APPENDIX G

Air Quality

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APPENDIX G AIR QUALITY ANALYSIS

G.1 INTRODUCTION

This document describes the methods used to calculate emissions of carbon monoxide (CO), volatile organic compounds (VOCs), oxides of nitrogen (NO_x), oxides of sulfur (SO_x), particulate matter less than ten microns in diameter (PM_{10}), particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), and carbon dioxide equivalent (CO_{2e}) in support of the Environmental Assessment (EA) for construction of a taxiway extension, apron expansion, and security fencing improvements at Key West International Airport (the Airport or EYW).

The emissions analysis was conducted to develop emissions inventories pursuant to the National Environmental Policy Act of 1969 (NEPA), and to determine whether emissions associated with the Proposed Action would exceed applicable *de minimis* thresholds as documented in the U.S. Environmental Protection Agency (USEPA) general conformity regulations. Construction-related activities are anticipated to occur in 2021, 2022, and 2023.

G.2 REGULATORY SETTING

Under the federal Clean Air Act (CAA), as amended, the EPA has developed National Ambient Air Quality Standards (NAAQS) for the following air pollutants, referred to as criteria air pollutants: CO, nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), lead (Pb), PM_{10}, and $PM_{2.5}$. The CAA defines the need to establish two standards—primary standards, which define maximum concentrations of criteria air pollutants to protect public health, and secondary standards, which define maximum concentrations of criteria air pollutants to protect public welfare.

Individual states are required to identify general geographic areas where the NAAQS for these criteria air pollutants are not met. The USEPA designates such areas as nonattainment areas and qualifies the nonattainment status by severity of nonattainment ranging from marginal to moderate to serious to extreme nonattainment. Areas that were in nonattainment but have since attained the NAAQS are considered to be an attainment/maintenance area for several years before being designated as attainment. A state with a nonattainment or maintenance area must prepare a State Implementation Plan (SIP) that describes the programs and requirements that the state will implement to attain or maintain the NAAQS by the deadlines specified in the CAA, as well as subsequent related documents promulgated by the USEPA.

The CAA requires federal agencies to ensure that actions proposed to occur in a designated nonattainment or maintenance area conform to the appropriate SIP, also known as General Conformity. The General Conformity Rule establishes the *de minimis* levels by which a proposed action may show that it complies with the SIP's purpose of eliminating or reducing the severity and number of violations of the NAAQS and achieving expeditious attainment of such standards. Pursuant to FAA Order 1050.1F, a proposed action would generally be considered in compliance if it would not cause emissions that exceed NAAQS *de minimis* levels. If the proposed action's emissions exceed the *de minimis* levels, a conformity determination would be required.

The Florida Department of Environmental Protection (DEP) works to protect and improve outdoor, or ambient, air quality in Florida. The DEP implements the CAA, monitors air quality, issues permits, and administers Florida's air pollution control programs. The DEP also coordinates the review and certification for buildings and power plants, transmission lines, and natural gas pipelines, and promotes sustainable initiatives and other programs that protect air quality.

Based on the USEPA Criteria Pollutant Nonattainment Summary Report, as of November 30, 2019, Monroe County is in an area of attainment for all NAAQS air pollutants.[1] Therefore, the FAA is not required to make a conformity determination.

G.3 METHODOLOGY

In support of evaluating air quality effects, an emissions inventory was prepared for the criteria air pollutants (or their precursor compounds) that may be affected by construction of the Proposed Action.

G.3.1 MODELS

The Airport Construction Emissions Inventory Tool (ACEIT) was used to estimate the construction emissions associated with the Proposed Action. ACEIT was developed in conjunction with the Transportation Research Board's Airport Cooperative Research Program Report 102, which provides guidance in developing airport construction emissions inventories. [2] ACEIT provides default values for most input data required to produce construction emissions inventories, including activity data and emission factors, and allows for the manipulation of various parameters to better define and refine a project analysis.

ACEIT calculates emissions for CO, VOC, NO_x, SO_2, PM_{10}, $PM_{2.5}$, carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) for both onroad and off-road construction sources.[3] The model uses the USEPA's nonroad equipment emissions model (NONROAD2008a) for nonroad construction vehicle/equipment emissions and the Motor Vehicle Emissions Simulator (MOVES2010b) for onroad vehicle emissions.[4] Because MOVES 2010b has been replaced with MOVES2014b, the latter model was used outside of the ACEIT model to derive onroad emission factors for use in this analysis. In addition to exhaust emissions, MOVES estimates fugitive emissions related to non-exhaust and non-equipment sources, including evaporative (VOC) emissions and brake and tire wear (PM) emissions. Fugitive emissions from other sources, including batch plants, asphalt drying, soil handling, and material movement, are also included in the model, using methodologies from the USEPA's AP-42.[5]

G.3.2 THRESHOLDS OF SIGNIFICANCE

The evaluation of significance involves identifying if the Proposed Action would cause pollutant concentrations to exceed one or more of the NAAQS for any of the time period(s) analyzed or would increase the frequency or severity of any such existing violations. Established under the CAA, the General Conformity Rule applies to proposed federal actions in a nonattainment or maintenance area if the total of direct and indirect emissions of the relevant criteria air pollutants and precursor pollutants caused by a project would equal or exceed defined *de minimis* amounts. If the project would cause an exceedance of *de minimis*, then the federal agency would need to make a determination of General Conformity. If project emissions would not exceed the *de minimis* thresholds, the federal agency can determine that the General Conformity Rule does not apply and no further analysis or documentation is required.

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[1] U.S. Environmental Protection Agency, Criteria Pollutant Nonattainment Summary Report, as of November 30, 2019 https://www3.epa.gov/airquality/greenbook/ancl3.html (accessed December 12, 2019).

[2] Transportation Research Board, Airport Cooperative Research Program Report 102, *Guidance for Estimating Airport Construction Emissions*, 2014.

[3] For purposes of this analysis, it was assumed that estimates of SO_X emissions are equal to calculated emissions of SO_2.

[4] The latest MOVES model incorporates the NONROAD2008a model for estimating emissions from nonroad construction vehicles and equipment.

[5] U.S. Environmental Protection Agency, AP-42, *Compilation of Air Pollutant Emission Factors*, Fifth Edition., January 1995, as amended.

Since the Proposed Action is not located in a maintenance or nonattainment area, the General Conformity Rule does not technically apply. However, for purposes of determining whether construction of the Proposed Action would contribute to an exceedance of the NAAQS for the criteria pollutants, *de minimis* thresholds of 100 tons per year for CO, VOCs, NOx, SOx, PM_{10}, and $PM_{2.5}$, were compared to project emissions. If the project emissions do not exceed the *de minimis* thresholds, the FAA can determine that the General Conformity Rule does not apply and no further analysis or documentation is required.

G.4 ASSUMPTIONS

Construction of the Proposed Action would result in short-term changes in air emissions from sources such as: exhaust emissions from nonroad construction equipment, haul trucks, and construction worker vehicles; fugitive VOC emissions from paving; and fugitive dust emissions from grading, materials handling, and vehicles traveling on paved and unpaved roads.

G.4.1 PROPOSED ACTION COMPONENTS

For purposes of this analysis, the Proposed Action was assumed to consist of the following components and schedule. Area estimates were used to scale construction activity in ACEIT and are consistent with information presented in Section 1 of this EA.

- **Taxiway A Extension:** Construction of the taxiway extension includes the addition of approximately 3,300 square yards (1,500 cubic yards) of asphalt pavement, the placement of approximately 600 cubic yards of fill, and grading of the project site. Construction is assumed to occur from October 2021 to September 2022.
- **Commercial Apron Expansion:** Expansion of the commercial apron includes the addition of approximately 13,200 yards (7,000 cubic yards) of concrete pavement, the placement of approximately 2,000 cubic yards of fill, and grading of the project site. Construction is assumed to occur from October 2022 to September 2023.
- **General Aviation Apron Expansion:** Expansion of the general aviation (overflow parking) apron includes the addition of approximately 5,400 square yards (1,800 cubic yards) of concrete pavement, the placement of approximately 1,800 cubic yards of fill, and grading of the project site. Construction is assumed to occur from October 2021 to September 2022.
- **Security Fence:** Construction of a new security fence includes a new 2,700-linear-foot section along the north boundary of the Airport, replacing 3,300 linear feet of non-standard fencing, and 360 linear feet of fencing to replace existing fencing to be removed as a result of the proposed general aviation apron expansion. The project includes an assumed 11,000 square yards of grading. Construction is assumed to occur from October 2021 to September 2022.
- **Taxiway B Improvements:** This project includes demolition/removal of approximately 2,300 square yards of asphalt pavement, the placement of approximately 1,100 cubic yards of fill, and grading of the project site. Construction is assumed to occur from October 2021 to September 2022.
- **Vehicle Service Road Relocation:** This project includes demolition/removal of approximately 1,900 square yards (600 cubic yards) of asphalt pavement, the addition of 1,500 square yards of asphalt pavement for the new roadway, the placement of approximately 500 cubic yards of fill, and grading of the project site.

G.4.2 CONSTRUCTION ACTIVITY

Construction emissions analyses generally require information such as the type of construction equipment to be used, the amount of time the equipment will operate, estimates of required construction material, areas to be paved,

and the number of employees anticipated to be on site. Such data was largely unavailable for purposes of conducting this analysis. The use of the ACEIT was particularly appropriate for this analysis due to the model's ability to estimate nonroad and onroad activity data for a variety of standard airport projects, including associated activity types and the equipment used in each activity. Based on project dimensions, ACEIT scales these activities. **Table G-1** presents the construction activities that were assumed to comprise each project component.

TABLE G-1: PROPOSED ACTION PROJECT ACTIVITIES

CONSTRUCTION ACTIVITY BY PROJECT COMPONENT		
Taxiway A Extension	**General Aviation Apron Expansion**	**Vehicle Service Road Relocation**
Asphalt Placement	Clearing and Grubbing	Asphalt Demolition
Clearing and Grubbing	Drainage - 24 inch SICPP	Asphalt Placement
Drainage - 24 inch SICPP	Drainage - 6 inch Perforated Underdrain	Clearing and Grubbing
Drainage - 6 inch Perforated Underdrain	Dust Control	Drainage - 24 inch SICPP
Dust Control	Excavation (Borrow)	Drainage - 6 inch Perforated Underdrain
Excavation (Borrow)	Excavation (Cut to Fill)	Dust Control
Excavation (Cut to Fill)	Excavation (Topsoil Stripping)	Excavation (Borrow)
Excavation (Topsoil Stripping)	Fencing	Excavation (Cut to Fill)
Fencing	Grading	Excavation (Topsoil Stripping)
Grading	Hydroseeding	Fencing
Hydroseeding	Markings	Grading
Markings	Soil Erosion/Sediment Control	Markings
Soil Erosion/Sediment Control	Subbase Placement	Soil Erosion/Sediment Control
Subbase Placement	Topsoil Placement	Street Lighting
Topsoil Placement	Lighting	Subbase Placement
Lighting	Concrete Placement	Topsoil Placement
	Sealing/Fuel Resistant	
		Security Fence
Commercial Apron Expansion		Clearing and Grubbing
Clearing and Grubbing	Hydroseeding	Excavation (Cut to Fill)
Drainage - 24 inch SICPP	Markings	Fencing
Drainage - 6 inch Perforated Underdrain	Soil Erosion/Sediment Control	Grading
Dust Control	Subbase Placement	Hydroseeding
Excavation (Borrow)	Topsoil Placement	Soil Erosion/Sediment Control
Excavation (Cut to Fill)	Lighting	Topsoil Placement
Excavation (Topsoil Stripping)	Concrete Placement	
Fencing	Sealing/Fuel Resistant	**Taxiway B Improvements**
Grading		Asphalt Demolition
		Excavation (Cut to Fill)
		Grading

SOURCE: Ricondo & Associates, Inc., December 2019.

For each construction activity, default construction (nonroad) equipment and usage hours were assumed, as assigned by ACEIT. Default equipment usage hours are estimated in ACEIT based on the overall size of the project and activity rates based on expert engineering judgment. Equipment operating hours were divided between summer and winter for purposes of assigning nonroad emission factors (see Section F.4.3). A summary of equipment types and usage hours for each construction year is presented in **Table G-2**.

TABLE G-2: NONROAD EQUIPMENT AND HOURS OF OPERATION

	2021 HOURS		2022 HOURS		2023 HOURS	
EQUIPMENT	SUMMER	WINTER	SUMMER	WINTER	SUMMER	WINTER
Air Compressor	--	14	14	70	56	56
Asphalt Paver	--	6	6	6	--	--
Chain Saw	--	35	35	70	35	35
Chipper/Stump Grinder	--	35	35	70	35	35
Concrete Saws	--	14	14	70	56	56
Concrete Truck	--	129	129	367	238	238
Distributing Tanker	--	14	14	50	35	35
Dozer	--	265	265	487	222	222
Dump Truck	--	378	378	456	78	78
Dump Truck (12 cy)	--	335	335	677	342	342
Excavator	--	120	120	149	29	29
Flatbed Truck	--	212	212	483	272	272
Grader	--	10	10	26	17	17
Hydroseeder	--	12	12	25	13	13
Loader	--	102	102	131	29	29
Off-Road Truck	--	12	12	25	13	13
Other General Equipment	--	579	579	1,056	477	477
Pickup Truck	--	885	885	1,644	760	760
Pumps	--	12	12	23	12	12
Roller	--	146	146	261	116	116
Rubber Tired Loader	--	14	14	70	56	56
Scraper	--	42	42	62	20	20
Skid Steer Loader	--	235	235	262	27	27
Slip Form Paver	--	14	14	70	56	56
Surfacing Equipment (Grooving)	--	22	22	78	56	56
Tractors/Loader/Backhoe	--	286	286	331	46	46
Vibratory Compactor	--	20	20	20	--	--
Water Truck	--	3,600	4,320	5,040	1,440	1,440
Total Hours	**0**	**7,548**	**8,268**	**12,082**	**4,534**	**4,534**

SOURCE: Airport Construction Emissions Inventory Tool (ACEIT), based on project input selections by Ricondo & Associates, Inc., December 2019.

Onroad construction vehicle trips include construction worker vehicle trips to and from the job site, off site hauling trips, and material delivery trips. The number of roundtrips per year for each type of onroad activity was calculated within ACEIT based on project dimensions and required quantities of various construction materials. Default roundtrip distances were assumed. Vehicle miles traveled (VMT) for each onroad activity was calculated by multiplying the total number of vehicle roundtrips by the roundtrip distance. **Table G-3** summarizes the onroad activity for the Proposed Action.

TABLE G-3: ONROAD VEHICLE ACTIVITY ASSUMPTIONS

TRIP TYPE BY YEAR	EQUIPMENT CATEGORY	FUEL	ROUND TRIP DISTANCE (MILES)	ROUNDTRIPS PER YEAR	VEHICLE MILES TRAVELED
2021					
Asphalt Delivery	Single Unit Short-haul Truck	Diesel	40	23	907
Concrete Delivery	Single Unit Short-haul Truck	Diesel	40	458	18,319
Construction Worker Trips	Passenger Car	Gasoline	30	17,355	520,650
Demolished Material Hauling	Single Unit Short-haul Truck	Diesel	40	195	7,800
Material Delivery	Combination Short-haul Truck	Diesel	40	16	640
Subbase Material Delivery	Single Unit Short-haul Truck	Diesel	40	350	13,988
			Total 2021	**18,396**	**562,304**
2022					
Asphalt Delivery	Single Unit Short-haul Truck	Diesel	40	45	1,814
Concrete Delivery	Single Unit Short-haul Truck	Diesel	40	1,603	64,111
Construction Worker Trips	Passenger Car	Gasoline	30	56,283	1,688,490
Demolished Material Hauling	Single Unit Short-haul Truck	Diesel	40	390	15,600
Material Delivery	Combination Short-haul Truck	Diesel	40	32	1,280
Soil Hauling	Combination Short-haul Truck	Diesel	40	500	20,000
Subbase Material Delivery	Single Unit Short-haul Truck	Diesel	40	1,066	42,628
			Total 2020	**59,919**	**1,833,923**
2023					
Concrete Delivery	Single Unit Short-haul Truck	Diesel	40	1,374	54,946
Construction Worker Trips	Passenger Car	Gasoline	30	13,386	401,580
Subbase Material Delivery	Single Unit Short-haul Truck	Diesel	40	733	29,304
			Total 2021	**15,492**	**485,830**

SOURCE: Airport Construction Emissions Inventory Tool (ACEIT), based on project input selections by Ricondo & Associates, Inc., December 2019.

The following types of onroad construction trips were assumed in the analysis:

- Asphalt delivery – Delivery of asphalt material to project site for roadway-related project components.
- Cement delivery – Delivery of pre-mixed cement to the project site in 10-cubic-yard cement mixers for taxiway-related project components.
- Construction worker trips – Travel of construction workers to/from the project site in passenger cars and truck.

- Demolished material hauling – Transport of demolished pavement material from the project site in dump.
- Material delivery – Delivery of general construction materials and supplies to the project site on large delivery/flatbed trucks.
- Soil hauling – Hauling fill material to the project site in 12-cubic-yard haul trucks.
- Subbase material delivery – Delivery of base material used for asphalt and concrete paving.

G.4.3 EMISSION FACTORS

Along with activity data, emission factors are key inputs for the estimation of construction emissions. ACEIT can produce emission factors for nonroad and onroad construction equipment, as well as fugitive sources, using USEPA-approved and industry standard models and methodologies. The integration of the USEPA's MOVES and NONROAD emissions models allows ACEIT to determine emission factors for all onroad and nonroad construction vehicles for which activity data for the Proposed Action was developed. However, as stated previously, ACEIT includes MOVES2010a, which has been replaced as the USEPA's approved model for developing onroad emissions with MOVES2014b. Therefore, onroad emission factors were developed using MOVES2014b and applied to estimates of VMT, as derived using ACEIT.

The following assumptions were used to develop appropriate emission factors for use in estimating construction emissions for the Proposed Action:

- Construction years—Vehicle age affects the emission factors assigned to a specific vehicle or piece of equipment. Emission factors were derived for each construction year: 2021-2023.
- Project location—Emission factors can be derived on a national or local basis. National average emission factors, as distributed to Monroe County using default distribution assumptions, were assumed in this analysis.
- Seasons—Seasonal variation in fuel characteristics can affect nonroad and onroad vehicle/equipment emissions. For each project component, the total number of months of construction in each year was distributed using ACEIT into "summer" (May-October) and "winter" (November-April). These distributions were used by ACEIT to more accurately estimate nonroad emissions using the integrated NONROAD2008 model. For onroad emissions, emission factors were developed through the MOVES2014b model using winter for CO and summer for all other pollutants. Emission factors for CO are generally higher during the winter, especially for gasoline vehicles, such as those assumed to be used for construction worker trips. Since construction worker trips comprise the majority of onroad vehicle trips in this analysis, this methodology results in a more conservative estimation of CO emissions.
- Equipment type—Default nonroad construction equipment was selected based on construction activities specific to each project component. Default onroad vehicles were assumed to include light-duty, gasoline passenger cars for construction worker trips, and heavy-duty, diesel long-haul trucks for material transport (i.e., 18-wheeler, tractor trailer, cement mixer, and dump truck).
- Fuel type—By default, all nonroad construction equipment was assumed to be diesel, except for chain saws, which were assumed to be gasoline due to the lack of diesel data for such equipment. Default fuel types for onroad vehicles were based on equipment type, as noted above.
- Fugitive emissions—Equipment-related emission factors for sources of fugitive emissions were derived from ACEIT for evaporative emissions, brake and tire-dust emissions, and re-suspended dust emissions. Dust emission factors in the analysis included dust emissions associated with activities such as earth moving, wind erosion,

material handling, travel on paved and unpaved roads, demolition, and material batching. Non-equipment related evaporative fugitive emission factors included in the analysis included asphalt paving (drying).

Table G-4 presents the default nonroad equipment specifications assumed in the analysis, while **Table G-5** shows the nonroad emission factors for each piece of construction equipment by year and by season, as applicable.

TABLE G-4: NONROAD CONSTRUCTION EQUIPMENT SPECIFICATIONS

EQUIPMENT	FUEL	HORSEPOWER	LOAD FACTOR
Air Compressor	Diesel	100	0.43
Asphalt Paver	Diesel	175	0.59
Chain Saw	Diesel	11	0.7
Chipper/Stump Grinder	Diesel	100	0.43
Concrete Saws	Diesel	40	0.59
Concrete Truck	Diesel	600	0.59
Distributing Tanker	Diesel	600	0.59
Dozer	Diesel	175	0.59
Dump Truck	Diesel	600	0.59
Dump Truck (12 cy)	Diesel	600	0.59
Excavator	Diesel	175	0.59
Flatbed Truck	Diesel	600	0.59
Grader	Diesel	300	0.59
Hydroseeder	Diesel	600	0.59
Loader	Diesel	175	0.59
Off-Road Truck	Diesel	600	0.59
Other General Equipment	Diesel	175	0.43
Pickup Truck	Diesel	600	0.59
Pumps	Diesel	11	0.43
Roller	Diesel	100	0.59
Rubber Tired Loader	Diesel	175	0.59
Scraper	Diesel	600	0.59
Skid Steer Loader	Diesel	75	0.21
Slip Form Paver	Diesel	175	0.59
Surfacing Equipment (Grooving)	Diesel	25	0.59
Tractors/Loader/Backhoe	Diesel	100	0.21
Vibratory Compactor	Diesel	6	0.43
Water Truck	Diesel	600	0.59

SOURCE: Airport Construction Emissions Inventory Tool (ACEIT).

TABLE G-5 (1 OF 4): NONROAD CONSTRUCTION EQUIPMENT SPECIFICATIONS

EQUIPMENT BY YEAR-SEASON	EMISSION FACTORS (GRAMS PER HORSEPOWER-HOUR)						
	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	CO_{2E}
2021-Winter							
Asphalt Paver	0.365	0.155	0.832	0.003	0.074	0.068	536.362
Chain Saw	293.535	61.888	1.323	0.140	9.748	8.968	685.996
Chipper/Stump Grinder	1.582	0.327	2.789	0.003	0.270	0.248	589.378
Concrete Truck	0.196	0.141	0.530	0.003	0.021	0.019	536.404
Dozer	0.310	0.150	0.706	0.003	0.059	0.054	536.377
Dump Truck	0.196	0.141	0.530	0.003	0.021	0.019	536.404
Dump Truck (12 cy)	0.196	0.141	0.530	0.003	0.021	0.019	536.404
Excavator	0.248	0.145	0.582	0.003	0.041	0.038	536.390
Flatbed Truck	0.196	0.141	0.530	0.003	0.021	0.019	536.404
Grader	0.209	0.145	0.629	0.003	0.030	0.028	536.390
Hydroseeder	0.196	0.141	0.530	0.003	0.021	0.019	536.404
Loader	0.400	0.159	0.935	0.003	0.083	0.077	536.350
Off-Road Truck	0.196	0.141	0.530	0.003	0.021	0.019	536.404
Other General Equipment	0.331	0.168	1.203	0.003	0.077	0.071	530.533
Pickup Truck	0.196	0.141	0.530	0.003	0.021	0.019	536.404
Pumps	4.456	0.629	4.537	0.004	0.402	0.370	588.462
Roller	1.092	0.167	1.085	0.003	0.122	0.113	595.649
Scraper	0.465	0.151	1.171	0.003	0.067	0.062	536.373
Skid Steer Loader	4.005	0.768	4.522	0.004	0.577	0.531	693.671
Surfacing Equipment (Grooving)	2.371	0.472	4.460	0.004	0.353	0.325	594.728
Tractors/Loader/Backhoe	3.677	0.564	2.798	0.004	0.497	0.458	694.290
Vibratory Compactor	4.455	0.606	4.412	0.004	0.380	0.350	588.533
Water Truck	0.196	0.141	0.530	0.003	0.021	0.019	536.404
Air Compressor	0.969	0.195	1.549	0.003	0.134	0.124	589.778
Concrete Saws	0.445	0.159	3.228	0.003	0.057	0.053	595.674
Rubber Tired Loader	0.400	0.159	0.935	0.003	0.083	0.077	536.350
Slip Form Paver	0.365	0.155	0.832	0.003	0.074	0.068	536.362
Distributing Tanker	0.196	0.141	0.530	0.003	0.021	0.019	536.404
2022-Summer							
Asphalt Paver	0.293	0.149	0.659	0.003	0.054	0.049	536.378
Chain Saw	293.535	61.888	1.323	0.140	9.748	8.968	685.996
Chipper/Stump Grinder	1.466	0.305	2.563	0.003	0.246	0.226	589.446
Concrete Truck	0.173	0.140	0.432	0.003	0.016	0.015	536.406
Dozer	0.249	0.146	0.556	0.003	0.042	0.038	536.390

TABLE G-5 (2 OF 4): NONROAD CONSTRUCTION EQUIPMENT SPECIFICATIONS

EQUIPMENT BY YEAR-SEASON	EMISSION FACTORS (GRAMS PER HORSEPOWER-HOUR)						
	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	CO_{2E}
Dump Truck	0.173	0.140	0.432	0.003	0.016	0.015	536.406
Dump Truck (12 cy)	0.173	0.140	0.432	0.003	0.016	0.015	536.406
Excavator	0.204	0.143	0.463	0.003	0.029	0.026	536.398
Flatbed Truck	0.173	0.140	0.432	0.003	0.016	0.015	536.406
Grader	0.175	0.143	0.503	0.003	0.023	0.021	536.398
Hydroseeder	0.173	0.140	0.432	0.003	0.016	0.015	536.406
Loader	0.321	0.152	0.753	0.003	0.061	0.056	536.369
Off-Road Truck	0.173	0.140	0.432	0.003	0.016	0.015	536.406
Other General Equipment	0.277	0.161	1.004	0.003	0.063	0.058	530.556
Pickup Truck	0.173	0.140	0.432	0.003	0.016	0.015	536.406
Pumps	4.453	0.619	4.480	0.004	0.387	0.356	588.495
Roller	0.880	0.158	0.864	0.003	0.088	0.081	595.677
Scraper	0.385	0.148	0.989	0.003	0.054	0.049	536.383
Skid Steer Loader	3.706	0.699	4.371	0.004	0.526	0.484	693.880
Surfacing Equipment (Grooving)	2.363	0.471	4.461	0.004	0.353	0.325	594.729
Tractors/Loader/Backhoe	3.383	0.508	2.522	0.004	0.447	0.411	694.459
Vibratory Compactor	4.455	0.600	4.380	0.004	0.370	0.340	588.551
Water Truck	0.173	0.140	0.432	0.003	0.016	0.015	536.406
Air Compressor	0.833	0.181	1.304	0.003	0.111	0.102	589.821
Concrete Saws	0.367	0.151	3.143	0.003	0.043	0.039	595.698
Rubber Tired Loader	0.321	0.152	0.753	0.003	0.061	0.056	536.369
Slip Form Paver	0.293	0.149	0.659	0.003	0.054	0.049	536.378
Distributing Tanker	0.173	0.140	0.432	0.003	0.016	0.015	536.406
2022-Winter							
Asphalt Paver	0.293	0.149	0.659	0.003	0.054	0.049	536.378
Chain Saw	293.535	61.888	1.323	0.140	9.748	8.968	685.996
Chipper/Stump Grinder	1.466	0.305	2.563	0.003	0.246	0.226	589.446
Concrete Truck	0.173	0.140	0.432	0.003	0.016	0.015	536.406
Dozer	0.249	0.146	0.556	0.003	0.042	0.038	536.390
Dump Truck	0.173	0.140	0.432	0.003	0.016	0.015	536.406
Dump Truck (12 cy)	0.173	0.140	0.432	0.003	0.016	0.015	536.406
Excavator	0.204	0.143	0.463	0.003	0.029	0.026	536.398
Flatbed Truck	0.173	0.140	0.432	0.003	0.016	0.015	536.406
Grader	0.175	0.143	0.503	0.003	0.023	0.021	536.398
Hydroseeder	0.173	0.140	0.432	0.003	0.016	0.015	536.406

TABLE G-5 (3 OF 4): NONROAD CONSTRUCTION EQUIPMENT SPECIFICATIONS

EQUIPMENT BY YEAR-SEASON	EMISSION FACTORS (GRAMS PER HORSEPOWER-HOUR)						
	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	CO_{2E}
Loader	0.321	0.152	0.753	0.003	0.061	0.056	536.369
Off-Road Truck	0.173	0.140	0.432	0.003	0.016	0.015	536.406
Other General Equipment	0.277	0.161	1.004	0.003	0.063	0.058	530.556
Pickup Truck	0.173	0.140	0.432	0.003	0.016	0.015	536.406
Pumps	4.453	0.619	4.480	0.004	0.387	0.356	588.495
Roller	0.880	0.158	0.864	0.003	0.088	0.081	595.677
Scraper	0.385	0.148	0.989	0.003	0.054	0.049	536.383
Skid Steer Loader	3.706	0.699	4.371	0.004	0.526	0.484	693.880
Surfacing Equipment (Grooving)	2.363	0.471	4.461	0.004	0.353	0.325	594.729
Tractors/Loader/Backhoe	3.383	0.508	2.522	0.004	0.447	0.411	694.459
Vibratory Compactor	4.455	0.600	4.380	0.004	0.370	0.340	588.551
Water Truck	0.173	0.140	0.432	0.003	0.016	0.015	536.406
Air Compressor	0.833	0.181	1.304	0.003	0.111	0.102	589.821
Concrete Saws	0.367	0.151	3.143	0.003	0.043	0.039	595.698
Rubber Tired Loader	0.321	0.152	0.753	0.003	0.061	0.056	536.369
Slip Form Paver	0.293	0.149	0.659	0.003	0.054	0.049	536.378
Distributing Tanker	0.173	0.140	0.432	0.003	0.016	0.015	536.406
2023-Summer							
Chain Saw	293.535	61.888	1.323	0.140	9.748	8.968	685.996
Chipper/Stump Grinder	1.350	0.282	2.338	0.003	0.222	0.204	589.515
Concrete Truck	0.150	0.139	0.334	0.003	0.012	0.011	536.408
Dozer	0.188	0.141	0.406	0.003	0.024	0.022	536.402
Dump Truck	0.150	0.139	0.334	0.003	0.012	0.011	536.408
Dump Truck (12 cy)	0.150	0.139	0.334	0.003	0.012	0.011	536.408
Excavator	0.161	0.140	0.344	0.003	0.016	0.015	536.406
Flatbed Truck	0.150	0.139	0.334	0.003	0.012	0.011	536.408
Grader	0.141	0.140	0.378	0.003	0.015	0.014	536.405
Hydroseeder	0.150	0.139	0.334	0.003	0.012	0.011	536.408
Loader	0.243	0.146	0.571	0.003	0.039	0.036	536.387
Off-Road Truck	0.150	0.139	0.334	0.003	0.012	0.011	536.408
Other General Equipment	0.224	0.153	0.806	0.003	0.048	0.044	530.579
Pickup Truck	0.150	0.139	0.334	0.003	0.012	0.011	536.408
Pumps	4.450	0.608	4.423	0.004	0.372	0.343	588.528
Roller	0.668	0.149	0.643	0.003	0.054	0.050	595.704
Scraper	0.305	0.145	0.806	0.003	0.040	0.037	536.393

TABLE G-5 (4 OF 4): NONROAD CONSTRUCTION EQUIPMENT SPECIFICATIONS

EQUIPMENT BY YEAR-SEASON	EMISSION FACTORS (GRAMS PER HORSEPOWER-HOUR)						
	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	CO_{2E}
Skid Steer Loader	3.407	0.631	4.219	0.004	0.474	0.436	694.088
Surfacing Equipment (Grooving)	2.355	0.471	4.461	0.004	0.353	0.325	594.730
Tractors/Loader/Backhoe	3.090	0.452	2.246	0.004	0.396	0.364	694.628
Water Truck	0.150	0.139	0.334	0.003	0.012	0.011	536.408
Air Compressor	0.697	0.166	1.059	0.003	0.087	0.080	589.865
Concrete Saws	0.289	0.143	3.058	0.003	0.029	0.026	595.723
Rubber Tired Loader	0.243	0.146	0.571	0.003	0.039	0.036	536.387
Slip Form Paver	0.221	0.144	0.487	0.003	0.033	0.031	536.394
Distributing Tanker	0.150	0.139	0.334	0.003	0.012	0.011	536.408
2023-Winter							
Chain Saw	293.535	61.888	1.323	0.140	9.748	8.968	685.996
Chipper/Stump Grinder	1.350	0.282	2.338	0.003	0.222	0.204	589.515
Concrete Truck	0.150	0.139	0.334	0.003	0.012	0.011	536.408
Dozer	0.188	0.141	0.406	0.003	0.024	0.022	536.402
Dump Truck	0.150	0.139	0.334	0.003	0.012	0.011	536.408
Dump Truck (12 cy)	0.150	0.139	0.334	0.003	0.012	0.011	536.408
Excavator	0.161	0.140	0.344	0.003	0.016	0.015	536.406
Flatbed Truck	0.150	0.139	0.334	0.003	0.012	0.011	536.408
Grader	0.141	0.140	0.378	0.003	0.015	0.014	536.405
Hydroseeder	0.150	0.139	0.334	0.003	0.012	0.011	536.408
Loader	0.243	0.146	0.571	0.003	0.039	0.036	536.387
Off-Road Truck	0.150	0.139	0.334	0.003	0.012	0.011	536.408
Other General Equipment	0.224	0.153	0.806	0.003	0.048	0.044	530.579
Pickup Truck	0.150	0.139	0.334	0.003	0.012	0.011	536.408
Pumps	4.450	0.608	4.423	0.004	0.372	0.343	588.528
Roller	0.668	0.149	0.643	0.003	0.054	0.050	595.704
Scraper	0.305	0.145	0.806	0.003	0.040	0.037	536.393
Skid Steer Loader	3.407	0.631	4.219	0.004	0.474	0.436	694.088
Surfacing Equipment (Grooving)	2.355	0.471	4.461	0.004	0.353	0.325	594.731
Tractors/Loader/Backhoe	3.090	0.452	2.246	0.004	0.396	0.364	694.628
Water Truck	0.150	0.139	0.334	0.003	0.012	0.011	536.408
Air Compressor	0.697	0.166	1.059	0.003	0.087	0.080	589.865
Concrete Saws	0.289	0.143	3.058	0.003	0.029	0.026	595.723
Rubber Tired Loader	0.243	0.146	0.571	0.003	0.039	0.036	536.387
Slip Form Paver	0.221	0.144	0.487	0.003	0.033	0.031	536.394
Distributing Tanker	0.150	0.139	0.334	0.003	0.012	0.011	536.408

SOURCE: Airport Construction Emissions Inventory Tool (ACEIT), using the U.S. Environmental Protection Agency NONROAD2008a emissions model.

Onroad vehicle emission factors by year are presented in **Table G-6**. Key assumptions and notes regarding the modeling of these factors are as follows:

- CO emission factors were modeled for winter; all other pollutant factors were modeled for summer
- Road type: urban unrestricted
- Fuel type: passenger car (gasoline); trucks (diesel)
- CO emission factors include running exhaust, crankcase running exhaust, and crankcase start exhaust
- VOC emission factors include running exhaust, evaporative permeation and fuel vapor venting, crankcase running exhaust, refueling displacement vapor loss, and refueling spillage loss
- NO_x emission factors include running exhaust and crankcase start exhaust
- SO_x emission factors include running exhaust and start exhaust
- PM emission factors include running exhaust, brakewear, tirewear, and crankcase running exhaust
- CO_{2e} emission factors include running exhaust

TABLE G-6: ONROAD CONSTRUCTION VEHICLE EMISSION FACTORS

	EMISSION FACTORS (GRAMS PER MILE)						
VEHICLE CATEGORY	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	CO_{2E}
2021							
Passenger Car	2.755	0.004	0.042	0.107	0.020	0.004	406.936
Single Unit Short-haul Truck	1.656	0.070	1.345	0.052	0.125	0.043	1,509.299
Combination Short-haul Truck	1.921	0.063	2.161	0.029	0.189	0.063	2,272.667
2022							
Passenger Car	2.228	0.004	0.035	0.109	0.021	0.004	391.036
Single Unit Short-haul Truck	1.379	0.063	1.191	0.053	0.116	0.038	1,493.709
Combination Short-haul Truck	1.581	0.058	1.911	0.030	0.176	0.055	2,246.570
2023							
Passenger Car	1.920	0.003	0.029	0.103	0.020	0.004	367.338
Single Unit Short-haul Truck	1.207	0.051	1.068	0.048	0.117	0.041	1,416.835
Combination Short-haul Truck	1.371	0.048	1.712	0.028	0.177	0.058	2,176.925

SOURCE: Ricondo & Associates, Inc., December 2019, using the U.S. Environmental Protection Agency MOVES2014b emissions model.

Table G-7 indicates the types of fugitive emissions sources for which ACEIT calculated emissions based on project-specific specifications, as well as methodologies included in the U.S. EPA's AP-42.

TABLE G-7: FUGITIVE EMISSIONS SOURCES

PROJECT COMPONENT	ASPHALT DRYING (VOC)	ASPHALT STORAGE AND BATCHING (CO, VOC NO_x, SO_x, PM_{10})	MATERIAL MOVEMENT (PM_{10})	SOIL HANDLING (PM_{10})	UNSTABILIZED LAND AND WIND EROSION (PM_{10})	CONCRETE MIXING/ BATCHING (PM_{10})
Taxiway A Extension	●	●	●	●	●	
Commercial Apron Expansion			●	●	●	●
General Aviation Apron Expansion			●	●	●	●
Security Fence			●	●	●	
Taxiway B Improvements			●	●	●	
Vehicle Service Road Relocation	●	●	●	●	●	

SOURCE: Airport Construction Emissions Inventory Tool (ACEIT), based on project input selections by Ricondo & Associates, Inc., December 2019.

G.5 SUMMARY OF CONSTRUCTION EMISSIONS

Emissions for nonroad and onroad construction equipment were estimated using the following equations:

*Nonroad Equipment Emissions (tons/year) = emission factor (grams per horsepower-hour) * size (horsepower) * load factor * hours per year * (1 pound/453.592 grams) * 1 ton/2,000 pounds)*

*Onroad Vehicle Emissions (tons/year) = emission factor (grams per vehicle-mile) * miles per year * (1 pound/453.592 grams) * 1 ton/2,000 pounds)*

Table G-8 summarizes the annual emissions of criteria air pollutants and CO_{2e} estimated by source for construction of the Proposed Action, which would occur from 2021-2023.

TABLE G-8: ANNUAL POLLUTANT EMISSIONS DUE TO CONSTRUCTION OF THE PROPOSED ACTION

	EMISSIONS (TONS/YEAR)						METRIC TONS/YEAR
	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	CO_{2E}
Taxiway A Extension							
2021	0.645	1.218	0.426	0.018	0.054	0.018	425.015
2022	1.411	2.437	0.707	0.052	0.122	0.029	904.166
	2.056	**3.655**	**1.132**	**0.070**	**0.177**	**0.046**	**1,329.181**
Commercial Apron Expansion							
2022	1.139	0.243	0.751	0.005	0.228	0.032	761.261
2023	2.401	0.511	1.153	0.010	0.444	0.047	1,576.088
	3.540	**0.753**	**1.904**	**0.015**	**0.672**	**0.079**	**2,337.349**
General Aviation Apron Expansion							
2021	1.008	0.167	0.569	0.003	0.113	0.024	503.578
2022	2.159	0.361	0.960	0.008	0.222	0.039	1,065.507
	3.167	**0.528**	**1.528**	**0.011**	**0.336**	**0.063**	**1,569.085**
Security Fence							
2021	0.361	0.042	0.138	0.001	0.029	0.008	106.737
2022	0.782	0.095	0.242	0.002	0.056	0.013	235.561
	1.143	**0.137**	**0.379**	**0.003**	**0.085**	**0.021**	**342.297**
Taxiway B Improvements							
2021	0.262	0.016	0.052	0.000	0.027	0.002	45.556
2022	0.584	0.040	0.094	0.001	0.064	0.004	110.043
	0.845	**0.056**	**0.146**	**0.002**	**0.091**	**0.006**	**155.600**
Vehicle Service Road Relocation							
2021	1.111	0.650	0.336	0.003	0.053	0.015	306.764
2022	2.484	1.373	0.710	0.007	0.128	0.029	819.320
	3.595	**2.023**	**1.046**	**0.010**	**0.180**	**0.044**	**1,126.084**

SOURCE: Ricondo & Associates, Inc., December 2019, based on inputs to the Airport Construction Emissions Inventory Tool (ACEIT), using the U.S. Environmental Protection Agency NONROAD2008a and MOVES2014b emissions models.

Table G-9 compares the maximum annual emissions with the applicable *de minimis* thresholds. Even with the short-term increase in emissions from the construction of the Proposed Action, emission levels would be well below *de minimis* thresholds. Changes in criteria air pollutant emissions due to construction of the Proposed Action would not result in an adverse effect on air quality.

TABLE G-9: PROPOSED ACTION CONSTRUCTION EMISSIONS SUMMARY AND COMPARISON TO DE MINIMIS

	EMISSIONS (TONS/YEAR)					
	CO	VOC	NO_X	SO_X[1]	PM_{10}	$PM_{2.5}$
Total Emission by Year						
2021	3.386	2.093	1.520	0.026	0.276	0.067
2022	8.559	4.549	3.463	0.075	0.821	0.146
2023	2.401	0.511	1.153	0.010	0.444	0.047
de minimis Threshold	100.000	100.000	100.000	100.000	100.000	100.000
Difference (Under)/Over de minimis threshold						
2021	(96.614)	(97.907)	(98.480)	(99.974)	(99.724)	(99.933)
2022	(91.441)	(95.451)	(96.537)	(99.925)	(99.179)	(99.854)
2023	(97.599)	(99.489)	(98.847)	(99.990)	(99.556)	(99.953)
Significant?	**No**	**No**	**No**	**No**	**No**	**No**

NOTE:

1 For purposes of this analysis, it was assumed that estimates of SO_x emissions are equal to calculated emissions of SO_2.

SOURCE: Ricondo & Associates, Inc., December 2019, based on inputs to the Airport Construction Emissions Inventory Tool (ACEIT), using the U.S. Environmental Protection Agency NONROAD2008a and MOVES2014b emissions models.