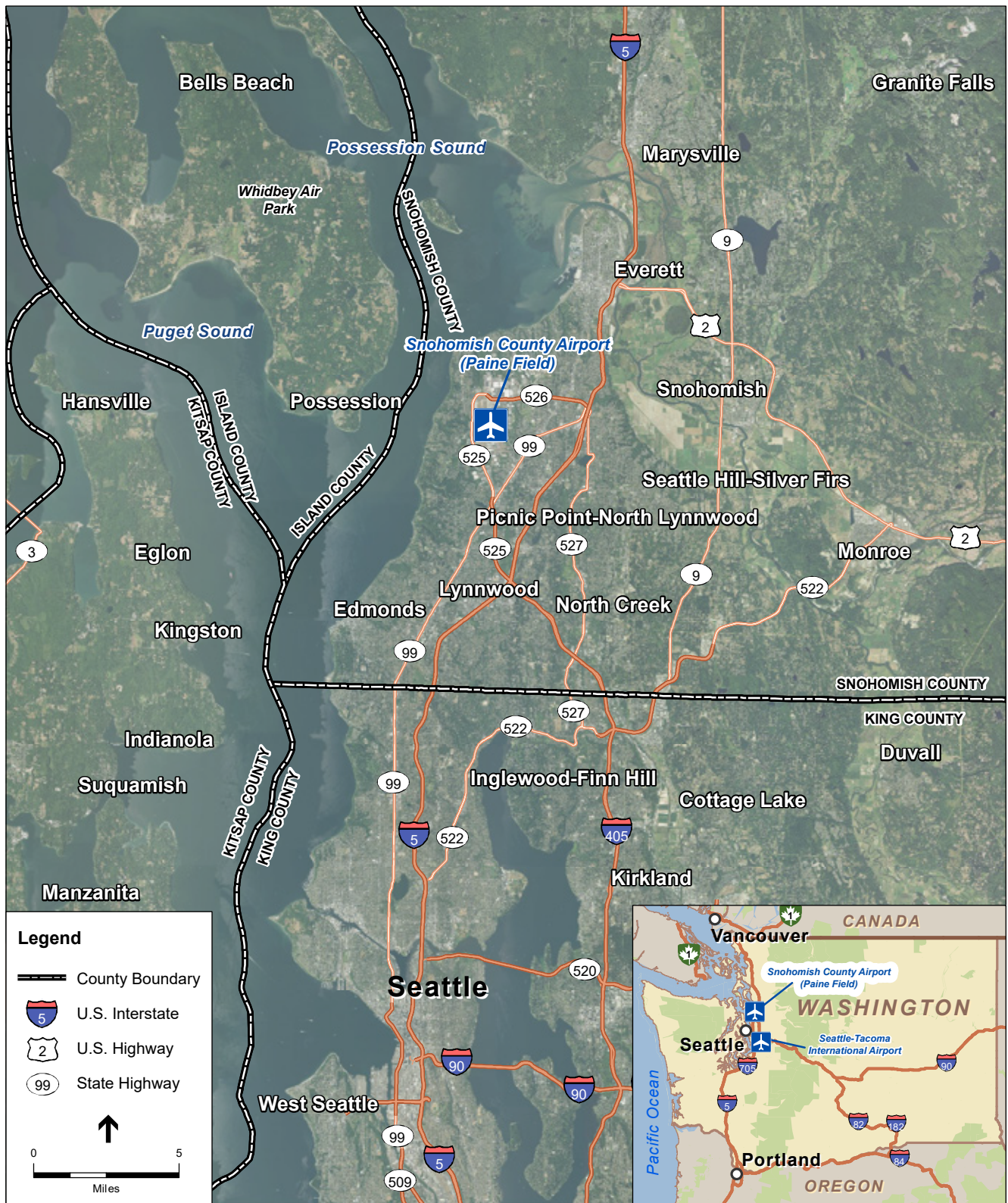
1.1 Project Overview

PAE is a public-use airport owned and operated by Snohomish County. The airport is located southwest of the City of Everett (adjoining the City boundary) and approximately 30 miles north of downtown Seattle. The location of the airport is shown on **Figure 1-1**. The airport and its environs are depicted on **Figure 1-2**.



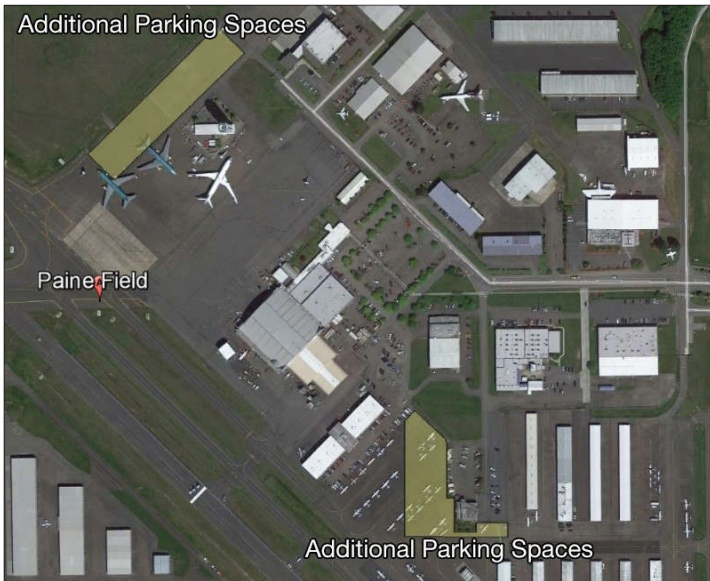
SOURCE: ESA, 2018..

Figure 1-2
Airport Vicinity Map



SOURCE: ESA, 2018..

Paine Field is designated in the FAA’s *National Plan of Integrated Airport Systems (NPIAS)*¹ as an airport having a national role. The NPIAS also defines the airport’s Service Level as a Reliever Airport (for Seattle-Tacoma International Airport).² Paine Field currently has a Class IV Part 139 operating certificate (allowing unscheduled large air carrier operations but not commercial service). Title 14 Code of Federal Regulations (CFR) Part 139 provides certification requirements for airports to provide scheduled or unscheduled commercial air service. Paine Field presently has no scheduled commercial air service.



Alaska Airlines and its partners (Horizon Air and SkyWest Airlines), United Airlines, Inc. and its partner SkyWest Airlines operating as United Express), and Southwest Airlines Co. collectively propose to conduct scheduled commercial air service at Paine Field. The service would offer up to 24 daily domestic round trip flights using Embraer 175 and Boeing 737 aircraft. The airlines are not proposing to construct any new, or expand any existing, terminal buildings, concourses, aircraft parking aprons, or support buildings at PAE. Commercial service would be provided using the airport’s commercial passenger terminal building and attendant facilities currently being constructed. However, the passenger terminal operator proposes to use portions of existing airfield pavement (shaded in yellow on the aerial photograph) to provide additional public vehicle parking.

The air quality and GHG Assessment will be completed for the following scenarios:

- Baseline existing conditions 2017
- Proposed “No-Action” Alternative for the year 2019
- Proposed “Action” Alternative for the year 2019
- Proposed “No-Action” Alternative for the year 2024
- Proposed “Action” Alternative for the year 2024

¹ Federal Aviation Administration, 2016. *Report to Congress, National Plan of Integrated Airport Systems (NPIAS) 2017-2021*. September 30, 2016.

² Reliever airports are airports designated by the FAA to relieve congestion at Commercial Service airports and to provide improved general aviation access to the overall community.

Substantial emission sources to be considered in terms of criteria air pollutants and impacts on air quality include:

- Aviation activity including changes in the following aspects:
 - number of annual aircraft operations,
 - aircraft fleet mix,
 - daytime and nighttime aircraft operations,
 - aircraft stage lengths,
 - ground support equipment (GSE) and auxiliary power units (APUs) operations,
 - changes in aircraft refueling operations, and
 - passenger enplanements.
- Terminal activity parameter modifications including changes to the following aspects:
 - Increase in energy use (if available)
- The use of existing airfield pavement to provide 424 additional parking spaces. This includes the installation of:
 - curbing,
 - access gates,
 - lighting, and
 - fencing, and related improvements
- Increase in surface road traffic and transit to account for the increase in passenger activity, including:
 - on-road passenger vehicle travel, and
 - on-road and off-road airport fleet vehicles

These are primarily fuel combustion sources and will be considered in terms of GHG emissions and impacts on climate as well.

The U.S. Environmental Protection Agency (EPA) has established national ambient air quality standards (NAAQS) for six “criteria” air pollutants including: ozone, carbon monoxide (CO), nitrogen dioxide (NO₂), particulate matter (PM₁₀ and PM_{2.5}), sulfur dioxide (SO₂), and lead. The Washington State Department of Ecology and the Puget Sound Clean Air Agency (PSCAA) have established State and local ambient air quality standards for the same pollutants. The Puget Sound Region including Snohomish County (County) is currently designated by the U.S. EPA as being in attainment for all six NAAQS pollutants.

Pollutant emissions associated with implementation of the Proposed Action have the potential to cause or contribute to an exceedance of the federal, state, and local ambient air quality standards. Implementation of the Proposed Action would result in an increase in the number of aircraft operations at PAE, as well as additional motor vehicle trips (passengers and employees) in the vicinity of PAE. Since the Proposed Action involves some minor construction, the analysis will assess construction-related emissions of criteria air pollutants.

1.2 Methodology Overview

The air quality and GHG modeling methodology and protocol will be developed consistent with FAA guidance provided in the *FAA 1050.1F Desk Reference* and the FAA's *Aviation Emissions and Air Quality Handbook*, Version 3, Update 1. ESA will utilize a number of different tools that are customized to address the specific conditions at PAE for this proposed action:

- The FAA's Aviation Environmental Design Tool, version 2d (AEDT 2d), will be used to calculate emissions associated with aviation activity. AEDT 2d is a modeling tool that calculates noise, fuel burn, and emissions associated with aviation operations. AEDT 2d is the latest version of AEDT and was released by the FAA on September 27, 2017. AEDT is the model required by the FAA for assessing air quality impacts.

For this project, AEDT will be used to calculate criteria pollutant emissions from the operation of aircraft main engines, aircraft auxiliary power units (APUs), and airport ground support equipment (GSE). AEDT will also be used to calculate carbon dioxide (CO₂) emissions from aircraft main engines. Aircraft operational emissions are computed by factoring aircraft operational activity against a database of aircraft/engine-specific emission factors based on engine manufacturer, model, and aircraft operational mode within the landing-takeoff (LTO) cycle. An LTO cycle includes the approach/landing, taxi in, start-up, taxi-out, takeoff, and departure. Aircraft operational activity is summarized in Tables 1 and 2. FAA Order 1050.1F Desk Reference, Appendix C, indicates that FAA approval is needed for the use of aircraft type substitutions or other non-default data in AEDT. If analysis of aircraft operations indicates that aircraft type substitutions or changes to standard flight profiles are needed for modeling purposes, ESA will create a technical memo describing the need and work with the client to submit the memo to the FAA for review.

APU criteria pollutant emissions are a function of the number of LTOs performed by the equipped aircraft, the time the assigned APU operates per LTO, and the emissions factors assigned to the APU. Considerations include the availability of fixed electrical ground power and pre-conditioned air, as well as meteorological conditions.

GSE criteria pollutant emissions include equipment servicing gated aircraft on the apron (e.g., baggage tugs) and other equipment and activities not related to gate service operations (de-icing trucks). AEDT computes emissions specific to the make/model/type of equipment, year of manufacture, approximate horsepower, fuel type, and annual hours of operation.

- AEDT does not calculate greenhouse gases other than CO₂ and also does not calculate CO₂ for APUs or GSE. To determine CO₂ for APUs and GSE as well as methane (CH₄) and nitrous oxide (N₂O) for aircraft main engines, APUs, and GSE, the methodologies presented in Section 6.3 and Appendix C of the FAA *Aviation Emissions and Air Quality Handbook* will be used.³

Because GHG emissions are primarily a function of fossil fuel use, most of the emission calculations for each source are based on estimating or obtaining fuel use (or activity) data and then applying the appropriate GHG emission factor. Aircraft-related GHG emissions will be computed using AEDT 2d for each phase of the LTO cycle. For APU GHG emissions, fuel use would be converted to GHG emissions using appropriate emission factors for each fuel type. GHGs from GSE would be computed from fuel use and/or operational time from the EPA NONROAD model and then combined with fuel-specific emission factors. For motor vehicle GSE, the EPA MOVES model would provide GHG emission factors.

³ All greenhouse gasses will be reported in metric tons of CO₂ equivalent emissions (MT CO₂e).

- Emissions from surface traffic associated with the Proposed Action (measured in vehicle miles traveled) will be modeled using the latest version of U.S. EPA’s MOVES2014a model. Because there is no scheduled passenger service at PAE, there would be no commercial service passenger and airline-related vehicle and truck trips at PAE under the No-Action Alternative in 2019 and 2024. The net change in surface traffic emissions would be those associated with the Proposed Action. Therefore, surface traffic emissions will not be modeled for the No-Action Alternative.

For the Proposed Action, emissions from delivery vehicle travel and idling (such as maintenance materials and food delivery) and both on-road and off-road airport fleet vehicles (such as service autos/trucks and non-road equipment such as forklifts, motorized carts, and portable generators) will also be estimated using the MOVES model, the information provided by the County, and the traffic study. Evaporative/fugitive sources such as aircraft refueling will be estimated based on information from the County, Airlines, and the AEDT model. This task will include a meeting and teleconferences with the PSCAA, Airlines, State and FAA to review and discuss inputs, assumptions, and preliminary modeling results.

Other emission models and sources to assess and analyze air emissions and may include, but are not limited to:

- The Airport Construction Emissions Inventory Tool (ACEIT), for calculating emissions associated with construction activity. This tool was released with the Transportation Research Board’s (TRB) Airport Cooperative Research Program (ACRP) Report 102, *Guidance for Estimating Airport Construction Emissions*.⁴ ACEIT contains construction emission factors from existing Environmental Protection Agency (EPA) regulatory models, such as MOVES, as well as emission factors for fugitive emissions from EPA’s *Compilation of Air Pollution Emission Factors (AP-42)*.⁵ Through the user specification of high-level inputs such as project site weather and project cost, the ACEIT uses a series of assumptions to generate lists of emissions sources (such as construction equipment and construction employee on-road automobiles) and associated usage factors in order to calculate a construction emissions inventory.
- The California Emissions Estimator Model (CalEEMod) (Version 2016.3.2) software, which is an emissions estimation/evaluation model developed for the State of California to calculate emissions during construction activities, may be used for those sources not captured by ACEIT.
- AERMOD version 15181,⁶ can be utilized to model the localized impacts of NO_x, CO, PM₁₀, and PM_{2.5} emissions if necessary and appropriate. AERMOD estimates air pollutant concentrations of single or multiple point, area, or volume sources using historical meteorological conditions. Point sources are used to represent emissions from stationary sources, such as stacks or vents and take into account buoyancy effects from plume temperature and flow rate and effects from building downwash. Area sources are two-dimensional sources that are used to represent emissions that occur over a wide area. Volume sources are similar to area sources, but are three-dimensional sources of emissions that are used to model emissions from a variety of equipment.

Table 1 summarizes the number of additional aircraft operations that would be generated at PAE if the Proposed Action was implemented. See the Airport Activity Forecast Memorandum for more information. **Table 2** compares activity levels from baseline to those for the proposed action. Additional detailed information related to air quality and GHG protocol and calculation methods can be found below in Sections 2.0 and 3.0.

⁴ Kim, B., et al., 2014. *Guidance for Estimating Airport Construction Emissions*. ACRP Report 102. <https://doi.org/10.17226/22437>.

⁵ Environmental Protection Agency, 2017. “AP-42: Compilation of Air Emission Factors.” <https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emission-factors>. Last accessed: December 5, 2017.

⁶ Lakes Environmental, AERMOD VIEW Software.

**TABLE 1
OPERATIONS AND ENPLANEMENTS SUMMARY**

Study Year	Alternatives	Annual Aircraft Operations	Enplaned Passengers
2017	Existing Condition	112,426	0
2019	No-Action Alternative	106,852	0
	Proposed Project	124,372	656,235
2024	No-Action Alternative	107,953	0
	Proposed Project	125,473	736,316

SOURCES:

Alaska Airlines and its partners (Horizon Air and SkyWest Airlines), 2017.
United Airlines and its partner (SkyWest Airlines operating as United Express) and Southwest Airlines, 2018.
ESA analysis, 2018.

**TABLE 2
ACTIVITY LEVELS BASELINE VS PROPOSED ACTION**

	Baseline (No-Action) Total ¹	New Activity	Total for Proposed Action ²
Annual Aircraft Operations			
2017	112,426	n/a	n/a
2019	106,852	17,520	124,372 (16.4% change)
2024	107,953	17,520	125,473 (16.2% change)
Annual Passenger Enplanements			
2017	0	n/a	n/a
2019	0	656,235	656,235
2024	0	736,316	736,316

NOTES:

1. FAA OPSNET (2017) and 2017 TAF (2019 and 2024) adjusted for operations when ATCT is closed. Subject to change.
2. Includes three airline proposals to initiate commercial passenger service at Paine Field in 2019.

SOURCES:

Alaska Airlines and its partners (Horizon Air and SkyWest Airlines), 2017.
United Airlines and its partner (SkyWest Airlines operating as United Express) and Southwest Airlines, 2018.
ESA analysis, 2018.

1.3 Assumptions

This memorandum makes the following key assumptions, grouped into major categories of the analysis:

1. ESA will conduct up to two rounds of emissions calculation modeling. The first round of modeling will include preliminary modeling results for review by the Airlines, County, FAA, and PSCAA. If refinements to the first round of modeling are deemed necessary by the Airlines and FAA, ESA will prepare a second round of modeling. If additional rounds of emissions modeling are requested, they will be conducted upon agreement by the stakeholder group.

2. Three total drafts of the document, and original and two review cycles.
3. Five alternatives of analysis as identified in Table 1 above.
4. Analysis limited to criteria air pollutants; there will be no Hazardous Air Pollutant calculations or dispersion modeling.
5. Energy use emissions will be completed only if utility data is available.
6. The County will provide ESA with all required project information as detailed in the tables 3 through 6 below.
7. Environmental Sciences Associates (ESA) assumes that no modeling will be conducted for airport sources for which activity/emissions data identified in tables 3 through 6 below is not readily available.

2.0 Construction Emissions

2.1 FAA Requirements

The Airports Desk Reference states that an air quality analysis is required for a Federal project “[i]nclude(ing) construction-related air quality emissions when a sponsor proposes an action in a nonattainment or maintenance area.”⁷ As described previously, PAE is located in a maintenance areas for the criteria pollutant CO. The 1050.1F Desk Reference requires that NEPA documentation define an *affected environment* for a proposed project, which is defined as, “as the entire geographic area that could be either directly or indirectly affected by the proposed project.”⁸ For construction emissions from the PAE project, the affected environment includes the Airport property as well as surrounding areas where construction-related vehicles are traveling to and from the Airport.

2.2 Construction Emissions Modeling Approach

Emissions associated with the installation of pavement markings, curbing, access gates, lighting, fencing, and signage necessary to use existing airfield pavement to provide additional parking spaces at PAE will be estimated for the Proposed Action for year 2019 using U.S. EPA’s MOVES2014a model (which incorporates EPA’s NONROAD2008) model. Emissions are anticipated to include off-road equipment, on-road vehicles, truck idling, and evaporative sources (e.g., paint). All information related to the installation of pavement markings, curbing, access gates, lighting, fencing, and signage (such as schedules, methods, equipment fleet, hours of operation, delivery trucks, etc.) will be supplied by the County and/or Airlines. This memorandum will discuss specific modeling methods for each source of these emissions.

ACEIT was created as a product of the TRB ACRP Project 02-33 (“Guidance for Estimating Airport Construction Emissions”)⁹ and was published along with ACRP Report 102.¹⁰ ACEIT facilitates the estimation of direct and indirect construction emissions by using emission factors from the EPA models MOVES 2010a (revised January 2013) and NONROAD 2008a (July 2009), EPA’s AP-42 emission factor compilation, and other sources, in combination with user-specified project complexity data to estimate construction activity levels.

⁷ Airports Desk Reference, Chapter 6, Section 2.

⁸ 1050.1F Desk Reference, Section 1.2.

⁹ Transportation Research Board, 2013. “Guidance for Estimating Airport Construction Emissions.” <https://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=3034>. Last accessed: December 4, 2017.

¹⁰ Transportation Research Board, 2016. “Guidance for Estimating Airport Construction Emissions.” <http://www.trb.org/Main/Blurbs/170234.aspx>. Last accessed: December 4, 2017.

ACEIT also allows revision and customization of many of the assumed construction vehicle activity levels in order to refine emissions estimates. CalEEMod may also be utilized as appropriate.

2.3 Modeling Inputs

To complete criteria air pollutants emissions calculation for construction, the following inputs will be required from the County and/or the private developer and operator of the new passenger terminal building:

1. A schedule for the development of the additional parking spaces on existing airfield pavement, including phasing and the duration of each phase (i.e., installation of curbing, electrical and access control systems, lighting, pavement marking, landscaping, and fencing). This also includes a general list of construction equipment (if not available, ESA can rely on default/general equipment list).
2. Construction-period workweek (5 or 6 days)? Will each workday be 8 or 10 hours long?
3. Conceptual or engineered design plans depicting the proposed conversion of existing airfield pavement to a surface parking lot.
4. The estimated (maximum) daily number of employees working on-site during each phase of construction. If construction employee details are not available, ESA can provide an estimate based on modeling assumptions and review of similar projects for Team review and approval.
5. Describe location of staging areas if any are proposed, along with ingress/egress points for construction traffic.
6. Approved construction truck haul route.

Table 3 below describes potential sources to be modeled along with data requirements and modeling methods.

TABLE 3
AIR QUALITY EMISSIONS SOURCE TYPES, DATA REQUIREMENTS, AND MODELING METHODS FOR CONSTRUCTION

Source Type	Data Requirements	Models/Methods
Heavy Duty Off Road Construction Equipment	Construction schedule (duration of installation of curbing, electrical and access control systems, lighting, pavement marking, landscaping, and fencing); list of off-road equipment; timing, number of material deliveries and concrete pouring activities; length of work week; daily number of employees; meteorological data	Airport Construction Emissions Inventory Tool (ACEIT), (TRB) Airport Cooperative Research Program (ACRP) Report 102 <i>Guidance for Estimating Airport Construction Emissions</i> , Motor Vehicle Emissions Simulator (MOVES2014a), California Air Resources Board's 2017 Off-Road Equipment Model (OFFROAD2017)
Fugitive emissions from construction activities (dust, asphalt, architectural coatings)	Square footage and acreage of disturbed site	ACEIT, CalEEMod, U.S. EPA, <i>Compilation of Air Pollution Emission Factors (AP-42)</i>
Localized Impacts of criteria air pollutants	To Be Determined if Necessary	AERMOD version 15181
On-road emissions from construction materials hauling	Number of daily and annual heavy-duty truck trips for all construction activities, haul route	ACEIT, CalEEMod, MOVES2014a

For some classes of emissions there are multiple options for emissions calculating models. ESA will select the most effective and accurate model based on the conditions and the data available. If multiple models are used, ESA will evaluate the inputs of each model to ensure there would be no double-counting of emissions.

It is possible there may be a phase during the early initiation of commercial service at PAE where the conversion of airfield pavement for vehicle surface parking occurs while daily flights are being conducted and there are emissions from both construction and commercial service flights occurring at the same time. If this is indicated by the construction schedule, ESA will complete a cumulative assessment to address the aggregate emissions. Emissions calculation methods for operating sources are described below in Section 3.0.

3.0 Operational Emissions

3.1 FAA Requirements

The 1050.1F Desk Reference requires that NEPA documentation define an *affected environment* for a proposed project, which is defined as, “as the entire geographic area that could be either directly or indirectly affected by the proposed project.” Operational emissions occur from ground sources within the immediate vicinity of the airport, such as GSE and on-airport boilers, and from aircraft on the ground and in flight. For operating emissions in the PAE project, the affected environment includes the Airport property as well as surrounding areas where aircraft arriving to and departing from PAE are below the mixing height, generally 3,000 feet above ground level (AGL). According to the FAA’s Presumed to Conform list, aircraft emissions above the mixing height do not affect air pollution concentrations at ground level and are thus presumed to conform to the SIP.

FAA Order 1050.1F states, “the latest FAA-approved model must be used for both air quality and noise analysis.”¹¹ The latest FAA-approved model for aviation air quality analysis was AEDT 2c SP2 when the environmental analysis began for the PAE project.

AEDT 2d can also be used to estimate criteria pollutant emissions from GSE and APUs. The 1050.1F Desk Reference, Appendix C, gives the following key guidance and requirements applicable to air quality¹²:

- The same AEDT-default airport-specific average weather data that are used for noise analysis are typically acceptable for the calculation of emissions inventories; and,
- “Modeled ground tracks should approximate actual flight paths in the study area.”

3.2 Operational Emissions Modeling Approach

Operation of the Proposed Action has the potential to generate criteria pollutant and GHG emissions from aircraft and passenger vehicle trips traveling to and from PAE. In addition, emissions would result from delivery vehicle travel and idling (such as maintenance materials and food delivery), on-road and off-road airport fleet vehicles (such as service autos/trucks and non-road equipment such as forklifts, motorized carts, and portable generators), and area source evaporative/fugitive emissions such as aircraft refueling.

Aviation emissions will be modeled for the Proposed Action, which provide for a conservative estimate as emission factors tend to decrease over time. Aviation-related emissions, including aircraft landings and take offs (LTOs) will be evaluated using AEDT 2d. The area source emissions can be estimated using CalEEMod. CalEEMod does not include an “airport” land use type. Surrogate land use types will be used to represent the emissions from the various structures. For example, the “general office building” land use type can be used to represent the terminal building. Hangar, cargo, GSE, and other buildings can be modeled as unrefrigerated

¹¹ FAA Order 1050.1F, Section 4.2.

¹² 1050.1F Desk Reference, Appendix C, Section 3.

warehouses or general light industrial buildings. In calculating mobile source emissions (i.e. ground access vehicles [GAV]), emissions can be estimated using either MOVES 2014a or California Air Resources Board (CARB's) road vehicle emissions factor (EMFAC) model. The most recent version is EMFAC2014, which "represents ARB's current understanding of motor vehicle travel activities and their associated emission levels."¹³

The localized effects from the onsite portion of daily emissions can be evaluated, if necessary at sensitive receptor locations potentially impacted using the AERMOD dispersion model. Sources of on-site emissions include aircraft LTOs, taxiing, GSE, and on-site stationary sources of emissions associated with heating, cooling, lighting, and powering buildings.

3.3 Modeling Inputs

The operational emissions analysis for the PAE will utilize the AEDT and other models for emissions calculations. Some of the required data inputs will include the following:

- Aircraft types and operational counts for each scenario
- Eurocontrol Aircraft Noise and Performance database (ANP) aircraft types¹⁴ for each scenario
- Airport-specific average weather, specifically, the AEDT 2c SP2 default average weather for PAE
- Aircraft flight tracks
- Aircraft stage lengths and vertical profiles

The implementation of the proposed PAE project has the potential to change on-airport emissions associated with energy use in the new passenger terminal building. The increase use due to the introduction of scheduled passenger service may lead to the increased combustion of natural gas for heating, ventilation, and air conditioning (HVAC) purposes.

To complete criteria air pollutants criteria air pollutants and GHG emissions calculation for operational emissions ESA will require the following inputs and outputs:

1. Equipment specifications for new equipment (e.g., emergency generators, etc.) that will be located at the new terminal.
2. ESA will determine aircraft LTO emissions using AEDT 2d:
 - a. Maximum daily emissions of criteria pollutants and toxic air contaminants (TACs) under: 1) existing conditions and 2) future passenger throughput for years 2019 and 2024. Separate emissions by aircraft type.
 - b. Greenhouse gas (GHG) emissions under: 1) existing conditions and 2) future passenger throughput for years 2019 and 2024. Separate emissions by aircraft type.

¹³ California Air Resources Board, Mobile Source Emissions Inventory, <http://www.arb.ca.gov/msei/categories.htm#emfac2014>. Accessed March 2016

¹⁴ Eurocontrol, 2017. "ANP – Eurocontrol Experimental Centre." <https://www.aircraftnoisemodel.org/>. Last accessed: November 25, 2017.

3. Using data, methods, and models developed for criteria air pollutants emissions, ESA will estimate and disclose projected GHG emissions (metric tons of carbon dioxide equivalent) for the No-Action Alternative and the Proposed Action in 2019 and 2024.

Table 5 below provides details related to emissions source type, data requirements and modeling methods for operational emissions.

**TABLE 5
AIR QUALITY SOURCE TYPES, DATA REQUIREMENTS, AND MODELING METHODS FOR OPERATIONS**

Source Type	Data Requirements	Models/Methods
Aircraft	Aircraft activity parameter data including; but not limited to, the following: <ul style="list-style-type: none"> • Taxi times, • Run ups • Gate powering information 	Aviation Environmental Design Tool Version 2c Service Pack 2 (AEDT 2c SP2) model, <i>Aviation Emissions and Air Quality Handbook Version 3 Update 1</i> ,
APUs	Aircraft parking locations, hardstand operations, and connections to power and air at these hardstand locations, along with default APU operations data from AEDT	AEDT
GSE	aircraft parking locations, hardstand operations, and connections to power and air at these hardstand locations, along with default GSE operations data from AEDT	AEDT
Off Road Equipment	Vehicle Fleet information if available or estimated using default values	OFFROAD2017, CalEEMod version 2016.3.2
Surface Traffic/On-site vehicle idling and other mobile sources	Traffic Study, County Transportation Data	MOVES2014a model, CalEEMod
Area sources (landscaping equipment, consumer products, paint and other architectural coatings, natural gas combustion (in heaters, boilers, and restaurant stoves), and evaporative sources such as aircraft refueling	Project-specific volume information or default factors	CalEEMod, AP-42
On-site natural gas emissions	Volume estimates or default factors	CalEEMod, AP-42
Evaporative Losses from Refueling	Volume estimates or default factors	AP-42
Emergency Generators	Manufacturers Specifications, default factors	AP-42

In terms of its GHG inventory, PAE's geographical boundary is defined as the geographic boundary of the Airport plus the airspace around PAE, which extends to an elevation of 3,000 feet above PAE's airport field elevation (relevant to landing and takeoff [LTO] operations), and the roads and public transit routes that deliver employees, passengers, and suppliers to and from the airport. The organization of emissions scopes is based on the accounting framework of the World Resource Institute's (WRI) GHG Protocol the GHG inventory uses the following industry-standard approach to accounting for PAE's GHG emissions and clearly distinguishes the emissions of PAE-controlled operations from other relevant indirect sources affiliated with Airport operations:

- **Scope 1 – Direct PAE-Controlled Emissions:** GHG emissions from operations or activities that are under the direct control of PAE, with emissions sources that include:
 - PAE fleet vehicles;
 - On-site heating and cooling infrastructure;

- Solid waste handling and disposal;
 - Fugitive refrigerant gas emissions; and
 - Wastewater treatment plant emissions (if applicable).
- **Scope 2 – Indirect Emissions from Electric Generation:** GHG emissions attributed to off-site sources of electricity, purchased and consumed by PAE
 - **Scope 3 – Other Indirect Emissions:** At PAE, sources of Scope 3 GHG emissions may include:
 - Employee commute and passenger travel on public roads, or by public transit;
 - Landing and takeoff by aircraft;
 - Delivery trucks;
 - Ground services support equipment; and
 - Rental car fleet operations.

Table 6 below describes sources, data requirement and modeling methods for GHG emissions from operations.

**TABLE 6
GHG EMISSIONS SOURCE TYPES, DATA REQUIREMENTS, AND MODELING METHODS FOR OPERATIONS**

Source Type	Data Requirements	Models/Methods
Imported Electricity	Utility Data or Estimates	CalEEMod, GHG Protocol (Utility-Specific or eGRID)
Aircraft	Aircraft activity parameter data including; but not limited to, the following: <ul style="list-style-type: none"> • Taxi times, • Ramp ups • Gate powering information 	AEDT 2d and FAA Aviation Emissions and Air Quality Handbook
APUs	Aircraft parking locations, hardstand operations, and connections to power and air at these hardstand locations, along with default APU operations data from AEDT	AEDT 2d and FAA Aviation Emissions and Air Quality Handbook
GSE	aircraft parking locations, hardstand operations, and connections to power and air at these hardstand locations, along with default GSE operations data from AEDT	AEDT 2d and FAA Aviation Emissions and Air Quality Handbook
Off-road equipment (Excluding GSE)	Vehicle Fleet information if available or estimated using default values	CalEEMod 2016.3.2
On-road vehicles	Traffic Study, County Transportation Data	MOVES2014a
Building natural gas use—space and water heating	Volume estimates or default factors	CalEEMod 2016.3.2
Stationary Sources (generators, vehicle idling)	Volume estimates or default factors	U.S. EPA AP-42, MOVES2014a
Refrigerant leakage/if necessary	Purchasing records	PAE criteria air pollutants calculations, AP-42, CARB and ICLEI
Solid Waste and Recycling	To be determined	CalEEMod 2016.3.2, ICLEI, and WARM
Wastewater treatment/if necessary	To be determined	PAE criteria air pollutants calculations and AP-42



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memorandum

date February 1, 2019

to Ms. Cayla Morgan, FAA

cc Puget Sound Clean Air Agency

from Chris Easter, Air Quality Director, Environmental Science Associates

subject Supplement to the Draft Air Quality and Greenhouse Gas (GHG) Assessment Methodology Protocol for the Supplemental Environmental Assessment for Operations Specifications Amendments and an Amendment to a 14 CFR Part 139 Certification to Allow Alaska Airlines and United Airlines Service to Snohomish County Airport/Paine Field

This memorandum was prepared to supplement and update the June 20, 2018, the *Draft Air Quality and Greenhouse Gas (GHG) Assessment Methodology Protocol for the Supplemental Environmental Assessment for Operations Specifications Amendments and an Amendment to a 14 CFR Part 139 Certification to Allow Alaska Airlines and United Airlines Service to Snohomish County Airport/Paine Field (Draft Protocol Memo)*.

The Draft Protocol Memo describes the methods used to assess the air quality and greenhouse gas (GHG) impacts for the Supplemental Environmental Assessment (EA) prepared for the Snohomish County Airport/Paine Field (PAE) and the Federal Aviation Administration's (FAA's) Conformity Analysis. The Draft Protocol Memo was reviewed and approved by the Puget Sound Clean Air Agency (PSCAA) and concurrence was received based on the original proposal from Alaska Airlines (and its partners Horizon Air and SkyWest Airlines), United Airlines (and its partner SkyWest Airlines operating as United Express) and Southwest Airlines, with results presented in the Draft Supplemental EA.

In early November 2018, after publication of the Draft Supplemental EA in September 2018 and the subsequent Public Information Workshop/Public Hearing in October 2018, the FAA was informed that Southwest Airlines had withdrawn its proposal to operate at Paine Field. The gate allocations (five flights per day) proposed by Southwest Airlines were acquired by Alaska Airlines in early November 2018.

The Final Supplemental EA has been revised to reflect the removal of Southwest Airlines and the corresponding change to Alaska Airlines' current proposal, which includes operation of the additional gate allocations (five flights per day) previously held by Southwest Airlines. The current proposals by United Airlines (and its partner SkyWest Airlines operating as United Express) and Alaska Airlines (and its partners Horizon Air and SkyWest Airlines) evaluated in the Final Supplemental EA reflect the same combined gate allocation (total number of operations) included in the Draft Supplemental EA that was circulated for public review. While the number of operations in the current proposals remain the same as that evaluated in the Draft Supplemental EA, five flights per day will be operated with smaller aircraft. In consideration of this change, a screening analysis was conducted for Air Quality and Climate.

In the Draft Supplemental EA, operational emissions of criteria air pollutants were estimated for the No Action Alternative and the Proposed Action for two future conditions: 2019 and 2024. The release of gate allocations from Southwest Airlines, which were acquired by Alaska Airlines, occurred after the completion of the emissions modeling and calculations included in the Draft Supplemental EA that was circulated for public review. There is a forecasted reduction in aircraft air emissions based on the replacement of the higher-emitting Boeing 737-700 aircraft that would have been used by Southwest Airlines with the lower-emitting Embraer 175 aircraft used by Alaska Airlines. To address this change in aircraft type, an emissions analysis was completed comparing Southwest Airlines' Boeing 737-700 and Alaska Airlines' Embraer 175.

Table 1 summarizes the comparative analysis that quantifies the annual criteria pollutant emissions reductions resulting from the replacement of Southwest Airlines' five daily round-trip Boeing 737-700 flights with Alaska Airlines' Embraer 175. **Table 2** summarizes the annual carbon dioxide-equivalent (CO_{2e}) greenhouse gas emissions changes by aircraft type.

TABLE 1 - CURRENT PROPOSED ACTION SCREENING: AIRCRAFT TYPE CRITERIA POLLUTANT EMISSIONS

Emissions Source	Criteria Pollutant Emissions (Tons per year)					
	CO	VOC	NO _x	SO _x	PM ₁₀	PM _{2.5}
Boeing 737-700 (Departure)	2.43	0.31	4.25	0.32	0.10	0.10
Embraer 175 (Departure)	1.21	0.01	1.58	0.19	0.05	0.05
Percent Change in Emissions (Departures)	-50.3%	-96.3%	-62.7%	-41.3%	-46.9%	-46.9%
Boeing 737-700 (Arrival)	1.09	0.12	0.73	0.12	0.02	0.02
Embraer 175 (Arrival)	0.66	0.01	0.43	0.07	0.01	0.01
Percent Change in Emissions (Arrivals)	-39.4%	-94.8%	-41.7%	-44.9%	-54.0%	-54.0%

SOURCE: Environmental Science Associates, 2019.

TABLE 2 - CURRENT PROPOSED ACTION SCREENING: AIRCRAFT TYPE GREENHOUSE GAS EMISSIONS

Emissions Source	CO _{2e} Emissions (Metric tons per year)
Boeing 737-700 (Departure)	775.01
Embraer 175 (Departure)	455.13
Percent Change in Emissions (Departures)	-41.3%
Boeing 737-700 (Arrival)	293.68
Embraer 175 (Arrival)	161.80
Percent Change in Emissions (Arrivals)	-44.9%

SOURCE: Environmental Science Associates, 2019.

Additionally, because the Embraer 175 aircraft has fewer seats, surface traffic emissions are anticipated to be reduced by the gate allocation acquisition by Alaska Airlines from Southwest Airlines. As a result of the reduction in passenger enplanements (see **Table 3**), the associated traffic analysis indicates a reduction in daily trips by approximately 9 percent in 2019 and approximately 6 percent in 2024. The reduction in daily trips would result in a similar change in Vehicle Miles Travelled (VMT) and a reduction in overall surface traffic emissions.

TABLE 3 – COMPARISON OF PASSENGER ENPLANEMENTS/SURFACE TRAFFIC EMISSIONS

Study Year	Alternatives	Enplaned Passengers	Vehicle Trips	Correlated Percent Impact to Surface Traffic Emissions
2019	Draft Supplemental EA Proposed Project	656,235	2,185	N/A
	Current Proposed Action	540,930	1,994	9%
2024	Draft Supplemental EA Proposed Project	736,316	2,212	N/A
	Current Proposed Action	621,011	2,075	6%

The emissions comparison from the screening analyses as presented above indicated that the emissions from the Embraer 175 aircraft are less than the Boeing 737-700 aircraft. Therefore, air quality impacts from the current Proposed Action would be less than the air quality impacts presented in the Draft Supplemental EA. As no significant impacts were identified in the Draft Supplemental EA and the current Proposed Action emissions are expected to be lower, there would be no significant impacts from the current Proposed Action. Therefore, the emissions models were not rerun to fully quantify this reduction.

The Draft Protocol Memo, this supplemental memo, and the correspondence between FAA and PSCAA are included in Appendix D, Air Quality, of the Final Supplemental EA. Revised forecast information, including enplanement data, is included in Chapter 3 and Appendix C, and information summarizing the emissions analysis completed herein is included in Chapter 6 of the Final Supplemental EA.