AIR QUALITY BASELINE (2016) CONDITION REPORT

Sustainable Airport Master Plan (SAMP) Environmental Review

Seattle-Tacoma International Airport

Preliminary Draft

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ACRONYMS

The following is a list of acronyms used in this Report.

AEDT	Airport Environmental Design Tool
ANOMS	Aircraft Noise and Operations Monitoring System
APU	Auxiliary Power Unit
ASPM	Aviation System Performance Metrics
ATADS	Air Traffic Activity System
BTU	British Thermal Unit
CAA	Clean Air Act
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2E	Carbon dioxide equivalent
FAA	Federal Aviation Administration
GAV	Ground Access Vehicle
GHG	Greenhouse Gas
GSE	Ground Support Equipment
H_2O	Water vapor
H_2SO_3	Sulfurous acid
H_2SO_4	Sulfric acid
HFC	Hydrofluorocarbon
LFA	LeighFisher
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NH_3	Carbon dioxide
NO	Nitric oxide
NO_X	Nitrogen oxides
NO_2	Nitrogen dioxide
O_3	Ozone
PFCs	Perfluorocarbon
PM_{10}	Coarse Particulate Matter
$PM_{2.5}$	Fine Particulate Matter
Pb	Lead
SAMP	Sustainable Airport Master Plan
SEPA	State Environmental Policy Act
SF_6	Sulfur hexafluoride
SIP	State Implementation Plan
SO_x	Sulfur oxide
SO_2	Sulfur dioxide
SO_3	Sulfur trioxide
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compounds

AIR QUALITY
BASELINE (2016) CONDITIONS

1.0 INTRODUCTION

The Port of Seattle, as the owner and operator of the Seattle-Tacoma International Airport (Sea-Tac or Airport), is currently completing a Sustainable Airport Master Plan (SAMP). The Master Plan will identify airport development projects for implementation. In order for the Port of Seattle to move forward with implementing these potential development projects, environmental approval will be required. It is anticipated that environmental documentation will be prepared to investigate, analyze, and disclose the potential environmental impacts of the proposed action and the reasonable alternatives in compliance with the National Environmental Policy Act of 1969 (NEPA) and the Washington State Environmental Policy Act (SEPA).

The preparation of the environmental documentation will follow Federal Aviation Administration (FAA) regulations and policies for implementing NEPA published in FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures*, and FAA Order 5050.4B, *NEPA Implementing Instructions for Airport Actions.* Potential air quality and climate impacts are categories that are required to be analyzed per these regulations. This report describes the regulatory setting and the existing air emissions generated by and at the Airport in advance of the formal NEPA/SEPA process and the identification of the preferred alternative in the Master Plan.

2.0 REGULATORY SETTING

2.1 NATIONAL AMBIENT AIR QUALITY STANDARDS

The Clean Air Act (CAA), including the 1990 Amendments, provides the establishment of standards and programs to evaluate, achieve, and maintain acceptable air quality in the United States. Under the CAA, the United States Environmental Protection Agency (USEPA) established a set of standards, or criteria, for six pollutants determined to be potentially harmful to human health and welfare.[1]

The USEPA considers the presence of the following six criteria pollutants to be indicators of air quality:

- Carbon monoxide (CO);
- Nitrogen dioxide (NO_2);
- Ground-level Ozone (O_3);
- Sulfur dioxide (SO_2);

1 USEPA, Code of Federal Regulations, Title 40, Part 50 (40 CFR Part 50) *National Primary and Secondary Ambient Air Quality Standards (*NAAQS), July 2011.

- Particulate matter (PM_{10} and $PM_{2.5}$);[2] and,
- Lead (Pb).[3]

The National Ambient Air Quality Standards for the criteria pollutants, known as the NAAQS, are summarized in **Table 1**. For each of the criteria pollutants, the USEPA established primary standards intended to protect public health, and secondary standards for the protection of other aspects of public welfare, such as preventing materials damage, preventing crop and vegetation damage, and assuring good visibility. Areas of the country where air pollution levels consistently exceed these standards may be designated nonattainment by the USEPA.

A nonattainment area is a homogeneous geographical area[4] (usually referred to as an air quality control region) that is in violation of one or more NAAQS and has been designated as nonattainment by the USEPA as provided for under the CAA. Some regulatory provisions, for instance the CAA conformity regulations, apply only to areas designated as nonattainment or maintenance.

A maintenance area describes the air quality designation of an area previously designated nonattainment by the USEPA and subsequently redesignated attainment after emissions are reduced. Such an area remains designated as maintenance for a period up to 20 years at which time the state can apply for redesignation to attainment, provided that the NAAQS were sufficiently maintained throughout the maintenance period.

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2 PM_{10} and $PM_{2.5}$ are airborne inhalable particles that are less than ten micrometers (coarse particles) and less than 2.5 micrometers (fine particles) in diameter, respectively.

3 Airborne lead in urban areas is primarily emitted by vehicles using leaded fuels.

4 A homogeneous geographical area, with regard to air quality, is an area, not necessarily bounded by state lines, where the air quality characteristics have been shown to be similar over the whole area. This may include several counties, encompassing more than one state, or may be a very small area within a single county.

Table 1
NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide		primary	8-hour	9 ppm	Not to be exceeded more than once/year
			1-hour	35 ppm	
Lead(2)		primary & secondary	Rolling 3 month average	0.15 µg/m3 (1)	Not to be exceeded
Nitrogen Dioxide		primary	1-hour	100 ppb	98th percentile of 1-hr daily maximum concentrations, averaged over 3 years
		primary & secondary	Annual	53 ppb(2)	Annual Mean
Ozone		primary & secondary	8-hour	0.075 ppm (3)	Annual 4th-highest daily maximum 8-hr concentration, averaged over 3 years
Particulate Matter	PM2.5	primary	Annual	12 µg/m^3	annual mean, averaged over 3 years
		secondary	Annual	15 µg/m^3	annual mean, averaged over 3 years
		primary & secondary	24-hour	35 µg/m^3	98th percentile, averaged over 3 years
	PM10	primary & secondary	24-hour	150 µg/m^3	Not to be exceeded more than once/year on average over 3 years
Sulfur Dioxide		primary	1-hour	75 ppb (4)	99th percentile of 1-hr daily maximum concentrations, averaged over 3 years
		secondary	3-hour	0.5 ppm	Not to be exceeded more than once/year

(1) In areas designated nonattainment for the Pb standards prior to the promulgation of the current (2008) standards, and for which implementation plans to attain or maintain the current (2008) standards have not been submitted and approved, the previous standards (1.5 µg/m3 as a calendar quarter average) also remain in effect.

(2) The level of the annual NO_2 standard is 0.053 ppm. It is shown here in terms of ppb for the purposes of clearer comparison to the 1-hour standard level.

(3) Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) O_3 standards additionally remain in effect in some areas. Revocation of the previous (2008) O_3 standards and transitioning to the current (2015) standards will be addressed in the implementation rule for the current standards.

(4) The previous SO2 standards (0.14 ppm 24-hour and 0.03 ppm annual) will additionally remain in effect in certain areas: (1) any area for which it is not yet 1 year since the effective date of designation under the current (2010) standards, and (2)any area for which an implementation plan providing for attainment of the current (2010) standard has not been submitted and approved and which is designated nonattainment under the previous SO2 standards or is not meeting the requirements of a SIP call under the previous SO2 standards (40 CFR 50.4(3)). A

SIP call is an EPA action requiring a state to resubmit all or part of its State Implementation Plan to demonstrate attainment of the required NAAQS.

Notes: ppm is parts per million; ppb is parts per billion, and μg/m^3 is micrograms per cubic meter.

Source: EPA, https://www.epa.gov/criteria-air-pollutants/naaqs-table accessed August 2017.

2.2 DESCRIPTION OF POLLUTANTS

The pollutants of concern related to airport activities in this analysis include ozone, carbon monoxide, volatile organic compounds, nitrogen dioxide, sulfur dioxide, particulate matter, and carbon dioxide. Since 1975, lead emissions have been in decline due in part to the introduction of catalyst-equipped vehicles and decline in production of leaded gasoline. In general, an analysis of lead is limited to projects that emit significant quantities of the pollutant (i.e. lead smelters) and are generally not applied to transportation projects and therefore not included in this emissions inventory.

Ozone (O_3) – Ozone is a pollutant which is not directly emitted; rather, ozone is formed in the atmosphere through photochemical reaction with nitrogen oxides (NO_X), volatile organic compounds (VOC), sunlight, and heat. Ozone is the primary constituent of smog and, because it is formed in the atmosphere, may result in health problems many miles away from the pollutant sources.

People with lung disease, children, older adults, and people who are active can be affected when ozone levels are unhealthy. Numerous scientific studies have linked ground-level ozone exposure to a variety of problems, including:

- lung irritation that can cause inflammation much like a sunburn;
- wheezing, coughing, pain when taking a deep breath, and breathing difficulties during exercise or outdoor activities;
- permanent lung damage to those with repeated exposure to ozone pollution; and
- aggravated asthma, reduced lung capacity, and increased susceptibility to respiratory illnesses like pneumonia and bronchitis.

Carbon Monoxide (CO) - Carbon monoxide is a colorless, odorless gas primarily associated with the incomplete combustion of fossil fuels in motor vehicles. Carbon monoxide combines with hemoglobin in the bloodstream and reduces the amount of oxygen that can be circulated through the body. High carbon monoxide concentrations can lead to headaches, aggravation of cardiovascular disease, and impairment of central nervous system functions. Carbon monoxide concentrations can vary greatly over comparatively short distances. Relatively high concentrations are typically found near crowded intersections, along heavily used roadways carrying slowmoving traffic, and at or near ground level. Even under the most severe meteorological and traffic conditions, high concentrations of carbon monoxide are limited to locations within a relatively short distance of heavily traveled roadways. Overall carbon monoxide emissions are decreasing as a result of the Federal Motor Vehicle Control Program, which has mandated increasingly lower emission levels for vehicles manufactured since 1973.

Volatile Organic Compound (VOC) – Volatile organic compounds are gases that are emitted from solids or liquids, such as stored fuel, paint, asphalt, and cleaning fluids. VOCs include a variety of chemicals, some which can have short and longterm adverse health effects. VOCs are precursor pollutants that react with heat, sunlight and nitrogen oxides to form ozone. VOCs can also mix with other gases to form fine particulate matter ($PM_{2.5}$).

Nitrogen Dioxide (NO_2) - Nitrogen gas, normally relatively inert (unreactive), comprises about 80% of the air. At high temperatures (i.e., in the combustion process) and under certain other conditions it can combine with oxygen, forming several different gaseous compounds collectively called nitrogen oxides (NO_x). Nitric oxide (NO) and nitrogen dioxide are the two most important compounds. Nitric oxide is converted to nitrogen dioxide in the atmosphere. Nitrogen dioxide is a red-brown pungent gas. Motor vehicle emissions are the main source of NO_x in urban areas.

Nitrogen dioxide is toxic to various animals as well as to humans. Its toxicity relates to its ability to form nitric acid with water in the eye, lung, mucus membrane and skin. In animals, long-term exposure to nitrogen oxides increases susceptibility to respiratory infections lowering their resistance to such diseases as pneumonia and influenza. Laboratory studies show susceptible humans, such as asthmatics, exposed to high concentrations of NO_2 can suffer lung irritation and potentially, lung damage. Epidemiological studies have also shown associations between NO_2 concentrations and daily mortality from respiratory and cardiovascular causes and with hospital admissions for respiratory conditions.

While the NAAQS only addresses NO_2, NO and the total group of nitrogen oxides is of concern. NO and NO_2 are both precursors in the formation of ozone and secondary particulate matter. Because of this and that NO emissions largely convert to NO_2, NO_x emissions are typically examined when assessing potential air quality impacts.

Sulfur Dioxide (SO_2) - Sulfur oxides (SO_x) constitute a class of compounds of which sulfur dioxide and sulfur trioxide (SO_3) are of greatest importance. SO_2 is commonly expressed as SO_X since it is a larger subset of sulfur dioxides. SO_2 is a colorless gas that is typically identified as having a strong odor and is formed when fuel-containing sulfur, like coal, oil, and/or jet fuel, is burned. SO_2 combines easily with water vapor, forming aerosols of sulfurous acid (H_2SO_3), a colorless, mildly corrosive liquid. This liquid may then combine with oxygen in the air, forming the even more irritating and corrosive sulfuric acid (H_2SO_4). Peak levels of SO_2 in the air can cause temporary breathing difficulty for people with asthma who are active outdoors. Longer-term exposures to high levels of SO_2 gas and particles cause respiratory illness and aggravate existing heart disease.

Particulate Matter (PM_{10} and $PM_{2.5}$) - Particulate matter includes both aerosols and solid particles of a wide range of size and composition. PM_{10} is considered coarse particles with a diameter of 10 micrometers or less, and $PM_{2.5}$, fine particles with a diameter of 2.5 micrometers or less. Emissions of $PM_{2.5}$ are a subset of emissions of PM_{10}. Particulate matter can be any particle of these sizes, including dust, dirt, and soot. Smaller particulates are of greater concern because they can penetrate deeper into the lungs than large particles.

$PM_{2.5}$ is directly emitted in combustion exhaust and formed from atmospheric reactions between various gaseous pollutants including nitrogen oxides (NO_x), sulfur oxides, and volatile organic compounds . PM_{10} is generally emitted directly as a result of mechanical processes that crush or grind larger particles or the resuspension of dust, most typically through construction activities and vehicular movements. $PM_{2.5}$ can remain suspended in the atmosphere for days and weeks and can be transported over long distances. PM_{10} generally settles out of the atmosphere rapidly and is not readily transported over large distances.

The principal health effect of airborne particulate matter is on the respiratory system. Short-term exposures to high $PM_{2.5}$ levels are associated with premature mortality, increased hospital admissions, and emergency room visits. Long-term exposures to high $PM_{2.5}$ levels are associated with premature mortality and development of chronic respiratory disease.

Carbon Dioxide (CO_2) - Carbon dioxide is a colorless, odorless gas produced through the incomplete combustion of fossil fuels. Carbon dioxide is considered to be the most significant greenhouse gas (GHG) that traps heat in the earth's atmosphere. Both naturally occurring and man-made greenhouse gases primarily include CO_2, water vapor (H_2O), methane (CH_4), and nitrous oxide (N_2O). These different chemical species that are emitted have a different effect on climate. The carbon dioxide equivalent (CO_2E) method is a way to show relative impacts on climate change of different chemical species.

2.3 KING COUNTY AIR QUALITY STATUS

Sea-Tac is located within King County, Washington, which is included in the Puget Sound Intrastate Air Quality Control Region.[5] The area was previously designated maintenance for ozone under the 1-hour ozone standard; however, the 1-hour standard was revoked by USEPA effective June 15, 2005. In the past, King County was also designated as nonattainment for CO; however, on October 11, 1996, the USEPA determined the area had attained the standard and the region was redesignated to attainment. The area now operates under a maintenance plan for CO. Several areas within King County are classified as maintenance for the PM_{10} standard, including Kent, Duwamish and Tacoma; however the Sea-Tac is not within any of these areas. The region is considered attainment for all other criteria pollutants including $PM_{2.5}$, nitrogen dioxide, sulfur dioxide, and lead.

3.0 BASELINE (2016) CONDITIONS

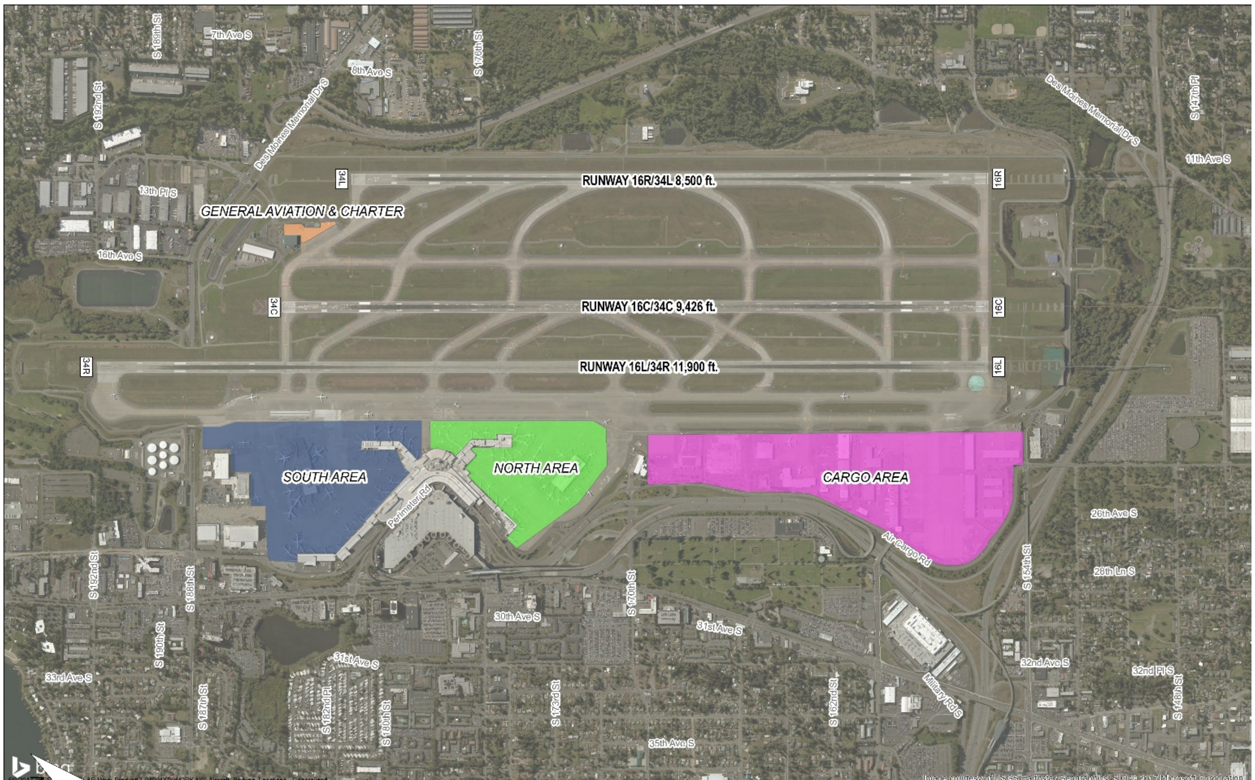
3.1 DESCRIPTION OF EXISTING AIRPORT

The Airport has three parallel runways. Runway 16L/34R is 11,900 feet long by 150 feet wide, Runway 16C/34C is 9,426 feet long by 150 feet wide, and Runway 16R/34L is 8,500 feet long by 150 feet wide. The passenger facilities at Sea-Tac are comprised of a terminal building including Concourses A, B, C, and D. In addition, there are two satellite concourses, referred to as the North and South satellites.

[5] USEPA, Title 40 Code of Federal Regulations Part 81.32.

For the purposes of this analysis, aircraft operations that occurred at Concourse A, B, and the South Satellite were considered to operate in the South area as shown in **Exhibit 1**. Aircraft operations that occurred at Concourse C, D, and the North Satellite were considered to operate in the North area. Cargo operations operated to the north in the area considered the cargo area. General Aviation and charter activity occurred to the south between Runway 16R/34L and Runway 16C/34C.

Exhibit 1
SEA-TAC GENERAL OPERATING AREAS



Source: Aerial imagery from Bing Maps, 2016; Landrum & Brown analysis, 2017.

The airport primarily operates in a south flow configuration. When the airport operates in this configuration, aircraft arrive from the north, landing on Runways 16L, 16C, and 16R; and depart to the south, taking off from Runways 16C, 16L, and to a lesser extent Runway 16R. When in a north flow configuration, aircraft arrive from the south, landing on Runways 34L, 34C, and 34R, and depart to the north, taking off on Runways 34C, 34R, and, to a lesser extent, 34L.

3.2 AIR QUALITY MONITORING IN REGION

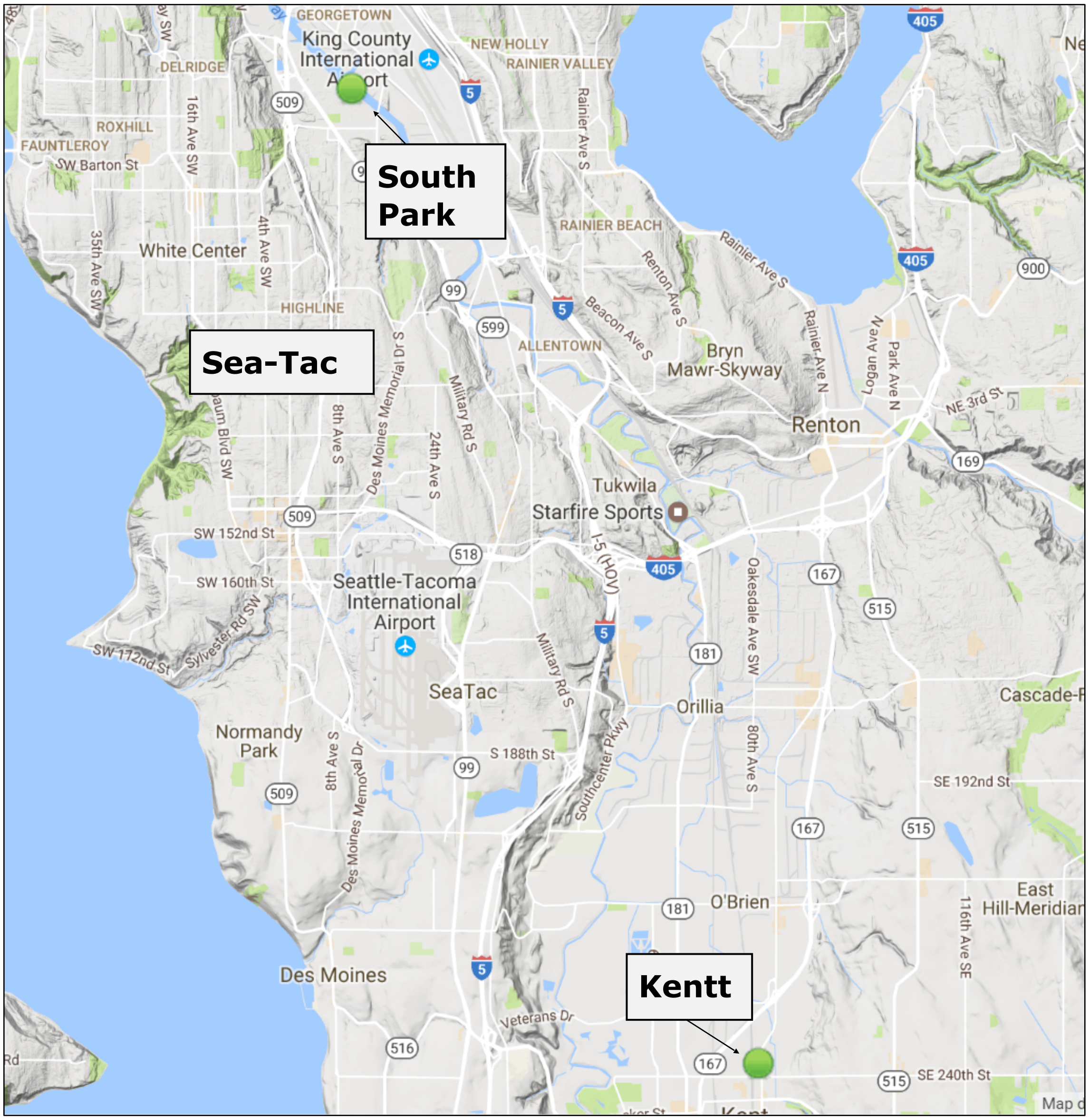
The State of Washington's Department of Ecology established an air monitoring network around the state that measures air pollution. King County's air quality monitoring stations are maintained by the Puget Sound Clean Air Agency. The two air quality monitoring stations closest to Sea-Tac are Seattle South Park and Kent. The air quality monitoring station at Kent is shown in **Exhibit 2**. The locations relative to Sea-Tac are provided in **Exhibit 3**. These two stations primarily monitor for the pollutant fine particulate matter ($PM_{2.5}$). Data from these monitors indicate if the air quality falls below the standard.[6]

Exhibit 2
AIR QUALITY MONITOR

Source: Puget Sound Clean Air Agency.

[6] Puget Sound Clean Air Agency. 2015 Air Quality Data Summary, August 2015.

Exhibit 3
AIR QUALITY MONITOR LOCATIONS NEAR SEA-TAC



Note: The two air quality monitoring stations (green identifier) nearest the Airport.
Source: Puget Sound Clean Air Agency.

3.3 EMISSION SOURCES

3.3.1 AIRCRAFT

The number and type of aircraft operations directly affects emissions. The existing conditions emissions inventory is based on aircraft operations occurring during calendar year 2016. Therefore, Air Traffic Activity System (ATADS) radar data was obtained for January 2016 through December 2016. A representative aircraft was determined based on the data obtained and JP Fleets was used to assign engine types for each aircraft.

In 2016, there were a total of 412,170 operations at Sea-Tac. Passenger operations comprised 97 percent of the total operations. Cargo, air taxi, charter, and general aviation operations make up the remaining three percent of the total operations. **Table 2** shows the breakdown of operations by type of operation.

Table 2
2016 ANNUAL OPERATIONS

TYPE OF OPERATION	ANNUAL OPERATIONS	PERCENT OF ANNUAL OPERATIONS
Passenger	398,593	97%
Cargo	9,195	2%
Air Taxi	453	< 1%
Charter	66	< 1%
General Aviation	3,863	< 1%
Total	**412,170**	**100%**

Note: Totals may not sum exactly due to rounding.
Source: Sea-Tac radar data for the period January 1, 2016 through December 31, 2016, Air Traffic Activity System (ATADS); Landrum & Brown analysis, 2017.

In 2016, there were a total of 398,593 passenger operations. Alaska Airlines made up approximately 29 percent of passenger operations. Horizon Air and Delta Airlines made up approximately 20 percent and 11 percent of passenger operations, respectively. The top passenger airlines are shown in **Table 3**.

Table 3
TOP 5 PASSENGER AIRLINES AT SEA-TAC

PASSENGER AIRLINE	PERCENT OF PASSENGER OPERATIONS
Alaska Airlines	29.70%
Horizon Air	20.15%
Delta Airlines	11.34%
SkyWest Airlines	10.21%
Southwest Airlines	6.90%

Source: Seattle-Tacoma International Airport EnvironmentalVue Monitoring System Data, January 2016-December 2016, Air Traffic Activity System (ATADS); Landrum & Brown analysis, 2017.

Horizon Air's Bombardier de Havilland Dash 8 Q400 was the most used passenger aircraft as it served approximately 20 percent of the passenger operations. This is followed by Alaska Airlines' Boeing 737-900 Series and Boeing 737-800 with winglets which served 14 percent and 10 percent of passenger operations. The detailed passenger aircraft fleet mix is shown in **Table 4**.

Table 4
2016 PASSENGER AIRCRAFT FLEET

AIRLINE	AIRCRAFT	ENGINE TYPE	OPERATIONS
Aeromexico	Boeing 737-800 with winglets	CFM56-7B27	4
Air Busan	Airbus A320-200 Series	V2527-A5	16
Air Busan	Boeing 737-500 Series	CFM56-3C-1	11
Air Canada	Airbus A319-100 Series	CFM56-5A5	274
Air Canada	Airbus A320-200 Series	CFM56-5-A1	26
Air Canada	Embraer ERJ190-AR	CF34-10E5	841
Alaska Airlines	Boeing 737-400 Series	CFM56-3C-1	12,218
Alaska Airlines	Boeing 737-700 Series	CFM56-7B22	9,724
Alaska Airlines	Boeing 737-800 with winglets	CFM56-7B24	38,947
Alaska Airlines	Boeing 737-900 Series	CFM56-7B24	57,478
All Nippon Airways	Boeing 777-300-ER	GE90-115B	6
All Nippon Airways	B787-8R	TRENT 1000-J2	513
All Nippon Airways	Boeing 787-900 Dreamliner	TRENT 1000-J2	228
American Airlines	Airbus A319-100 Series	CFM56-5B6/2	766
American Airlines	Airbus A320-100 Series	V2527-A5	1,554
American Airlines	Airbus A321-200 Series	V2533-A5	7,220
American Airlines	Boeing 737-800 with winglets	CFM56-7B26	8,649
American Airlines	Boeing 757-200 Series	RB211-535E4	33
American Airlines	Boeing 767-300 ER	CF6-80C2B6	5
American Airlines	B787-8R	GENX-1B70	4
American Airlines	Boeing MD-83	JT8D-217	8
Asiana Airlines	Airbus A330-300 Series	PW4168	164
Asiana Airlines	Boeing 747-400 Series	CF6-80C2B1F	341
Asiana Airlines	Boeing 777-200-ER	PW4090	426
Atlas Air	Boeing 747-400 Series	CF6-80C2B1F	12
Atlas Air	Boeing 767-300 ER Freighter	CF6-80C2B7F	132
British Airways	Boeing 747-400 Series	RB211-524H	397
British Airways	Boeing 777-200-ER	GE90-85B	331
British Airways	Boeing 777-300-ER	GE90-115B	436
Compass Airlines	Embraer ERJ175-LR	CF34-8E5	11,344
Compass Airlines	Embraer ERJ175	CF34-8E5	3

AIRLINE	AIRCRAFT	ENGINE TYPE	OPERATIONS
Compass Airlines	Embraer ERJ175-LR	CF34-8E5	959
Compass Airlines	Embraer ERJ175-LR	CF34-8E5	5,765
Condor	Boeing 767-300 ER	PW4062	275
Delta Airlines	Airbus A319-100 Series	CFM56-5A5	301
Delta Airlines	Airbus A320-200 Series	CFM56-5A3	821
Delta Airlines	Airbus A330-200 Series	PW4168	1,098
Delta Airlines	Airbus A330-300 Series	PW4168	1,304
Delta Airlines	Boeing 717-200 Series	BR700-715A1-30	6,713
Delta Airlines	Boeing 737-800 Series	CFM56-7B26	10,813
Delta Airlines	Boeing 737-900-ER	CFM56-7B26	8,988
Delta Airlines	Boeing 747-400 Series	PW4056	224
Delta Airlines	Boeing 757-200 Series	PW2037	7,986
Delta Airlines	Boeing 757-300 Series	PW2043	2,325
Delta Airlines	Boeing 767-300 ER	PW4060	4,214
Delta Airlines	Boeing 767-400 ER	CF6-80C2B8F	118
Delta Airlines	Boeing 777-200-LR	GE90-110B1	278
Delta Airlines	Boeing 777-200-LR	GE90-110B1	12
Delta Airlines	Boeing MD-90	V2525-D5	6
Emirates Airlines	Boeing 777-200-LR	GE90-110B1	501
Emirates Airlines	Boeing 777-300-ER	GE90-115B	871
EVA Air	Boeing 747-400 Series	CF6-80C2B1F	293
EVA Air	Boeing 777-300-ER	GE90-115B	505
Executive Jet Management	Cessna 750 Citation X	AE3007C	6
Executive Jet Management	Raytheon Hawker 800	TFE731-3	8
Flexjets	Bombardier Challenger 300	HTF7000	28
Flexjets	Bombardier Global Express	BR700-710A2-20	5
Flexjets	Gulfstream IV-SP	TAY 611-8C	8
Flexjets	Bombardier Learjet 75	TFE731-3	14
FlightOptions	Raytheon Beechjet 400	JT15D-5, -5A, -5B	14
FlightOptions	Cessna 750 Citation X	AE3007C2	6
FlightOptions	Embraer 505	BIZLIGHTJET_F	22
Frontier Airlines	Airbus A319-100 Series	CFM56-5A5	1,185
Frontier Airlines	Airbus A320-100 Series	CFM56-5B4	1,000

AIRLINE	AIRCRAFT	ENGINE TYPE	OPERATIONS
Frontier Airlines	Airbus A321-200 Series	V2533-A5	48
Hainan Airlines	Airbus A330-200 Series	TRENT 772	93
Hainan Airlines	Airbus A330-300 Series	TRENT 772	527
Hainan Airlines	B787-8R	GENX-1B74/75/P1	355
Hainan Airlines	Boeing 787-900 Dreamliner	GENX-1B74/75/P1	30
Hawaii Airlines	Airbus A330-200 Series	TRENT 772	1,523
Hawaii Airlines	Boeing 767-300 ER	PW4060	4
Horizon Air	Bombardier de Havilland Dash 8 Q300	PW123C	6
Horizon Air	Bombardier de Havilland Dash 8 Q400	PW150A	80,327
Iceland Air	Boeing 757-200 Series	RB211-535E4	961
Jazz Aviation LP	Bombardier CRJ-200-ER	CF34-3B	12
Jazz Aviation LP	Bombardier CRJ-900-ER	CF34-8C5	273
Jazz Aviation LP	Bombardier de Havilland Dash 8 Q300	PW123	1,413
Jazz Aviation LP	Bombardier de Havilland Dash 8 Q400	PW150A	1,979
JetBlue Airways	Airbus A320-200 Series	V2527-A5	4,381
JetBlue Airways	Airbus A321-200 Series	V2533-A5	4
Korean Air	Boeing 747-400 ER	PW4060	165
Korean Air	Boeing 747-800 Freighter	GENX-2B67	220
Korean Air	Boeing 777 Freighter	GE90-110B1	607
Lufthansa	Boeing 747-400 Series	CF6-80C2B1F	59
Mountain Aviation "FOOT HILLS"	Cessna 560 Citation V	JT15D-5, -5A, -5B	8
Mountain Aviation "FOOT HILLS"	Bombardier Learjet 31	TFE731-2-2B	4
Netjets Aviation "EXECJET"	Cessna 560 Citation XLS	JT15D-5, -5A, -5B	87
Netjets Aviation "EXECJET"	Cessna 680 Citation Sovereign	PW306B	26
Netjets Aviation "EXECJET"	Cessna 750 Citation X	AE3007C	44
Netjets Aviation "EXECJET"	Bombardier Challenger 300	HTF7000 (AS907-1-1A)	33
Netjets Aviation "EXECJET"	Bombardier Challenger 600	AS907-1-1A	12
Netjets Aviation "EXECJET"	Embraer 505	BIZLIGHTJET_F	37
Netjets Aviation "EXECJET"	Dassault Falcon 2000	PW308C	24
Netjets Aviation "EXECJET"	Bombardier Global Express	BR700-710A2-20	12
Netjets Aviation "EXECJET"	Raytheon Hawker 800	TFE731-3	29
Netjets Aviation "EXECJET"	Cessna 560 Citation V	PW530	38
Omni Air	Boeing 767-300 ER	CF6-80C2B6	447

AIRLINE	AIRCRAFT	ENGINE TYPE	OPERATIONS
SkyWest Airlines	Bombardier CRJ-200-ER	CF34-3B	571
SkyWest Airlines	Bombardier CRJ-700-ER	CF34-8C1	26,983
SkyWest Airlines	Bombardier CRJ-900-ER	CF34-8C5	4,578
SkyWest Airlines	Embraer ERJ170	CF34-8E5	2,513
SkyWest Airlines	Embraer ERJ175	CF34-8E5	6,043
Southwest Airlines	Boeing 737-300 Series	CFM56-3-B1	3,075
Southwest Airlines	Boeing 737-700 Series	CFM56-7B22	17,504
Southwest Airlines	Boeing 737-800 Series	CFM56-7B26	6,924
Spirit Airlines	Airbus A319-100 Series	V2524-A5	1,017
Spirit Airlines	Airbus A320-200 Series	V2527-A5	1,152
Sun Country Airlines	Boeing 737-700 Series	CFM56-7B22	262
Sun Country Airlines	Boeing 737-800 with winglets	CFM56-7B27	826
Travel Management C	Raytheon Hawker 800	TFE731-3	10
Turkish Airlines	Boeing 737-700 Series	CFM56-7B22	4
United Airlines	Airbus A319-100 Series	V2522-A5	1,708
United Airlines	Airbus A320-200 Series	V2527-A5	4,474
United Airlines	Boeing 737-700 Series	CFM56-7B24	374
United Airlines	Boeing 737-800 Series	CFM56-7B26	3,769
United Airlines	Boeing 737-900-ER	CFM56-7B26	7,949
United Airlines	Boeing 757-200 Series	PW2037	81
United Airlines	Boeing 757-300 Series	RB211-535E4B	835
United Airlines	Boeing 767-300 ER	PW4060	7
United Airlines	Boeing 767-400	CF6-80C2B8F	8
United Airlines	Boeing 787-900 Dreamliner	GENX-1B74/75/P1	12
Virgin America	Airbus A319-100 Series	CFM56-5B6/2	2,014
Virgin America	Airbus A320-200 Series	CFM56-5B4	3,067
Volaris	Airbus A320-200 Series	CFM56-5B4	158
Xiamen Airlines	B787-8R	TRENT 1000-J2	86
XOJet	Cessna 750 Citation X	AE3007C2	16
XOJet	Bombardier Challenger 300	AS907-1-1A	8
		TOTAL PASSENGER OPERATIONS	**398,593**

Source: Seattle-Tacoma International Airport EnvironmentalVue Monitoring System Data, January 2016-December 2016, Air Traffic Activity System (ATADS); Landrum & Brown analysis, 2017.

In 2016, there were a total of 9,195 cargo operations. FedEx Express made up approximately 47 percent of cargo operations. Empire Airlines and ABX Air made up approximately 15 percent and 10 percent of cargo operations, respectively. FedEx Express' Boeing MD-11 Freighter was the most used cargo aircraft as it served approximately 19 percent of the cargo operations. This is followed by Empire Airlines' Cessna 208 Caravan and FedEx Express' Boeing MD-10-30 which served 15 percent and 12 percent of the cargo operations. The detailed cargo aircraft fleet mix is shown in **Table 5**.

Table 5
2016 CARGO AIRCRAFT FLEET MIX

AIRLINE	AIRCRAFT	ENGINE TYPE	OPERATION
ABX Air	Boeing 767-200 Series	CF6-80A	694
ABX Air	Boeing 767-300 ER Freighter	CF6-80C2B6	192
Air Bridge Cargo	7478	GENX-2B67	58
Air China Cargo	Boeing 777 Freighter	GE90-110B1	30
Air Transport	Boeing 757-200 Series	PW2037	432
Air Transport	Boeing 767-200 Series	CF6-80A2	77
Air Transport	Boeing 767-300 Series	CF6-80C2B6	164
Asiana Airlines	Airbus A330-300 Series	PW4168	6
Asiana Airlines	Boeing 747-400 Series	CF6-80C2B1F	20
Atlas Air	Boeing 767-200 Series	JT9D-7R4D,	6
Atlas Air	Boeing 767-300 ER Freighter	CF6-80C2B7F	6
Cargolux	Boeing 747-400 Series	CF6-80C2B1F	104
Cargolux	Boeing 747-800 Freighter	GENX-2B67	202
China Airlines	Boeing 747-400 Series	CF6-80C2B5F	554
China Cargo Airlines	ATR 42-200	PW120	46
Empire Airlines	Cessna 208 Caravan	PT6A-114	1,383
FEDEX EXPRESS	Airbus A300F4-600 Series	CF6-80C2A5	760
FEDEX EXPRESS	Airbus A310-200 Series	CF6-80A3	4
FEDEX EXPRESS	Boeing 757-200 Series	RB211-535E4	534
FEDEX EXPRESS	Boeing 767-300 ER Freighter	CF6-80C2B6	157
FEDEX EXPRESS	Boeing 777 Freighter	GE90-110B1	40
FEDEX EXPRESS	Boeing MD-10-30	CF6-50C2	1,063
FEDEX EXPRESS	Boeing MD-11 Freighter	CF6-80C2D1F	1,751
Kalitta Air	Boeing 747-200 Series	JT9D-7A	22
Kalitta Air	Boeing 747-400 Series	CF6-80C2B5F	37

AIRLINE	AIRCRAFT	ENGINE TYPE	OPERATION
Kalitta Charters	Boeing 727-200 Series	JT8D-15	12
Kalitta Charters	Bombardier Learjet 35	TFE731-2-2B	6
Korean Air	Boeing 747-400 ER	PW4060	26
Korean Air	Boeing 747-800 Freighter	GENX-2B67	6
Lufthansa	Boeing 747-400 Series	CF6-80C2B1F	624
Polar Air Cargo	Boeing 747-400 Series	CF6-80C2B5F	17
Polar Air Cargo	Boeing 747-800 Freighter	GENX-2B67	4
Singapore Airlines Cargo	Boeing 747-400 Series	PW4056	123
UPS Airlines	Boeing 757-200 Series	RB211-535E4	4
UPS Airlines	Boeing 767-300 ER Freighter	CF6-80C2B6	8
Volga-Dnepr Airlines	Antonov 124 Ruslan	D-36	23
		TOTAL CARGO OPERATIONS	**9,195**

Source: Seattle-Tacoma International Airport EnvironmentalVue Monitoring System Data, January 2016-December 2016, Air Traffic Activity System (ATADS); Landrum & Brown analysis, 2017.

In 2016, there were a total of 453 air taxi operations. Airpac Airlines, Inc and Ameriflight made up approximately 52 percent and 47 percent of air taxi operations, respectively. Ameriflight's Raytheon Beech 99 was the most used air taxi aircraft as it served approximately 47 percent of the air taxi operations. This is followed by Airpac Airlines, Inc's Piper PA-31 Navajo which served 45 percent of the air taxi operations. The detailed air taxi aircraft fleet mix is shown in **Table 6**.

Table 6
2016 AIR TAXI AIRCRAFT FLEET MIX

AIRLINE	AIRCRAFT	ENGINE TYPE	OPERATIONS
Airnet Express	Bombardier Learjet 35	TFE731-2-2B	4
Airpac Airlines, Inc	Cessna 208 Caravan	PT6A-114	32
Airpac Airlines, Inc	Piper PA-31 Navajo	TIO-540-J2B2	203
Ameriflight	Raytheon Beech 99	PT6A-20	214
		TOTAL AIR TAXI OPERATIONS	**453**

Source: Seattle-Tacoma International Airport EnvironmentalVue Monitoring System Data, January 2016-December 2016, Air Traffic Activity System (ATADS); Landrum & Brown analysis, 2017.

In 2016, there were a total of 66 charter operations. Xtra Airways made up approximately 50 percent of the charter operations. Xtra Airways' Boeing 737-400 Series was the most used charter aircraft as it served approximately 40 percent of the charter operations. The detailed charter aircraft fleet mix is shown in **Table 7**.

Table 7
2016 CHARTER AIRCRAFT FLEET

AIRLINE	AIRCRAFT	ENGINE	OPERATIONS
Ameristar Air Cargo	Boeing DC-9-10 Series	JT8D-7 SERIES	8
Miami Air International/Quest Cargo International	Boeing 737-800 with winglets	CFM56-7B26	13
Red Wing Charter	Cessna 560 Citation V	JT15D-5, -5A, -5B	4
Royal Air	Dassault Falcon 200	CF700-2D	4
Royal Air	Bombardier Learjet 35	TFE731-2-2B	4
Xtra Airways	Boeing 737-400 Series	CFM56-3C-1	26
Xtra Airways	Boeing 737-800 with winglets	CFM56-7B27	7
		TOTAL CHARTER OPERATIONS	**66**

Source: Seattle-Tacoma International Airport EnvironmentalVue Monitoring System Data, January 2016-December 2016, Air Traffic Activity System (ATADS); Landrum & Brown analysis, 2017.

In 2016, there were a total of 3,863 general aviation operations. The Cessna 208 Caravan aircraft and the Cessna 172 Skyhawk aircraft were the most used general aviation aircraft as they served approximately 34 percent and 17 percent of general aviation operations, respectively. The detailed general aviation aircraft fleet mix is shown in **Table 8**.

Table 8
2016 GENERAL AVIATION AIRCRAFT FLEET

AIRCRAFT	ENGINE	OPERATIONS
Bombardier Challenger 600	CF34-3B	148
Bombardier Learjet 35	TFE731-2-2B	151
Cessna 172 Skyhawk	IO-320-D1AD	659
Cessna 182	IO-360-B	140
Cessna 208 Caravan	PT6A-114	1,298
Cessna 560 Citation Excel	JT15D-5, -5A, -5B	288
Cessna 680 Citation Sovereign	PW306B	77
DeHavilland DHC-6-100 Twin Otter	PT6A-20	222
EADS Socata TB-9 Tampico	O-320	232
Falcon 900DX	TFE731-3	443
Gulfstream IV-SP	TAY MK611-8	138
Piper PA-28 Cherokee Series	IO-320-D1AD	67
TOTAL GENERAL AVIATION OPERATIONS		**3,863**

Source: Seattle-Tacoma International Airport EnvironmentalVue Monitoring System Data, January 2016-December 2016, Air Traffic Activity System (ATADS); Landrum & Brown analysis, 2017.

3.3.2 AUXILAIRY POWER UNITS

The larger jet aircraft use auxiliary power units (APUs) while at the gate to operate the heating, air conditioning, and electric systems. The APU is also used to start or restart the aircraft engines before departing from the gate area. APU usage causes emissions and is under the control of the pilot; therefore, APU use and emissions can vary greatly from one airline to another and even one aircraft to another. Therefore, APUs are modeled by aircraft operation. For the existing conditions emissions inventory, AEDT defaults were used for APUs.

3.3.3 MOBILE SOURCES

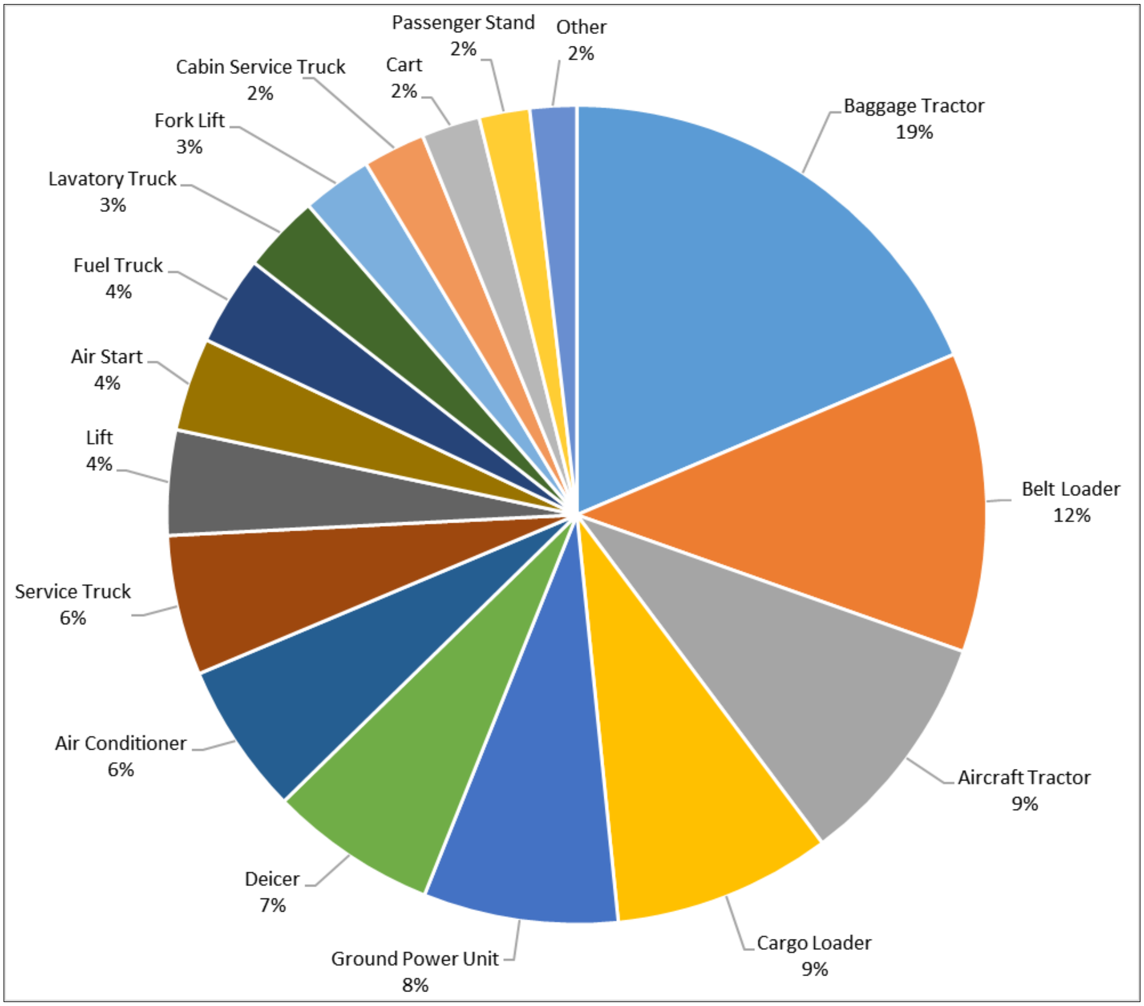
Mobile sources of air pollution include motor vehicles and other engines and equipment that can be moved from one location to another. These are typically classified as road sources and non-road sources. Non-road sources include ground support equipment (GSE) and construction equipment. Road sources include automobiles, light duty and heavy-duty trucks, buses, and motorcycles referred to as Ground Access Vehicles (GAVs). The determination of GAV emissions will be conducted during the formal NEPA/SEPA process.

For this baseline conditions emissions inventory, it is important to identify all of the types of GSE in order to determine emissions. Typical GSE includes air conditioning, air start, baggage tractors, belt loaders, catering vehicles, and emergency vehicles that support airport operations.

GSE can be modeled using two different methods: 1) GSE assignment to a specific aircraft operation and 2) by total GSE equipment population. For the method of assigning GSE to an aircraft by operation, GSE emissions are dependent upon the number of specific aircraft operations and type of aircraft. GSE emissions generated per operation are the product of the emission factor, horsepower, load factor, and operating time per the aircraft operation. GSE may also be modeled by the equipment population method. For a known population of GSE, the emissions are the product of the emission factor for the given pollutant, horsepower, load factor, usage, and population.

For this analysis, GSE was modeled by total population. Data was provided by Sea-Tac. For the existing conditions, there are a total of 651 GSE units supporting Sea-Tac. The reported number of baggage tractor and belt loader units are the highest out of the rest of the GSE equipment, as shown in **Exhibit 4**.

Exhibit 4
GSE EQUIPMENT



Source: LeighFisher, 2016.

GSE usage from 2014 was obtained from Sea-Tac. It was assumed that GSE for 2016 would be directly related to projected increases in annual aircraft operations. In 2016, baggage tractors were the most frequently used GSE. Belt loaders and cargo loaders are the second and third most used GSE. The 2016 GSE equipment inventory the total annual usage and the fuel type is shown in **Table 9**.

Table 9
2016 GROUND SUPPORT EQUIPMENT INVENTORY

FUEL TYPE	GSE TYPE	REFERENCE	POPULATION	HORSEPOWER	LOAD FACT	YEAR	ANNUAL USAGE
Diesel	Air	ACE 802	3	300	0.75	199	977
Diesel	Air	ACE 802	1	300	0.75	199	977
Diesel	Air	ACE 802	1	300	0.75	200	977
Diesel	Air	ACE 802	1	300	0.75	200	977
Diesel	Air	ACE 802	1	300	0.75	200	977
Diesel	Air	ACE 802	4	300	0.75	200	977
Diesel	Air	ACE 802	28	300	0.75	200	977
Gasoli	Air Start	ACE 180	1	425	0.90	199	403
Diesel	Air Start	ACE 180	1	425	0.90	200	403
Diesel	Air Start	ACE 180	1	425	0.90	198	403
Diesel	Air Start	ACE 180	1	425	0.90	199	403
Diesel	Air Start	ACE 180	13	425	0.90	199	403
Diesel	Air Start	ACE 180	1	425	0.90	199	403
Diesel	Air Start	ACE 180	1	425	0.90	199	403
Diesel	Air Start	ACE 180	1	425	0.90	199	403
Diesel	Air Start	ACE 180	1	425	0.90	199	403
Diesel	Air Start	ACE 180	1	425	0.90	200	403
Diesel	Air Start	ACE 180	1	425	0.90	200	403
Diesel	Air Start	ACE 180	1	425	0.90	200	403
Gasoli	Aircraft	Stewart & Stevenson TUG	1	0	0.80	199	775
Diesel	Aircraft	Stewart & Stevenson TUG	1	0	0.80	199	775
Diesel	Aircraft	Stewart & Stevenson TUG	1	0	0.80	200	775
Diesel	Aircraft	Stewart & Stevenson TUG	2	0	0.80	200	775
Diesel	Aircraft	Stewart & Stevenson TUG	1	0	0.80	200	775
Diesel	Aircraft	Stewart & Stevenson TUG	1	0	0.80	200	775
Diesel	Aircraft	Stewart & Stevenson TUG	46	0	0.80	199	775
Diesel	Aircraft	Stewart & Stevenson TUG	1	0	0.80	198	775
Diesel	Aircraft	Stewart & Stevenson TUG	1	0	0.80	198	775
Diesel	Aircraft	Stewart & Stevenson TUG	1	0	0.80	198	775
Diesel	Aircraft	Stewart & Stevenson TUG	1	0	0.80	198	775

FUEL TYPE	GSE TYPE	REFERENCE	POPULATION	HORSEPOWER	LOAD FACT	YEAR	ANNUAL USAGE
Diesel	Aircraft	Stewart & Stevenson TUG	1	0	0.80	199	775
Diesel	Aircraft	Stewart & Stevenson TUG	1	0	0.80	199	775
Diesel	Aircraft	Stewart & Stevenson TUG	1	0	0.80	199	775
Diesel	Aircraft	Stewart & Stevenson TUG	1	0	0.80	199	775
Gasoli	Baggage	Stewart & Stevenson TUG	37	71	0.55	199	1813
Gasoli	Baggage	Stewart & Stevenson TUG	2	71	0.55	198	1813
Gasoli	Baggage	Stewart & Stevenson TUG	1	71	0.55	200	1813
Gasoli	Baggage	Stewart & Stevenson TUG	1	71	0.55	200	1813
Gasoli	Baggage	Stewart & Stevenson TUG	1	71	0.55	200	1813
Gasoli	Baggage	Stewart & Stevenson TUG	1	71	0.55	200	1813
Gasoli	Baggage	Stewart & Stevenson TUG	6	71	0.55	200	1813
Diesel	Baggage	Stewart & Stevenson TUG	3	71	0.55	199	1813
Diesel	Baggage	Stewart & Stevenson TUG	2	71	0.55	199	1813
Diesel	Baggage	Stewart & Stevenson TUG	4	71	0.55	199	1813
Diesel	Baggage	Stewart & Stevenson TUG	1	71	0.55	200	1813
Diesel	Baggage	Stewart & Stevenson TUG	1	71	0.55	200	1813
Diesel	Baggage	Stewart & Stevenson TUG	1	71	0.55	200	1813
Diesel	Baggage	Stewart & Stevenson TUG	1	71	0.55	200	1813
Diesel	Baggage	Stewart & Stevenson TUG	2	71	0.55	200	1813
Diesel	Baggage	Stewart & Stevenson TUG	3	71	0.55	200	1813
Diesel	Baggage	Stewart & Stevenson TUG	18	71	0.55	199	1813
Diesel	Baggage	Stewart & Stevenson TUG	33	71	0.55	199	1813
Diesel	Baggage	Stewart & Stevenson TUG	3	71	0.55	198	1813
Gasoli	Belt Loader	Stewart & Stevenson TUG	22	71	0.50	200	1572
Gasoli	Belt Loader	Stewart & Stevenson TUG	1	71	0.50	199	1572
Gasoli	Belt Loader	Stewart & Stevenson TUG	1	71	0.50	199	1572
Gasoli	Belt Loader	Stewart & Stevenson TUG	1	71	0.50	199	1572
Gasoli	Belt Loader	Stewart & Stevenson TUG	6	71	0.50	200	1572
Gasoli	Belt Loader	Stewart & Stevenson TUG	2	71	0.50	200	1572
Gasoli	Belt Loader	Stewart & Stevenson TUG	2	71	0.50	200	1572
Gasoli	Belt Loader	Stewart & Stevenson TUG	1	71	0.50	200	1572
Gasoli	Belt Loader	Stewart & Stevenson TUG	1	71	0.50	200	1572

FUEL TYPE	GSE TYPE	REFERENCE	POPULATION	HORSEPOWER	LOAD FACT	YEAR	ANNUAL USAGE
Diesel	Belt Loader	Stewart & Stevenson TUG	29	71	0.50	200	1572
Diesel	Belt Loader	Stewart & Stevenson TUG	6	71	0.50	200	1572
Diesel	Belt Loader	Stewart & Stevenson TUG	1	71	0.50	200	1572
Propa	Belt Loader	Stewart & Stevenson TUG	1	71	0.50	200	1572
Propa	Belt Loader	Stewart & Stevenson TUG	3	71	0.50	199	1572
Gasoli	Cabin	Hi-Way F650	3	210	0.53	200	1934
Gasoli	Cabin	Hi-Way F650	1	210	0.53	199	1934
Diesel	Cabin	Hi-Way F650	11	210	0.53	200	1934
Diesel	Cabin	Hi-Way F650	1	210	0.53	200	1934
Gasoli	Cargo Loader	FMC Commander 15	7	80	0.50	199	1330
Diesel	Cargo Loader	FMC Commander 15	21	80	0.50	199	1330
Diesel	Cargo Loader	FMC Commander 15	1	80	0.50	198	1330
Diesel	Cargo Loader	FMC Commander 15	1	80	0.50	199	1330
Diesel	Cargo Loader	FMC Commander 15	1	80	0.50	199	1330
Diesel	Cargo Loader	FMC Commander 30	8	80	0.50	200	1330
Diesel	Cargo Loader	FMC Commander 30	1	133	0.50	200	1330
Diesel	Cargo Loader	FMC Commander 30	2	133	0.50	200	1330
Diesel	Cargo Loader	FMC Commander 30	1	133	0.50	200	1330
Diesel	Cargo Loader	FMC Commander 30	3	133	0.50	200	1330
Diesel	Cargo Loader	FMC Commander 30	2	133	0.50	200	1330
Diesel	Cargo Loader	FMC Commander 30	1	133	0.50	199	1330
Diesel	Cargo Loader	FMC Commander 30	2	133	0.50	199	1330
Diesel	Cargo Loader	FMC Commander 30	1	133	0.50	199	1330
Diesel	Cargo Loader	FMC Commander 30	1	133	0.50	199	1330
Diesel	Cargo Loader	FMC Commander 30	2	133	0.50	200	1330
Propa	Cargo Loader	FMC Commander 30	1	80	0.50	199	1330
Gasoli	Cart	Taylor Dunn	12	25	0.50	199	121
Gasoli	Cart	Taylor Dunn	3	25	0.50	199	121
Gasoli	Deicer	FMC Tempest II, Single	32	165	0.95	199	604
Gasoli	Deicer	FMC Tempest II, Single	1	165	0.95	198	604
Gasoli	Deicer	FMC Tempest II, Single	1	165	0.95	198	604
Gasoli	Deicer	FMC Tempest II, Single	1	165	0.95	199	604

FUEL TYPE	GSE TYPE	REFERENCE	POPULATION	HORSEPOWER	LOAD FACT	YEAR	ANNUAL USAGE
Gasoli	Deicer	FMC Tempest II, Single	4	165	0.95	199	604
Gasoli	Deicer	FMC Tempest II, Single	1	165	0.95	199	604
Gasoli	Deicer	FMC Tempest II, Single	1	165	0.95	198	604
Gasoli	Deicer	FMC Tempest II, Single	1	165	0.95	199	604
Gasoli	Deicer	FMC Tempest II, Single	1	165	0.95	199	604
Diesel	Fork Lift	Toyota 5,000 lb	5	55	0.30	199	1180
Propa	Fork Lift	Toyota 5,000 lb	13	55	0.30	199	1180
Diesel	Fuel Truck	F750, Dukes Transportation Services,	1	175	0.25	1995	682
Diesel	Fuel Truck	F750, Dukes Transportation Services,	21	175	0.25	1997	682
Diesel	Fuel Truck	F750, Dukes Transportation Services,	1	175	0.25	1998	682
Gasoli	Ground	TLD, 400 Hz AC	1	194	0.75	200	2055
Diesel	Ground	TLD, 400 Hz AC	36	194	0.75	200	2055
Diesel	Ground	TLD, 400 Hz AC	1	194	0.75	201	2055
Diesel	Ground	TLD, 400 Hz AC	1	194	0.75	198	2055
Diesel	Ground	TLD, 400 Hz AC	2	194	0.75	198	2055
Diesel	Ground	TLD, 400 Hz AC	1	194	0.75	199	2055
Diesel	Ground	TLD, 400 Hz AC	2	194	0.75	199	2055
Diesel	Ground	TLD, 400 Hz AC	2	194	0.75	200	2055
Diesel	Ground	TLD, 400 Hz AC	1	194	0.75	200	2055
Diesel	Ground	TLD, 400 Hz AC	2	194	0.75	200	2055
Diesel	Ground	TLD, 400 Hz AC	1	194	0.75	200	2055
Gasoli	Lavatory	TLD 1410	13	56	0.25	199	1804
Diesel	Lavatory	Wollard TLS-770 / F350	7	235	0.25	199	1804
Gasoli	Lift	*EPA Default*	1	115	0.50	199	412
Gasoli	Lift	*EPA Default*	1	115	0.50	200	412
Gasoli	Lift	*EPA Default*	2	115	0.50	200	412
Gasoli	Lift	*EPA Default*	1	115	0.50	200	412
Diesel	Lift	*EPA Default*	20	115	0.50	200	412
Propa	Lift	*EPA Default*	2	115	0.50	200	412
Gasoli	Other	*EPA Default*	1	140	0.50	200	1990

FUEL TYPE	GSE TYPE	REFERENCE	POPULATION	HORSEPOWER	LOAD FACT	YEAR	ANNUAL USAGE
Diesel	Other	*EPA Default*	11	140	0.50	200	1990
Gasoli	Passenger	Wollard CMPS170 /	4	65	0.57	199	227
Diesel	Passenger	Wollard CMPS170 /	1	65	0.57	200	227
Diesel	Passenger	Wollard CMPS170 /	1	65	0.57	200	227
Diesel	Passenger	Wollard CMPS170 /	1	65	0.57	201	227
Diesel	Passenger	Wollard CMPS170 /	4	65	0.57	199	227
Diesel	Passenger	Wollard CMPS170 /	1	65	0.57	197	227
Propa	Passenger	Wollard CMPS170 /	1	65	0.57	199	227
Gasoli	Service Truck	F250 / F350	5	235	0.20	200	1016
Diesel	Service Truck	F250 / F350	1	235	0.20	200	1016
Diesel	Service Truck	F250 / F350	26	235	0.20	200	1016
Diesel	Service Truck	F250 / F350	1	235	0.20	200	1016
Natural Gas	Service Truck	F250 / F350	1	235	0.20	2005	1016
Propa	Service Truck	F250 / F350	2	235	0.20	200	1016

Source: LeighFisher, 2016 and Landrum & Brown analysis, 2017.

3.3.4 STATIONARY SOURCES

Stationary sources of air pollution include generators and boilers located on Airport property. These stationary sources are a small percentage of the overall emission inventory and are unlikely to change significantly from year-to-year. It is important for the modeling of air pollution that run-time hours and estimated energy used by boilers are identified. In 2016, the most frequently used boiler was the wall-fired boiler fueled by natural gas. The boiler inventory is shown in **Table 10**.

Table 10
2016 STATIONARY SOURCES INVENTORY - BOILERS

TYPE	1000^3 CUBIC METERS PER YEAR
Natural Gas: Wall Fired Boiler, <100 Million BTU/hr, Uncontrolled	59.22
Natural Gas: Wall Fired Boiler, <100 Million BTU/hr, Uncontrolled	8,015.16
Natural Gas: Residential Furnace	16.14
Natural Gas: Wall Fired Boiler, <100 Million BTU/hr, Uncontrolled	76.60
Natural Gas: Wall Fired Boiler, <100 Million BTU/hr, Uncontrolled	144.86
Natural Gas: Residential Furnace	23.78
Natural Gas: Residential Furnace	3.50

Source: LeighFisher, 2016.

The most frequently used generator was the generator with a horsepower of 2,400, operating approximately 630 hours per year. The generator inventory is shown in **Table 11**.

Table 11
2016 STATIONARY SOURCES INVENTORY - GENERATORS

FUEL TYPE	HORSEPOWER (HP)	ANNUAL USAGE (HOURS)
Diesel Fuel	2,400	122.7
Diesel Fuel	2,400	122.7
Diesel Fuel	2,400	122.7
Diesel Fuel	2,400	87.7
Diesel Fuel	2,400	87.7
Diesel Fuel	2,400	87.7
Diesel Fuel	67	4
Diesel Fuel	80	5.2
Diesel Fuel	380	1
Diesel Fuel	1,341	33
Diesel Fuel	1,341	33
Diesel Fuel	240	3.5
Diesel Fuel	2012	2
Diesel Fuel	2012	2
Diesel Fuel	235	4.4
Diesel Fuel	412	6.8
Diesel Fuel	412	6.6
Diesel Fuel	412	2.6
Diesel Fuel	412	7.4
Diesel Fuel	380	4.5
Diesel Fuel	380	5.6
Diesel Fuel	380	4.4
Diesel Fuel	503	4.1
Diesel Fuel	165	16.6

Source: LeighFisher, 2016; Landrum & Brown analysis, 2017.

3.4 EMISSION INVENTORIES

3.4.1 2014 EDMS INVENTORY

A 2014 emissions inventory was prepared for the SAMP by LeighFisher (LFA) using the Emissions and Dispersion Modeling System (EDMS) version 5.1.4.1. **Table 12** shows the total emissions for 2014 conditions as modeled in EDMS.

Table 12
2014 EDMS ANNUAL EMISSIONS

EMISSION SOURCE	SHORT TONS OF POLLUTANTS (2014)					
	NO_X	VOC	CO	SO_X	PM_{10}	$PM_{2.5}$
Aircraft Engines	1,623	242	1,329	158	8	8
APUs	72	5	48	9	22	22
GSE	307	78	2,292	21	20	19
Stationary Sources	17	1	12	0	1	1
TOTAL	2,019	326	3,681	188	51	50

Source: LeighFisher, 2016.

3.4.2 2016 AEDT INVENTORY

To prepare a baseline condition for the future NEPA/SEPA work, an emission inventory was developed for the Airport's sources during 2016 using the FAA's AEDT Version 2c Service Pack 2. AEDT is now the FAA's required software system that models aircraft performance in space and time to estimate fuel consumption, emissions, noise, and air quality consequences at airports. **Table 13** shows the total emissions for the Baseline (2016) Condition as modeled in AEDT.

Table 13
BASELINE (2016) CONDITION AEDT ANNUAL EMISSIONS

EMISSION SOURCE	SHORT TONS OF POLLUTANTS (2016)						
	NO_X	VOC	CO	SO_X	PM_{10}	$PM_{2.5}$	CO_2 *
Aircraft Engines	1,775	261	1,455	162	13	13	396,306
APUs	40	3	33	5	5	5	-
GSE	370	94	2,769	19	25	25	-
Stationary Sources	18	1	12	0	1	1	-
TOTAL	2,267	379	4,841	190	48	47	396,306

Source: Landrum & Brown analysis, 2017.
*Note: CO_2 annual emissions are reported in metric tons.

Table 14 shows the percent change between the 2014 and 2016 emission inventories, for comparison of the results from the EDMS and AEDT models.

Table 14
PERCENT CHANGE BETWEEN 2014 AND 2016 ANNUAL EMISSIONS

EMISSION SOURCE	PERCENT CHANGE					
	NO_X	VOC	CO	SO_X	PM_{10}	$PM_{2.5}$
Aircraft Engines	9%	8%	9%	3%	67%	67%
APUs	-45%	-43%	-31%	-39%	-77%	-77%
GSE	21%	21%	21%	-10%	27%	27%

Source: Landrum & Brown analysis, 2017.

Specific data was available to determine APU use for the 2014 emission inventory. However, for 2016 default values for APUs were used in AEDT, which resulted in lower total emissions of APUs.

The increase in total emissions from 2014 to 2016 is primarily a result of the increase in aircraft operations from 340,478 in 2014 to 412,170 in 2016.