REPORT

Air Dispersion Modeling Evaluation

Proposed Amazon Distribution Center

Detroit, Michigan

City of Detroit
Environmental Affairs
2 Woodward Avenue – CAYMC, Suite 401
Detroit, MI 48226

March 2, 2022

NTH Project No. 74-200457-04

NTH Consultants, Ltd.
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City of Detroit
Environmental Affairs
2 Woodward Avenue – CAYMC, Suite 401
Detroit, MI 48226

March 2, 2022
NTH Project No. 74-200457-04

RE: Post-Development Air Dispersion Modeling Evaluation
Proposed Amazon Distribution Center
Detroit, Michigan

Dear Mr. Hassanien:

The City of Detroit (City) recently completed a property transaction for a new Amazon Distribution Center to be constructed on a 137-acre parcel at the former State Fairgrounds property located at 1120 W. State Fair Avenue in Detroit, Michigan. The City contracted with NTH Consultants, Ltd. (NTH) to conduct ambient air quality monitoring at the proposed Amazon Distribution Center (Site) and complete an ambient impact analysis utilizing dispersion modeling to predict pollutant impacts surrounding the developed project site during post-construction operations. The attached report provides an overview of the air dispersion modeling methodology and results.

EXECUTIVE SUMMARY

NTH conducted an air quality evaluation utilizing dispersion modeling for particulate matter (PM_{10} and $PM_{2.5}$) and nitrogen oxide (NO_x, as NO_2) for the proposed Site. Additionally, a secondary formation assessment was conducted for ozone using U.S. Environmental Protection Agency's (EPA's) Modeled Emission Rates for Precursor Pollutants (MERPs) to predict impacts of ozone resulting from emissions of precursor pollutants (NO_x and volatile organic compounds (VOCs)) emitted from the Site during post-construction facility operations.

The most prevalent emissions anticipated to occur during post-construction facility operations are NO_x, PM_{10}, $PM_{2.5}$, and VOCs from the combustion of diesel and gasoline fuel in the vehicles entering and exiting the Site. Additionally, this analysis includes a worst-case estimate of emissions for PM_{10} and $PM_{2.5}$ from fugitive dust/sediment that may be "disturbed" by vehicular traffic traversing road surfaces on the Site. NTH estimated emissions from fugitive dust/sediment and combustion of diesel and gasoline from heavy-duty trucks and employee light-duty passenger vehicles at the facility based on emissions factors from U.S. EPA's *AP-42 Compilation of Air Pollutant Emissions Factors* and U.S. EPA's Motor Vehicle Emission Simulator (MOVES3).

NTH conducted the ambient impact analysis using the AMS/EPA Regulatory Model Improvement Committee Model (AERMOD) dispersion modeling system. The results of the ambient impact analysis and ozone assessment indicate that the proposed operation of the facility is not anticipated to cause or contribute to a violation of National Ambient Air Quality Standards (NAAQS).

We appreciate this opportunity to be of service to you. If you have questions or need additional information, please contact us at (248) 662-2740.

Sincerely,

NTH Consultants, Ltd.

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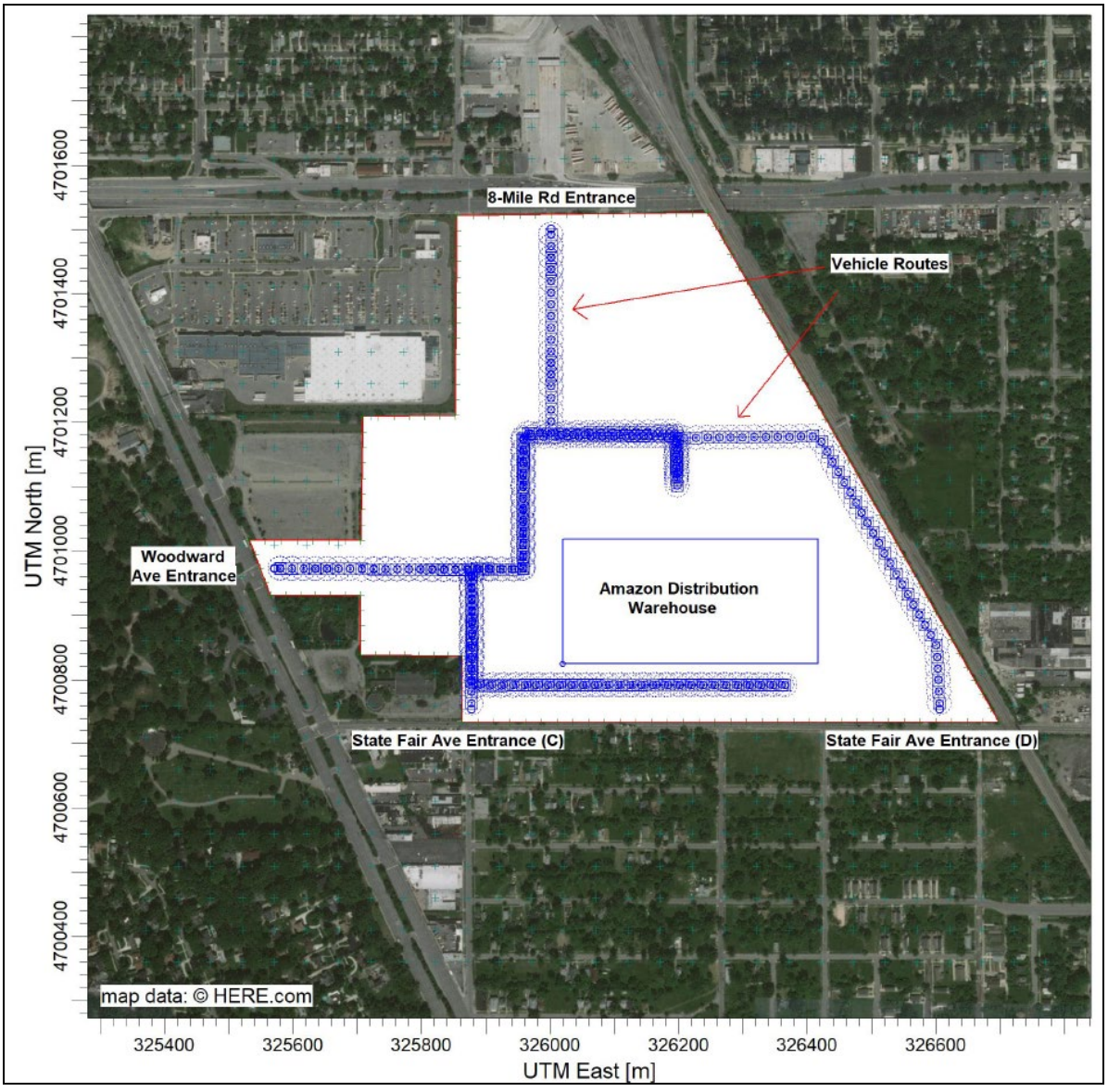
1.0 BACKGROUND

The City of Detroit (City) recently completed a property transaction for a new Amazon Distribution Center to be constructed on a 137-acre parcel at the former State Fairgrounds property located at 1120 W. State Fair Avenue in Detroit, Michigan. The City contracted with NTH Consultants, Ltd. (NTH) to conduct ambient air quality monitoring at the proposed Amazon Distribution Center (Site) and conduct an ambient impact analysis utilizing dispersion modeling to predict pollutant impacts surrounding the developed project site during post-construction operations. The site layout is presented in Figure 1 below.

FIGURE 1. SITE LAYOUT



The following sections present methodology for the development of emission factors, an ambient impact analysis utilizing dispersion modeling, and the secondary formation assessment for ozone.

2.0 EMISSION ESTIMATES FOR POST-CONSTRUCTION FACILITY OPERATIONS

Emissions calculation methodology for road surface emissions and vehicle engine emissions are presented below. Appendix A includes detailed calculations for each emission source type. Road configurations, traffic volumes, and vehicle classification data used to determine post-construction emissions are based on the *Transportation Impact Study for Project Panda* by Langan Engineering and Environmental Services, dated July 2020.

NTH estimated emissions from fugitive dust/sediment and combustion of diesel and gasoline from heavy-duty trucks and employee light-duty passenger vehicles at the facility based on emission factors from U.S. EPA's *AP-42 Compilation of Air Pollutant Emissions Factors* and U.S. EPA's Motor Vehicle Emission Simulator (MOVES3).

2.1 ROAD SURFACE EMISSIONS

Fugitive emissions can occur from road surfaces mostly as a result of meteorological conditions (i.e., dry and windy conditions) and the nature of vehicular traffic. Calculations of particulate matter (PM_{10} and $PM_{2.5}$) from road surfaces are based on U.S. EPA's AP-42 Chapter 13.2.2.

Vehicular traffic (delivery trucks and employee vehicles) at the Site will occur on paved road surfaces. To calculate $PM_{10}/PM_{2.5}$ emissions, the following factors are utilized:

- Weight of the heavy-duty trucks and employee light-duty passenger vehicles
- Distance traveled for trucks and employee vehicles, expressed in units of vehicle miles traveled (VMT), based on the final Site layout depicting truck routes and employee vehicle routes in and out of the Site
- Projected number of vehicles entering and exiting the Site per day, based on the trip generation information provided in *Transportation Impact Study for Project Panda* by Langan Engineering and Environmental Services, dated July 2020:
    - 226 trucks and other delivery vehicles used in transport of goods based on 451 truck trips per day
    - 2,031 employee personal vehicles based on 4,062 trips per day
- Projected operating hours
- Fugitive dust mitigation measures, such as road surface pavement and speed limits

Employee personal vehicle weight is conservatively assumed to be 8,500 lbs and based on the maximum weight for passenger vehicles as defined in U.S. EPA's guidance document *Exhaust Emission Rates for Light-Duty Onroad Vehicles in MOVES3*, dated November 2020. The average truck weight is assumed to be 29 tons, based on the average of the maximum legal vehicle weights unloaded (34,000 lbs) and loaded (80,000 lbs) for heavy-duty vehicles in Michigan according to the U.S. Dept of Transportation Federal Highway Administration (FHWA). Based on the proposed Site layout, it is estimated that the distance of a typical trip taken into or out of the facility for a heavy-duty truck is 0.72 miles and a light-duty passenger vehicle is 0.48 miles. Based on the projected number of heavy-duty truck trips, light-duty passenger vehicle trips, and distance per trip, heavy-duty trucks are responsible for 322 vehicle miles traveled per day

(VMT/day) at the Site, and employee light-duty passenger vehicles are responsible for 1,951 VMT/day at the Site.

Fugitive dust mitigation measures include surface pavement and limiting speeds. $PM_{10}/PM_{2.5}$ emission estimates include a total control factor of 94 percent based on the Western Regional Air Partnership (WRAP) Fugitive Dust Handbook, dated September 7, 2006, for control technology including surface pavement (> 90% control) and limiting vehicle speeds to 25 miles per hour (mph) (44% control).

Emission factors for PM_{10} and $PM_{2.5}$ were developed using Equation 1a from AP-42 Chapter 13.2.2:

$$E = k \times (s/12)^a \times (W/3)^b \times (1-0.90) \times (1-0.44)$$

Where:

- E = *$PM_{10}/PM_{2.5}$ Filterable Emission Factor (lb/VMT)*
- k, a and b = *empirical constants from Table 13.2.2-2 based on particulate matter size (k is in units of lb/VMT)*
- s = *surface material silt content (%)*
- W = *mean vehicle weight (tons)*

Natural mitigation of fugitives will occur on road surfaces due to rainfall and other precipitation. Therefore, the emission factor is adjusted to account for mitigation as a result of rainfall and other precipitation utilizing Equation 2 from AP-42 Chapter 13.2.2:

$$E_{ext} = E \times \frac{(365 \text{ days} - P)}{365 \text{ days}}$$

Where:

- E_{ext} = *$PM_{10}/PM_{2.5}$ Filterable Emission Factor (lb/VMT) extrapolated for natural mitigation*
- E = *$PM_{10}/PM_{2.5}$ Filterable Emission Factor from Equation 1a*
- P = number of days in a year with at least 0.01 inches of precipitation, obtained from Figure 13.2.2-1

Figure 13.2.2-1 from AP-42 Chapter 13.2.2 indicates that, for southeastern lower Michigan, there are, on average, 140 days per year with at least 0.01 inches of precipitation.

Below is an example calculation for the adjusted $PM_{2.5}$ filterable emission factor for heavy-duty truck traffic at the Site:

$$\text{PM}_{2.5}\text{ Filterable Emission Factor (corrected)} = \frac{0.15 \text{ lb}}{VMT} \times (4.3\% / 12)^{0.9} \times (29 \text{ tons} / 3)^{0.45} \times \frac{(365 \text{ days} - 140 \text{ days})}{365 \text{ days}} = \frac{0.10 \text{ lb}}{VMT}$$

Below is an example calculation for daily $PM_{2.5}$ emissions from heavy-duty truck traffic and utilizing the emission factor derived above.

$$PM_{2.5}\ Filterable\ Emissions\ (lb/day) = \frac{0.10\ lb}{VMT} \times \frac{451\ trips}{day} \times \frac{0.72\ miles}{truck} \times 1 - 0.944 = \frac{1.8\ lb}{day}$$

Detailed calculations are presented in Appendix A, Table A-1.

2.2 VEHICLE ENGINE EMISSIONS

Vehicle engine emissions include emissions resulting from idling or running engines and from starting the vehicle. Vehicle engine emission factors were obtained from U.S. EPA's Motor Vehicle Emission Simulator (MOVES3). MOVES3 estimates emissions and energy use for onroad vehicles and nonroad equipment. The model accounts for national emission standards, vehicle populations and activity, state and local rules, fuels, temperatures & humidity. Emission factors were generated separately for heavy-duty long-haul combination diesel trucks, and light-duty passenger trucks. The fleet mix of light-duty passenger trucks included diesel, gasoline, electric, and ethanol, based on MOVE3 estimated proportions for Wayne County, Michigan, for the year 2022.

NTH utilized the following options in MOVES3 to generate emission factors for $PM_{10}/PM_{2.5}$, nitrogen oxide (NO_x, as NO_2), and volatile organic compounds (VOCs) from running engines (in lb/VMT) and engine starts (lb/start). Emission factors are representative of operating 24-hours per day with emissions profiles corresponding to January and July meteorology data to account for seasonal variability in temperatures and humidity. The emissions for running engines were modeled for speeds less than 22.5 miles per hour.

The lb/VMT emission factors for each vehicle class were multiplied by the VMT for the vehicle class to calculate emissions, as presented in Appendix A, Table A-2. The emission factors (lb/start) for each vehicle class were multiplied by the number of engine starts (outbound trips) to calculate emissions for the vehicle class, as presented Appendix A, Table A-3.

Emissions from fugitive dust, running engines, and engine starts were summed, and re-apportioned to each road segment based on vehicle type, segment length, and number of trips across the segment, as presented in Appendix A, Tables A-4, A-5, and A-6.

Table 1 summarizes the emission rates incorporated into the dispersion model by vehicle type, for each vehicle entrance depicted in Figure 1.

Table 1. Total Emission Rates by Road Segment

Vehicle	Entrance	$PM_{2.5}$	PM_{10}	NOx
		lb/hr	lb/hr	lb/hr
Heavy-Duty Trucks	Woodward	0.016	0.143	0.149
	Eight Mile	0.072	0.630	0.654
Light-Duty Passenger Vehicles	Woodward	0.034	0.317	0.037
	Eight Mile	0.095	0.889	0.103
	St. Fair (D)	0.046	0.428	0.050
	St. Fair (C)	0.036	0.334	0.039

3.0 DISPERSION MODELING INPUTS, METHODOLOGY AND RESULTS

The following summarizes the dispersion model used, model inputs, and methodology.

3.1 DISPERSION MODEL DESCRIPTION

NTH developed a dispersion model using the AMS/EPA Regulatory Model Improvement Committee Model (AERMOD) dispersion modeling system. More specifically, the dispersion model utilized Lakes Environmental ISC-AERMOD View Software to prepare and run AERMOD. This computer program was developed by Lakes Environmental and contains recent AERMOD source code (U.S. Environmental Protection Agency (EPA) source code version 19191). The modeling analysis has been conducted in a manner consistent with Michigan Department of Environment, Great Lakes, and Energy's (EGLE's) *Air Dispersion Modeling Guidance Document* (September 2009 revision) and U.S. EPA guidance and standard practices, using the regulatory default mode in AERMOD.

3.2 RECEPTOR GRID

A dispersion model calculates impacts at specific locations (receptors), which are generally placed in areas considered ambient air. The dispersion modeling completed for this project incorporates a receptor grid sufficient to identify the point of maximum impact. A multi-tiered receptor grid is utilized in conducting ambient impact analyses to compare the ground level impacts to the appropriate National Ambient Air Quality Standards (NAAQS). The receptor grid is denser in close proximity to the proposed Site and gradually becomes less dense at distances further from the facility. The Site boundary is used to define the receptor grid in the modeling analyses.

The following multi-tiered receptor grid system was generated for the modeling analysis:

Facility Boundary: Receptors placed along the Site boundary at 25-meter spacing.
Tier 1: Receptors placed at 50-meter spacing in the near-field, from facility's source "center" out to a distance of 0.7 km.

Tier 2:	Receptors placed at 100-meter spacing from a distance of 0.7 km to 1.0 km.
Tier 3:	Receptors placed at 500-meter spacing from a distance of 1.0 km to 5.0 km.
Tier 4:	Receptors placed at 1,000-meter spacing from a distance of 5.0 km to 10.0 km.

This receptor grid configuration results in 1,715 receptors considered representative of the ambient air that could be impacted from site operations.

3.3 TERRAIN

The Site is located in the City of Detroit, Wayne County, Michigan, and the area surrounding the facility is heavily populated. Based upon these observations, the modeling analyses have been conducted utilizing the URBAN dispersion option, with an URBAN GROUP population of 1,000,000 within the densely populated urban area including Detroit and surrounding cities. North American Datum 1983 (NAD83) based USGS National Elevation Dataset (NED) terrain files are incorporated into the AERMOD model using the AERMAP pre-processor via www.webgis.com and utilized to assign elevation and hill heights to receptors, buildings, and emission sources.

3.4 METEOROLOGICAL DATA

The most recent five (5) years of meteorological data (2016-2020) were utilized for the dispersion modeling analysis to cover a wide range of meteorological conditions. Meteorological data are made available through EGLE. Surface data used for the modeling analysis is taken from the Detroit City Airport (DET) Surface Station No. 14822, with a mean surface station elevation of 190 meters above mean sea level (MSL). The upper air station data are from the National Weather Service (NWS) White Lake Station No. 72632. The DET meteorological dataset is representative data for the area and hourly meteorological data measurements are taken at 1-minute intervals averaged over the hour.

3.5 AMBIENT BACKGROUND CONCENTRATIONS

The monitoring program for the Site includes monitoring meteorological conditions and ambient concentrations of PM_{10}, $PM_{2.5}$, NO_2, and VOC located on the upwind and downwind edges of the property. The monitoring is used to evaluate air quality from the Site during three (3) distinct phases:

- Pre-development baseline period
- Construction phase
- Post-construction facility operation

The Baseline Monitoring Report, dated May 14, 2021, includes site-specific baseline ambient concentrations, based on monitoring conducted prior to significant Site construction activities, as presented in Table 2 below. NTH utilized these pre-development baseline concentrations as the ambient backgrounds for emissions from pre-construction facility operations.

Table 2. Site-Specific Baseline Concentrations from Pre-Development Period

Pollutant	Averaging Period	Operator	Monitor [1]	Baseline Concentration	NAAQS [2]	Units
PM_{10}	24-hr	Langan	ML2	47	150	$\mu g/m^3$
$PM_{2.5}$	24-hr	Langan	ML2	22	35	$\mu g/m^3$
NO_2	1-hr	MAQS	Unit 1480	52	100	ppb

[1] Baseline Monitoring included two (2) Site monitors operated by Montrose Air Quality Services (MAQS) on behalf of NTH from January 22 through March 5, 2021 and identified as Unit 1479 (upwind location) and Unit 1480 (downwind location), as well as monitoring data provided by Hillwood Development Company (HDC), the project developers, for the period November 13, 2020 through December 2, 2020 from five (5) monitoring locations at the project Site, identified as ML1, ML2, ML3, ML4 and ML5.

[2] NAAQS have not been established for VOC. VOCs are considered precursors to the formation of ozone. Ozone is formed downwind by photochemical reaction of NO_x and VOCs in certain ambient conditions (typically hot, sunny weather)

3.6 SOURCE AND BUILDING PARAMETERS

The building at the Site will be 85 feet tall. Modeled parameters for vehicular emissions are based on volume source methodology from the U.S. EPA guidance document *Haul Road Workgroup Final Report Submission to EPA-OAQPS*, dated March 2, 2012. Table 3 summarizes the source parameters that were modeled for the Site by vehicle type, for each entrance depicted in Figure 1 above.

Table 3. Source Parameters

Vehicle	Entrance	Line Volume Config. [1]	Line Volume Type [1]	Road Length	Base Elevation	Release Height [1]	Side Length [1]
				miles	meters	meters	meters
Heavy-Duty Trucks	Woodward	Adjacent	Surface-Based	0.61	194.8	3.50	18.19
	Eight Mile	Adjacent	Surface-Based	0.82	194.3	3.50	18.19
Light-Duty Passenger Vehicles	Woodward	Adjacent	Surface-Based	0.57	194.8	1.55	18.19
	Eight Mile	Adjacent	Surface-Based	0.37	194.3	1.55	18.19
	St. Fair (D)	Adjacent	Surface-Based	0.47	194.0	1.55	18.19
	St. Fair (C)	Adjacent	Surface-Based	0.51	194.5	1.55	18.19

[1] Source parameters based on *Haul Road Workgroup Final Report Submission to EPA-OAQPS*, dated March 2, 2012

3.7 DISPERSION MODELING METHODOLOGY AND RESULTS

The dispersion modeling analysis is based on incorporating the emission rates of NO_x, PM_{10} and $PM_{2.5}$ from running the vehicle engines, starting the vehicle engines, and fugitive emissions from driving on the Site, and adding ambient background concentrations for comparison to the NAAQS. No additional off-site sources of emissions were included. It is assumed that

concentrations due to other nearby emissions sources are included in the ambient monitor values used for background concentrations. For the 1-hour NO_x, 24-hour PM_{10} and 24-hour $PM_{2.5}$ NAAQS averaging periods, pre-development baseline concentrations were used as the ambient background. For the annual NO_x, PM_{10} and $PM_{2.5}$ NAAQS averaging periods, the most recent data from 2018 - 2021 from EGLE's nearby network of monitoring stations were used as the ambient background concentration because a full year of data is not available from the on-site monitors.

Results of the modeled impacts with background concentrations are compared to the NAAQS for NO_x (as NO_2), PM_{10}, and $PM_{2.5}$ as summarized in Table 4. The results of the modeling analysis demonstrate that the modeled impacts, including background concentrations, will be below the applicable NAAQS.

Table 4. NAAQS and Modeling Results

Pollutant	Averaging Time Period	NAAQS ($\mu g/m^3$)	Maximum Impact ($\mu g/m^3$)	Baseline Background Concentration ($\mu g/m^3$)	Total Impact ($\mu g/m^3$)	Maximum Impact as % of NAAQS ($\mu g/m^3$)
NO_2	1-hour	188	15.3	98 [1]	113.3	60%
	Annual	100	3.9	29 [2]	32.9	33%
$PM_{2.5}$	24-hour	35	2.3	22 [3]	24.3	69%
	Annual	12	0.8	7.8 [4]	8.6	72%
PM_{10}	24-hour	150	27.6	47 [3]	74.6	50%

[1] NO_2 background value converted from the on-site monitor baseline concentration of 52 ppb to 98 $\mu g/m^3$ to match AERMOD output units.
[2] Background for annual NO_2 is based on 2018-2020 maximum annual average from EGLE's East 7-Mile monitor; a full year of data is not available from the on-site monitors.
[3] $PM_{2.5}$ and PM_{10} 24-hour backgrounds are based on the on-site monitor baseline concentrations.
[4] Background for annual $PM_{2.5}$ is based on 2018-2020 3-year average from EGLE's Oak Park $PM_{2.5}$ monitor; a full year of data is not available from the on-site monitors.

4.0 SECONDARY OZONE FORMATION ASSESSMENT/MERPS

Secondary formation of ozone can occur from emissions of NO_x and VOCs. In Sections 5.3.2 and 5.4.2 of Appendix W, U.S. EPA prescribes a qualitative analysis where existing technical information is available to address secondary formation ("Tier 1") as an alternative to photochemical grid modeling ("Tier 2"). The preamble to Appendix W states that Modeled Emission Rates for Precursor Pollutants (MERPs) "can be used to develop empirical relationships for specific areas that may be appropriate as a Tier 1 demonstration tool."

On April 30, 2019, U.S. EPA published final *Guidance on the Development of MERPs as a Tier 1 Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program* ("final MERPs guidance"). The final MERPs guidance is intended to provide a regulatory framework for state agencies and permit applicants to develop MERPs as part of the "Tier 1" approach to meet

requirements for precursor assessments. The Tier 1 approach allows a permit applicant to assess impacts of ozone from secondary formation using "technically credible relationships between emissions and ambient impacts developed from existing modeling studies deemed sufficient for evaluating a project source's impacts."

MERPs were utilized to complete a "Tier 1" qualitative secondary formation assessment. MERPs provide a streamlined path to demonstrating compliance with new Appendix W requirements for a project of this size, compared to conducting full photochemical modeling. Site-specific MERPs were developed following the methodology in U.S. EPA's draft MERPs guidance. The site-specific MERPS were used to estimate impacts of secondary formation of ozone.

4.1 SITE-SPECIFIC MERPS

U.S. EPA provides several scenarios to choose from to estimate precursor contributions to ozone formation. NTH utilized U.S. EPA guidance to develop site-specific MERPs by selecting comparable emission rates, source heights, and representative locations from hypothetical precursor sources modeled by U.S. EPA. Available U.S. EPA hypothetical sources are based on several parameters:

- Source emission rates (500, 1,000, or 3,000 tpy) of each pollutant;
- Source heights (H = 90 meters or L = surface level release (10 meters)); and
- Location (Macomb, Marquette, Montcalm, Ogemaw or Van Buren counties in Michigan).

Emission rates of NO_x and VOC from the Site would be each less than 500 tpy. The release heights for vehicular traffic emissions are ground level releases. Of the available locations that U.S. EPA modeled for use in MERP evaluations, Macomb County represents the closest county to the proposed Amazon Distribution Center in Detroit. U.S. EPA's modeled hypothetical source that is the most representative of the Site is:

- Emission rates up to approximately 500 tpy of NOx and VOC precursor pollutants
- Surface level release heights (i.e., 10 meters)
- Located in Macomb County

The site-specific MERPs calculated by U.S. EPA's MERPs View Qlik application, based on U.S. EPA's modeled values for the scenario listed above, are presented in Appendix C. Project VOC and NO_x emissions are each calculated as a percent of their respective MERP. The percentages are then combined to determine whether the project emissions are less than the 8-hour ozone Significant Impact Level (SIL). Pursuant to U.S. EPA guidance, if impacts from a proposed project are less than the SIL (a conservative first-tier modeling analysis), then the project will not cause or contribute to a violation of the respective NAAQS. The combined impacts indicate that secondary formation of ozone due to the proposed Amazon Distribution Center project will not exceed the 8-hour ozone SIL; therefore, the proposed project will not cause or contribute to a violation of the ozone NAAQS.

APPENDIX A

// EMISSION CALCULATIONS

City of Detroit
Proposed Amazon Distribution Center
Vehicle Traffic and Fugitive Dust Emission Estimates

Table A-1. Road Surfaces - Fugitive Dust Emissions

Pollutant	Constants [1]			Average Surface Silt Content [2]	Mean Vehicle Weight [3]	Emission Factor [4]	Rainfall > 0.01 in [5]	Emission Factor $_{corr}$ [6]	Projected Number of Daily Trips [7]	Length of Trip [8]	Miles Traveled	Emissions Estimate	Fugitive Dust Mitigation [9]	Emissions After Mitigation		
	k	a	b	(%)	(tons)	lb/VMT	days/yr	lb/VMT	trips/day	mi/trip	VMT/day	lb/day	% decrease	lb/hr [10]	lb/day	tpy [10]
Heavy-Duty Trucks																
$PM_{2.5}$	0.15	0.9	0.45	4.3	29	0.16	140	0.10	451	0.72	322	32.6	94%	0.1	1.8	0.3
PM_{10}	1.5	0.9	0.45	4.3	29	1.64	140	1.0	451	0.72	322	326	94%	0.8	18.3	3.3
Light-Duty Passenger Vehicles																
$PM_{2.5}$	0.15	0.9	0.45	4.3	4	0.07	140	0.043	4,062	0.48	1,951	83.8	94%	0.2	4.7	0.9
PM_{10}	1.5	0.9	0.45	4.3	4	0.70	140	0.43	4,062	0.48	1,951	838	94%	2.0	46.9	8.6

[1] Constants for emission factor calculation are based on AP-42 Chapter 13.2.2, Table 13.2.2-2.

[2] The Amazon Distribution Center will be paved with a mix of regular vehicle traffic in the parking lots and truck traffic for loading and unloading packages. Therefore, it is assumed the silt content on the paved areas will be minimal. Based on available silt content information presented in AP-42 Chapter 13.2.2, Table 13.2.2-1, the silt content of a service road is assumed to be appropriately conservative and therefore utilized to derive the particulate emission factors.

[3] Average weight of trucks is based on U.S. Dept of Transportation FHWA maximum heavy-duty vehicle weights empty (34,000 lbs) and loaded (80,000 lbs). Weight of light-duty passenger vehicles is based on maximum listed gross vehicle weight ratings of less than 8,500 lbs, as defined in U.S. EPA's guidance *Exhaust Emission Rates for Light-Duty Onroad Vehicles in MOVES3* , dated November 2020.

[4] Emission factor is calculated based on Equation 1a in AP-42 Chapter 13.2.2.

[5] Days of rainfall > 0.01 inches is based on AP-42 Chapter 13.2.2, Figure 13.2.2-1.

[6] Corrected emission factor is calculated based on Equation 2 in AP-42 Chapter 13.2.2.

[7] Projected daily number of heavy-duty trucks and passenger vehicle trips at the facility are obtained from a traffic study for the Site by Langan Engineering and Environmental Services, Inc. dated July 2020.

[8] Distance traveled assumes a length of one trip into or out of the facility, based on the proposed layout of the facility depicting the parking lot area and driveways for passenger vehicles and truck traffic areas.

[9] Mitigation estimated based on the WRAP Fugitive Dust Handbook for control technology including surface pavement (> 90% control) and limiting vehicle speeds to 25 mph (44%).

[10] Hourly and annual emission rates are based on 24 hours per day and 365 days per year, respectively.

Table A-2. Vehicle Running Engine Emissions

Pollutant	Emission Factor [1]		Projected Number of Daily Trips [2]	Length of Trip [3]	Miles Traveled	Emissions Rates		
	g/VMT	lb/VMT	trips/day	mi/trip	VMT/day	lb/hr [4]	lb/day	tpy [4]
Heavy-Duty Trucks								
$PM_{2.5}$	0.42	0.00093	451	0.72	322	0.012	0.30	0.055
PM_{10}	0.39	0.00085	451	0.72	322	0.011	0.28	0.050
NO_x	23.91	0.05271	451	0.72	322	0.708	17.00	3.102
VOC	1.00	0.00221	451	0.72	322	0.030	0.71	0.130
Light-Duty Passenger Vehicles								
$PM_{2.5}$	0.020	0.000045	4,062	0.48	1,951	0.0036	0.09	0.016
PM_{10}	0.018	0.000041	4,062	0.48	1,951	0.0033	0.08	0.014
NO_x	0.58	0.00127	4,062	0.48	1,951	0.103	2.48	0.452
VOC	0.37	0.00082	4,062	0.48	1,951	0.066	1.59	0.291

[1] Emission factor is calculated based on emission factors generated by U.S. EPA's MOVES3 model for heavy-duty combination trucks and light-duty passenger trucks.

[2] Projected daily number of trucks and passenger vehicle trips at the facility are obtained from traffic study by Langan Engineering and Environmental Services, Inc. dated July 2020.

[3] Distance traveled assumes a length of one trip into or out of the facility, based on the proposed layout of the facility depicting the parking lot area and driveways for passenger vehicles and truck traffic areas.

[4] Hourly and annual emission rates are based on 24 hours per day and 365 days per year, respectively.

Table A-3. Vehicle Engine Start Emissions

Pollutant	Emission Factor [1]	Emission Factor [1]	Projected Number of Vehicle Starts [2]	Emissions Rates		
	g/start	lb/start	starts/day	lb/hr [3]	lb/day	tpy [3]
Heavy-Duty Trucks						
$PM_{2.5}$	0.02	0.00004	226	0.0003	0.01	0.001
PM_{10}	0.01	0.00003	226	0.0003	0.01	0.001
NO_x	4.55	0.01004	226	0.094	2.26	0.413
VOC	0.63	0.00139	226	0.013	0.31	0.057
Light-Duty Passenger Vehicles						
$PM_{2.5}$	0.060	0.000133	2,031	0.0112	0.27	0.049
PM_{10}	0.053	0.000117	2,031	0.0099	0.24	0.043
NO_x	0.67	0.00149	2,031	0.126	3.02	0.550
VOC	1.15	0.00254	2,031	0.215	5.16	0.941

[1] Emission factor is calculated based on emission factors generated by U.S. EPA's MOVES3 model for heavy-duty combination trucks and light-duty passenger trucks.

[2] Projected number of vehicle starts are based on the projected daily number of heavy-duty trucks and passenger vehicle trips at the facility, obtained from traffic study by Langan Engineering and Environmental Services, Inc. dated July 2020. The projected number of starts are assumed to be half the projected daily number of trips since only outbound trips from the facility require a vehicle startup.

[3] Hourly and annual emission rates are based on 24 hours per day and 365 days per year, respectively.

Table A-4. Summary of Total Annual Emission Rates

Pollutant	Road Surface Fugitive Emissions	Running Engine Emissions	Engine Starts	Total Emission Rates
	tpy	tpy	tpy	tpy
Heavy-Duty Truck Emissions				
$PM_{2.5}$	0.33	5.46E-02	1.47E-03	0.39
PM_{10}	3.33	5.02E-02	1.35E-03	3.38
NO_x	--	3.10	0.41	3.52
VOC	--	0.13	0.06	0.19
Light-Duty Passenger Vehicle Emissions				
$PM_{2.5}$	0.86	1.59E-02	4.91E-02	0.92
PM_{10}	8.56	1.45E-02	4.35E-02	8.62
NO_x	--	0.45	0.55	1.00
VOC	--	0.29	0.94	1.23
Total Emissions (Heavy-Duty Trucks and Light-Duty Passenger Vehicles)				
$PM_{2.5}$	1.19	7.05E-02	5.06E-02	1.31
PM_{10}	11.89	6.47E-02	4.48E-02	12.00
NO_x	--	3.55	0.96	4.52
VOC	--	0.42	1.00	1.42

Table A-5. Summary of Total Hourly Emission Rates

Pollutant	Fugitive Emissions	Running Engine Emissions	Engine Starts	Total Emission Rates
	lb/hr	lb/hr	lb/hr	lb/hr
Heavy-Duty Truck Emissions				
$PM_{2.5}$	0.1	0.012	0.0003	0.09
PM_{10}	0.8	0.011	0.0003	0.77
NO_x	--	0.708	0.094	0.80
Light-Duty Passenger Vehicle Emissions				
$PM_{2.5}$	0.20	0.004	0.0112	0.210
PM_{10}	1.95	0.003	0.0099	1.968
NO_x	--	0.10	0.13	0.229

Table A-6. Modeled Total Hourly Emissions by Vehicle Type and Facility Entrance

Vehicle Type	Entrance	Number of Trips at AM/PM Peaks [1]	Road Length	Traffic Fraction	$PM_{2.5}$ Emissions	PM_{10} Emissions	NO_x Emissions
		No. Trips	mi	%	lb/hr	lb/hr	lb/hr
Heavy-Duty Trucks	Woodward	8	0.61	19%	0.016	0.143	0.149
	Eight Mile	26	0.82	81%	0.072	0.630	0.654
Light-Duty Passenger Vehicles	Woodward	136	0.57	16%	0.034	0.317	0.037
	Eight Mile	583	0.37	45%	0.095	0.889	0.103
	St. Fair (D)	220	0.47	22%	0.046	0.428	0.050
	St. Fair (C)	161	0.51	17%	0.036	0.334	0.039

[1] Projected daily number of heavy-duty trucks and passenger vehicle trips at the facility are obtained from a traffic study for the Site by Langan Engineering and Environmental Services, Inc. dated July 2020.

APPENDIX B

// DISPERSION MODELING SOURCE PARAMETERS

Table B-1. Modeled Source Parameters [1]

Vehicle	Entrance	Configuration	Line Volume Type	Road Length	Line Volume Height	Base Elevation	Release Height	Side Length
				miles	meters	meters	meters	meters
Heavy-Duty Trucks	Woodward	Adjacent	Surface-Based	0.61	7.00	194.8	3.50	18.19
	Eight Mile	Adjacent	Surface-Based	0.82	7.00	194.3	3.50	18.19
Light-Duty Passenger Vehicles	Woodward	Adjacent	Surface-Based	0.57	3.11	194.8	1.55	18.19
	Eight Mile	Adjacent	Surface-Based	0.37	3.11	194.3	1.55	18.19
	St. Fair (D)	Adjacent	Surface-Based	0.47	3.11	194.0	1.55	18.19
	St. Fair (C)	Adjacent	Surface-Based	0.51	3.11	194.5	1.55	18.19

[1] Configuration based on *Haul Road Workgroup Final Report Submission to EPA-OAQPS*, dated March 2, 2012

APPENDIX C

// SECONDARY FORMATION ASSESSMENT

City of Detroit
Proposed Amazon Distribution Center
Secondary Formation
MERP Development

Table C-1. Calculated Site-Specific MERPs for Source Type

Source Type			MERP for SIL Critical Air Quality Threshold [2]	
			8-hour O_3	
Emissions (tpy)	Height	County	NO_x (tpy)	VOC (tpy)
500	L [1]	Macomb	531	1,994

[1] L = 10 Meter Release Height

[2] MERPs are from U.S. EPA's Qlik Application for this source type.

Table C-2. Vehicle Traffic Emissions

Location/Region	Emissions	
	8-hour O_3	
	NO_x Emissions (tpy)	VOC Emissions (tpy)
Wayne County, Michigan (Eastern U.S.)	4.5	1.4

Table C-3. Project Precursor and Primary Impacts

Parameter	Project Impacts		
	8-hour O_3		
	NO_x	VOC	Units
Calculated Site-Specific MERP	531	1,994	tpy
Individual Precursor (%) of Calculated Site-Specific MERP	0.9%	0.1%	%
Combined Precursor Percentage of SIL [1]	**0.9%**		%

[1] U.S. EPA's *Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program* , dated April 30, 2019 indicates that *"A value less than 100% indicates that the O_3 SIL would not be exceeded when considering the combined impacts of these precursors. Thus, the project level O_3 impacts associated with both NO_X and VOC precursor emissions from this source would be expected to be below the EPA recommended 8-hour O_3 SIL. "*