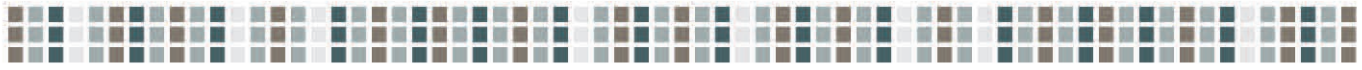
Appendix E

Air Quality



Appendix E Air Quality Analysis

E.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 runway and parallel taxiway separation improvements (the Proposed Action) at Florida Keys Marathon International Airport (the Airport or MTH).

This analysis was prepared in February 2018 based on the Proposed Action Alternative at that time and the project schedule contained in the *Marathon Airport Five Year Capital Improvement Plan*, prepared in June 2016.[1] Subsequent to this analysis, two things occurred. First, the capital improvement plan was updated to shift the construction schedule back one year, with project completion now expected to occur in 2023, rather than 2022. In addition, Hurricane Irma damaged the T-hangars northeast of Runway 7-25 in September 2017, prompting the demolition of the hangars sooner than previously planned. Therefore, the hangar demolition was removed from the Proposed Action Alternative. The air quality analysis has not been updated to reflect these changes. By delaying construction one year, construction emissions would be lower than estimated in the analysis because construction equipment emission factors generally decrease in future years due to the retirement of older construction equipment and the introduction of newer, cleaner construction equipment in the overall construction equipment fleet. Furthermore, emissions associated with the demolition of the T-hangars is still included in this analysis, although that project component has already occurred. Given these two changes, the air quality analysis described in this appendix represents a more conservative estimate of construction emissions than the Proposed Action Alternative described in Section 1.3 of this Draft EA.

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

[1] Jacobs Engineering, *Marathon Airport Five Year Capital Improvement Plan*, June 28, 2016.

exceed applicable *de minimis* thresholds as documented in the U.S. Environmental Protection Agency (EPA) general conformity regulations. Construction-related activities are anticipated to occur in 2020, 2021, and 2022.

In addition to emissions generated by construction activity, the operation of aircraft at the Airport is another source of pollutant emissions. The Proposed Action includes shifting Runway 7-25 to the northwest 40 feet to provide a runway-to-taxiway centerline separation distance of 240 feet. This shift would therefore increase the distance that aircraft must taxi between the primary apron areas and the runway, thereby potentially increasing emissions from taxiing aircraft. It is also possible that aircraft taxi routes may vary from existing taxi routes during construction to accommodate implementation of the Proposed Action. However, it is not anticipated that any increase in aircraft taxi time, either during or after construction, would be enough to significantly impact emissions. Further, the Proposed Action would not result in an increase in aircraft operations at the Airport. Therefore, for purposes of this analysis, emissions from aircraft operations were not estimated.

E.2 Methodology

In support of evaluating air quality effects, estimates were prepared for various criteria air pollutants (or their precursor compounds) for inventory purposes, even though Monroe County is in attainment of all NAAQS pollutants. As such, the air quality analysis is based on the following:

- CO— For inventory purposes, emissions of CO were estimated.
- NO_2—Emissions were not estimated for this criteria pollutant.
- O_3—Volatile organic compounds (VOCs) and NO_x are primary precursor compounds that lead to the formation of O_3, so VOC and NO_x emissions were estimated in the air quality analysis to evaluate O_3 effects.
- SO_2—For inventory purposes, emissions of SOx were estimated and it was assumed that estimates of SO_x emissions are equal to calculated emissions of SO_2.
- Pb—Although Pb is a criteria air pollutant, it was not evaluated in the analysis because the Proposed Action would not affect Pb emissions. The only source of Pb emissions at the Airport is aviation gasoline, and the Proposed Action would not change the number of aircraft operations.
- PM_{10} and $PM_{2.5}$—For inventory purposes, emissions of PM_{10} and $PM_{2.5}$ were estimated.

E.2.1 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 U.S. EPA'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 MOVES2010b has been replaced with MOVES2014a, 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 U.S. EPA's AP-42.[5]

E.2.2 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 the Proposed Action would equal or exceed defined *de minimis* amounts. If the project would cause an exceedance of *de minimis* thresholds, 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.

Monroe County is in attainment of all NAAQS pollutants and therefore *de minimis* thresholds do not apply to the Proposed Action. However, for purposes of this analysis, annual emissions were compared against *de minimis* values of 100 tons per year for CO, NO_x, VOCs, SO_2, PM_{10}, and $PM_{2.5}$ to determine whether the Proposed Action would cause an exceedance of the NAAQS.

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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 supplemented and amended.

E.3 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.

1.1.2 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 were estimated from construction drawings. Estimated schedule assumptions were based on the Airport's Capital Improvement Program.[6]

- Tree clearing in an area of the tropical hardwood hammock that would be within the Object Free Area of the relocated runway | January 2020 – September 2020 | 4.43 acres
- Construction of new runway and taxiway pavement, including blast pads | October 2021 – June 2022 | 475,299 square feet
- Demolition of existing pavement, including runways and taxiways, associated shoulders, and service roads | July 2022 – August 2022 | 737,556 square feet
- Demolition of existing hangar facilities | September 2022 | 43,352 square feet

E.1.1 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 E-1** shows the construction activities that were assumed to comprise each project component.

[6] Jacobs Engineering, *Marathon Airport Five Year Capital Improvement Plan*, June 28, 2016.

Table E-1: Proposed Action Project Activities

CONSTRUCTION ACTIVITY BY PROJECT COMPONENT			
TREE CLEARING	**TAXIWAY AND RUNWAY CONSTRUCTION**		**DEMOLITION**
Remove Trees and Shrubs	Asphalt Placement	Grading	Asphalt Demolition
	Clearing and Grubbing	Hydroseeding	Building Demolition
	Curbing	Lighting	
	Drainage - 24-inch Corrugated Pipe	Markings	
	Drainage - 6-inch Perforated Underdrain	Soil Erosion/Control	
	Excavation (Borrow)	Subbase Placement	
	Excavation (Cut to Fill)	Topsoil Placement	
	Excavation (Topsoil Stripping)		
	Fencing		

SOURCE: Airport Construction Emissions Inventory Tool (ACEIT), based on project selections by Ricondo & Associates, Inc., January 2018.

For each construction activity, default construction 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 A.1.2). A summary of equipment types and usage hours for each construction year is presented in **Table E-2**. Due to the availability of project funding, grant funding in federal fiscal year 2021 is designated for design of the next phase of the project. Construction is not anticipated in the summer of 2021.

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 were calculated by multiplying the total number of vehicle roundtrips by the roundtrip distance. **Table E-3** summarizes the onroad activity for the Proposed Action.

Table E-2: Nonroad Equipment and Hours of Operation

EQUIPMENT	SUMMER	WINTER	EQUIPMENT	SUMMER	WINTER
2020			Surfacing Equipment (Grooving)		17
Bulldozer	429	343	Tractors/Loader/Backhoe		159
Chain Saws	429	343	Water Truck		720
Flat Bed or Dump Trucks	858	686	**2021 Total Hours**	**0**	**3,854**
Front Loader	429	343	**2022**		
Grub the site down 2'-0	429	343	Asphalt Paver	17	17
Log Chipper	429	343	Bob Cat	1,040	
Mulcher	429	343	Chain Saw	40	40
Ten Wheelers	429	343	Chipper/Stump Grinder	40	40
Tractor	858	686	Concrete Truck	19	19
2020 Total Hours	**4,719**	**3,773**	Dozer	1,050	313
2021			Dump Truck	1,321	280
Asphalt Paver		14	Dump Truck (12 cy)	440	440
Chain Saw		32	Excavator	838	101
Chipper/Stump Grinder		32	Excavator with Bucket	520	
Concrete Truck		22	Flatbed Truck	288	288
Dozer		250	Generator Sets	520	
Dump Truck		289	Grader	36	36
Dump Truck (12 cy)		341	Hydroseeder	14	14
Excavator		99	Loader	107	107
Flatbed Truck		223	Off-Road Truck	14	14
Grader		13	Other General Equipment	518	518
Hydroseeder		12	Pickup Truck	2,837	755
Loader		124	Pumps	13	13
Off-Road Truck		12	Roller	219	219
Other General Equipment		473	Scraper	58	58
Pickup Truck		661	Skid Steer Loader	115	115
Pumps		11	Surfacing Equipment (Grooving)	22	22
Roller		176	Tractors/Loader/Backhoe	141	141
Scraper		45	Water Truck	480	480
Skid Steer Loader		127	**2022 Total Hours**	**10,709**	**4,031**

SOURCE: Airport Construction Emissions Inventory Tool (ACEIT), based on project input selections by Ricondo & Associates, Inc., January 2018.

Table E-3: Onroad Vehicle Activity Assumptions

YEAR	EQUIPMENT	EQUIPMENT CATEGORY	FUEL	ROUND TRIP DISTANCE (MILES)	ROUNDTRIPS PER YEAR	VEHICLE MILES TRAVELED
2020	Dump Truck Subbase Material	Single Unit Short-haul Truck	Diesel	40	62	2,466
	Construction Worker Vehicle	Passenger Car	Gasoline	30	2,619	78,570
	Tractor Trailer	Combination Short-haul Truck	Diesel	40	810	32,400
				Total 2020	**3,491**	**113,436**
2021	Asphalt 18 Wheeler	Combination Short-haul Truck	Diesel	40	35	1,418
	Dump Truck - Asphalt	Single Unit Short-haul Truck	Diesel	40	50	2,008
	Dump Truck Subbase Material	Single Unit Short-haul Truck	Diesel	40	301	12,050
	Construction Worker Vehicle	Passenger Car	Gasoline	30	6,338	190,125
				Total 2021	**6,724**	**205,601**
2022	Asphalt 18 Wheeler	Combination Short-haul Truck	Diesel	40	137	5,478
	Dump Truck	Single Unit Short-haul Truck	Diesel	40	5,101	204,040
	Dump Truck - Asphalt	Single Unit Short-haul Truck	Diesel	40	194	7,761
	Dump Truck Subbase Material	Single Unit Short-haul Truck	Diesel	40	1,164	46,565
	Construction Worker Vehicle	Passenger Car	Gasoline	30	12,936	388,080
				Total 2022	**19,532**	**651,924**

SOURCE: Airport Construction Emissions Inventory Tool (ACEIT), based on project input selections by Ricondo & Associates, Inc., January 2018.

E.1.2 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 U.S. EPA-approved and industry standard models and methodologies. The integration of the U.S. EPA'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 U.S. EPA's approved model for developing onroad emissions with MOVES2014a. Therefore, onroad emission factors were developed using MOVES2014a and applied to estimates of vehicle miles traveled, 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: 2020-2022.

- 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 MOVES2014a 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, 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 E-4 presents the default nonroad equipment specifications assumed in the analysis, while **Table E-5** shows the nonroad emission factors for each piece of construction equipment by year and by season, as applicable.

Table E-4: Nonroad Construction Equipment Specifications

EQUIPMENT	FUEL	HORSEPOWER	LOAD FACTOR	EQUIPMENT	FUEL	HORSEPOWER	LOAD FACTOR
Asphalt Paver	Diesel	175	0.59	Skid Steer Loader	Diesel	75	0.21
Bob Cat	Diesel	75	0.21	Surfacing Equipment (Grooving)	Diesel	25	0.59
Bulldozer	Diesel	175	0.59	Ten Wheelers	Diesel	600	0.59
Chain Saw	Diesel	11	0.7	Tractor	Diesel	100	0.21
Chain Saws	Gasoline	11	0.7	Tractors/Loader/Backhoe	Diesel	100	0.21
Chipper/Stump Grinder	Diesel	100	0.43	Water Truck	Diesel	600	0.59
Concrete Truck	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				
Excavator with Bucket	Diesel	175	0.59				
Flat Bed or Dump Trucks	Diesel	600	0.59				
Flatbed Truck	Diesel	600	0.59				
Front Loader	Diesel	100	0.21				
Generator Sets	Diesel	40	0.43				
Grader	Diesel	300	0.59				
Grubber	Diesel	40	0.59				
Hydroseeder	Diesel	600	0.59				
Loader	Diesel	175	0.59				
Log Chipper	Diesel	100	0.43				
Mulcher	Diesel	100	0.43				
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				
Scraper	Diesel	600	0.59				

SOURCE: Airport Construction Emissions Inventory Tool (ACEIT).

Table E-5 (1 of 3): Nonroad Construction Equipment Emission Factors

	EMISSION FACTORS (GRAMS PER HORSEPOWER-HOUR)						
EQUIPMENT	**CO**	**VOC**	**NO_X**	**SO_2**	**PM_{10}**	**$PM_{2.5}$**	**CO_2e**
2020-Summer							
Bulldozer	0.371	0.154	0.855	0.003	0.076	0.070	536.364
Chain Saws	293.535	61.888	1.323	0.140	9.748	8.968	685.996
Flat Bed or Dump Trucks	0.220	0.142	0.628	0.003	0.025	0.023	536.401
Front Loader	3.970	0.620	3.074	0.004	0.548	0.504	694.122
Grub the site down 2'-0	0.523	0.168	3.313	0.003	0.072	0.066	595.649
Log Chipper	1.698	0.350	3.014	0.003	0.294	0.271	589.309
Mulcher	1.698	0.350	3.014	0.003	0.294	0.271	589.309
Ten Wheelers	0.220	0.142	0.628	0.003	0.025	0.023	536.401
Tractor	3.970	0.620	3.074	0.004	0.548	0.504	694.122
2020-Winter							
Bulldozer	0.371	0.154	0.855	0.003	0.076	0.070	536.364
Chain Saws	293.535	61.888	1.323	0.140	9.748	8.968	685.996
Flat Bed or Dump Trucks	0.220	0.142	0.628	0.003	0.025	0.023	536.401
Front Loader	3.970	0.620	3.074	0.004	0.548	0.504	694.122
Grubber	0.523	0.168	3.313	0.003	0.072	0.066	595.649
Log Chipper	1.698	0.350	3.014	0.003	0.294	0.271	589.309
Mulcher	1.698	0.350	3.014	0.003	0.294	0.271	589.309
Ten Wheelers	0.220	0.142	0.628	0.003	0.025	0.023	536.401
Tractor	3.970	0.620	3.074	0.004	0.548	0.504	694.122
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

Table E-5 (2 of 3): Nonroad Construction Equipment Emission Factors

	EMISSION FACTORS (GRAMS PER HORSEPOWER-HOUR)						
EQUIPMENT	**CO**	**VOC**	**NO_X**	**SO_2**	**PM_{10}**	**$PM_{2.5}$**	**CO_2e**
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
Water Truck	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
Bob Cat	3.706	0.699	4.371	0.004	0.526	0.484	693.880
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
Excavator with Bucket	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
Generator Sets	0.943	0.267	3.819	0.003	0.178	0.164	589.560
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
Water Truck	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

Table E-5 (3 of 3): Nonroad Construction Equipment Emission Factors

EQUIPMENT	EMISSION FACTORS (GRAMS PER HORSEPOWER-HOUR)						
	CO	VOC	NO_X	SO_2	PM_{10}	$PM_{2.5}$	CO_2e
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
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
Water Truck	0.173	0.140	0.432	0.003	0.016	0.015	536.406

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 E-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
- NOx emission factors include running exhaust and crankcase start exhaust
- SOx emission factors include running exhaust and start exhaust
- PM emission factors include running exhaust, brake wear, tire wear, and crankcase running exhaust
- CO2e emission factors include running exhaust

Table E-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 E-6: Onroad Construction Vehicle Emission Factors

	EMISSION FACTORS (GRAMS PER MILE)						
EQUIPMENT CATEGORY	**CO**	**VOC**	**NO_X**	**SO_2**	**PM_{10}**	**$PM_{2.5}$**	**CO_{2e}**
2020							
Passenger Car	2.812	0.005	0.051	0.106	0.024	0.004	425.599
Single Unit Short-haul Truck	1.818	0.081	1.528	0.053	0.147	0.052	1,541.945
Combination Short-haul Truck	2.112	0.071	2.475	0.029	0.223	0.074	2,295.232
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

SOURCE: Ricondo & Associates, Inc., January 2018, using the U.S. Environmental Protection Agency MOVES2014a emissions model.

Table E-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})**
Tree Clearing					
Runway/Taxiway Construction	●	●	●	●	●
Demolition			●	●	●

SOURCE: Airport Construction Emissions Inventory Tool (ACEIT), based on project input selections by Ricondo & Associates, Inc., January 2018.

E.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 E-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 2020-2022.

Table E-8: Annual Emissions of Criteria Pollutants Due to Construction of the Proposed Action

	EMISSIONS TONS/YEAR						METRIC TONS/YEAR
	CO	VOC	NO_X	SO_2 1/	PM_{10}	$PM_{2.5}$	CO_2e
Tree Clearing (2020)							
Nonroad	2.502	0.615	1.104	0.004	0.146	0.134	570.344
Onroad	0.324	0.003	0.097	0.010	0.010	0.003	123.025
Fugitive	--	--	--	--	--	--	--
Total	2.826	0.619	1.201	0.014	0.156	0.137	693.369
Runway/Taxiway Construction (2021)							
Nonroad	0.333	0.170	0.621	0.003	0.034	0.031	499.773
Onroad	0.606	0.002	0.033	0.023	0.006	0.002	112.225
Fugitive	0.236	3.632	0.015	0.003	0.080	--	--
Total	1.176	3.803	0.669	0.029	0.120	0.033	611.998
Runway/Taxiway Construction (2022)							
Nonroad	0.652	0.350	1.054	0.006	0.058	0.053	1,024.654
Onroad	1.019	0.006	0.097	0.049	0.017	0.004	265.658
Fugitive	0.914	14.034	0.057	0.010	0.272	--	--
Total	2.584	14.390	1.209	0.065	0.347	0.058	1,290.312
Demolition (2022)							
Nonroad	0.337	0.219	0.756	0.004	0.039	0.036	720.073
Onroad	0.337	0.014	0.268	0.013	0.026	0.008	340.594
Fugitive	0.000	0.000	0.000	0.000	0.411	--	--
Total	0.674	0.233	1.024	0.017	0.476	0.044	1,060.667

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., January 2018, based on inputs to the Airport Construction Emissions Inventory Tool (ACEIT), using the U.S. Environmental Protection Agency NONROAD2008a and MOVES2014a emissions models.

Table E-9 compares the maximum annual emissions with *de minimis* thresholds of 100 tons per year for each criteria pollutant. 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 because of construction of the Proposed Action would not result in a significant impact to air quality.

Table E-9: Proposed Action Construction Emissions Summary and Comparison to De Minimis

	EMISSIONS TONS/YEAR					
	CO	**VOC**	**NO_X**	**SO_2 1/**	**PM_{10}**	**$PM_{2.5}$**
Total Emissions by Year						
2020	2.826	0.619	1.201	0.014	0.156	0.137
2021	1.176	3.803	0.669	0.029	0.120	0.033
2022	3.258	14.623	2.233	0.082	0.823	0.102
de minimis Threshold	100.000	100.000	100.000	100.000	n.a.	100.000
Difference (Under)/Over de minimis Threshold						
2020	(97.174)	(99.381)	(98.799)	(99.986)	(99.844)	(99.863)
2021	(98.824)	(96.197)	(99.331)	(99.971)	(99.880)	(99.967)
2022	(96.742)	(85.377)	(97.767)	(99.918)	(99.177)	(99.898)
Significant?	**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., January 2018, based on inputs to the Airport Construction Emissions Inventory Tool (ACEIT), using the U.S. Environmental Protection Agency NONROAD2008a and MOVES2014a emissions models.

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