ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276 · (217) 782-3397
JB PRITZKER, GOVERNOR JAMES JENNINGS, ACTING DIRECTOR

MEMORANDUM

Date: December 18, 2024

To: Muhammed Huq, FESOP/State Permits/BOA

From: Jason Tran and Jada Strother, Modeling Unit, Permits/BOA

Subject: Equinix, LLC, ID 031440AVZ, Permit Application 23080013

Equinix, LLC (Equinix) submitted an initial Construction Permit application package on August 11, 2023, for the proposed installation of 10 engine-generators then submitted a revised construction permit application (#23080013), on September 25th, 2024, for a proposed project providing for the installation of 15 engine-generators (emergency generators) at a new Equinix data center. The project would require an expansion of one new data center adjacent to its existing facility, Equinix CH-3 data center (CH-3 Facility). Equinix currently operates the existing CH-3 data center under a Federally Enforceable State Operating Permit [FESOP (Source ID No. 031440ANI)].

The proposed data center would be called the CH-5 data center (CH-5 Facility) and would be located at 2001 Lunt Avenue, Elk Grove Village, Cook County, IL 60007. The center of the CH-5 Facility is in Universal Transverse Mercator (UTM) Zone 16, at approximately 421,000 meters (m) Easting and 4,650,350 m Northing.

The CH-5 Facility is proposed to have (14) 3,500-electrical kilowatt (kWe) emergency generators and (1) 2,500 kWe emergency generator. The 15 emergency generators will operate based on a fuel consumption limit of up to 17,300 gallons per year per generator for all non-emergency operations.

Although the combined Potential to Emit (PTE) for Equinix CH-3 and CH-5 is less than the New Source Review (NSR) major source threshold of 100 tons per year, the proposed CH-5 Facility is presently located in an Environmental Justice (EJ) area. The issued permit would provide for increases in permitted emissions of nitrogen oxides (NOx), carbon monoxide (CO), particulate matter (PM),sulfur dioxide (SO_2), and volatile organic compounds (VOC). Consequently, the Illinois EPA requested Equinix to submit an air quality analysis as part of its permit application to ensure the project would not threaten or compromise existing National Ambient Air Quality Standards (NAAQS) for any pollutant with an increase in permitted emissions.

In response to Illinois EPA's request, Equinix had ALL4, LLC (ALL4) conduct an air quality review of $PM_{2.5}$, PM_{10}, SO_2, NOx, and CO. The Modeling Unit also independently evaluated the

secondary O_3 and $PM_{2.5}$ impacts from the combined Equinix site (both CH-3 and CH-5) NOx, SO_2, and VOC emissions.

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Modeling Unit Review

ALL4 submitted an air quality analysis summary for the CH-5 Facility along with its modeling files to the Modeling Unit electronically on March 27th, 2024, with 10 proposed emergency generators. ALL4 submitted revised modeling files with a summary of updates on September 25th, 2024. The updated modeling revision included the addition of five emergency generators for analysis, a total of 15 proposed emergency generators. On November 19th, 2024, ALL4 submitted a revised modeling report with updates to the background concentration for $PM_{2.5}$.

The following main dot entries identify key aspects of the modeling methodology used in this analysis:

- ALL4 used AERMOD (v. 23132), the AMS/USEPA Regulatory Model. AERMOD is a federally approved regulatory model appropriate for use in an air quality analysis of this nature. While updated versions of AERMOD, AERMAP, and AERMET (v. 24142)[1] have been released, the updates will not impact the results of this modeling analysis. Therefore, the use of AERMOD (v. 23132), AERMET (v. 23132), and AERMAP (v. 18081) was accepted for this analysis. The audit runs conducted by the Modeling Unit used v. 23132.

- Modeling inputs utilized by IEPA -and USEPA-recommended default regulatory options, which simulate phenomena such as atmospheric stability, plume rise, and downwash. The modeling analysis incorporated five years of locally representative meteorology. The Modeling Unit obtained National Weather Service (NWS) meteorological data files for years 2019 through 2023 from the National Centers for Environmental Information (NCEI) which consisted of surface data collected at the O'Hare International Airport in Chicago, Illinois, and upper air data collected at Davenport Municipal Airport in Davenport, Iowa. Surface and upper air stations were selected because of their proximity and representativeness to the project site in Elk Grove Village. The Modeling Unit provided the applicant with meteorology data processed with AERMET (v. 23132) in its review.

- ALL4 processed National Elevation Data (NED) terrain elevations from USGS using the most recent version of AERMAP (v. 18081) to develop the receptor terrain elevations and hill height scales required by AERMOD. The elevation at the project site is approximately 206 meters above mean sea level.

- ALL4 used a Cartesian grid in their distribution of 2,305 receptors. The following receptor grid densities were used:
    - 25 m spacing of receptors from the site's boundary out to 300 meters.

[1] Tillerson, Clint (2024, November 20) *Release of the regulatory AERMOD Modeling System (AERMOD, AERMET, and AERMAP), AERSURFACE, and AERPLOT (Version 24142), and MMIF (Version 4.1.1).* USEPA

- 50 m spacing of receptors from 300 meters out to 500 meters.
- 100 m spacing of receptors from 500 meters to 1000 meters.
- 250 m spacing of receptors from 1000 meters to 3000 meters.
- 500 m spacing of receptors from 3000 meters to 5000 meters.
- 1000 m spacing of receptors from 5000 meters to 10000 meters.

- ALL4 selected the urban modeling option in their analysis. The Modeling Unit conducted an Auer's Analysis as part of its review to characterize the area surrounding Equinix and determine whether the AERMOD urban option should be implemented. The Modeling Unit developed its Auer's Analysis using 2021 National Land Cover Data (NLCD) within a 3-km radius of the site. Results of the analysis showed that the surrounding area is 18% rural and 82% urban.

- ALL4 used USEPA's Building Profile Input Program (BPIPPRM) to account for downwash effects of on-site structures. All on-site nearby buildings were included in the modeling analysis.

- NO_2 modeling options consist of multiple tiers. Tier 1 assumes that all NOx emitted from emission units at the source converts to NO_2. Tier 2 is based upon a representative atmospheric equilibrium default value that was developed using conversion ratios generated from monitored concentrations of NOx and NO_2. Tier 3 allows the user to perform a detailed analysis using either the Ozone Limiting Method (OLM) or the Plume Volume Molar Ratio Method (PVMRM) regulatory screening options in AERMOD. These options consider the chemical mechanism of ozone titration and the resulting NO_2 concentrations. Based on the submitted modeling files, ALL4 selected the regulatory default Ambient Ratio Method (ARM2) option in AERMOD which uses a range of ambient NO_2/NOx ratios, with 0.5 as the lower limit and 0.9 as the upper limit.

Operating Scenarios

Equinix will conduct routine testing of each generator at the CH-5 Facility. Routine testing of each generator would occur for up to one hour per week during testing days at up to 100% load, with no more than 8 hours of routine testing occurring per day. Such testing would be limited to 52 hours per year for each generator. In addition to routine maintenance and testing, Equinix would undergo two special operating scenarios at both the CH-3 and CH-5 sites where multiple generators would operate simultaneously at 50% operating load. These two special operating scenarios would be switchboard maintenance, which would occur once annually for a duration of up to eight hours per generator, and a pull-the-plug test, which would occur once annually for a duration of approximately two hours per generator. Equinix opted for 50% operating load as it is the minimum operating load to provide power to the generator's respective facility of CH-3 or CH-5. The operating scenarios would be performed on a once per year basis and these operating scenarios were also modeled. See **Table 1** for the list of scenarios.:

Table 1
List of Operating Scenarios

Operating Scenario	Annual Duration (hours/year)	Facility Operating	Maximum Number of Generators Operating Simultaneously	Operating Load
Switchboard Maintenance (SBM)	8	CH-3	16	50%
Pull the Plug Test (PTP)	2	CH-3	16	50%
Switchboard Maintenance (SBM)	8	CH-5	8	50%
Pull the Plug Test (PTP)	2	CH-5	8	50%
Routine Maintenance and Testing	52	CH-3	1	100%
Routine Maintenance and Testing	52	CH-5	1	100%

The emission rates are based on the following scenarios:

- For PM_{10} and $PM_{2.5}$, Routine testing utilized the 24-hour daily average emission rate for 1-hour of operation; Pull-the-Plug test used the 24-hour daily average for 2-hours of operation; and Switchboard maintenance used the daily average for 8-hours of operation.

- For NOx, Routine testing used the annualized emissions at 250 hours and 115 hours per year for CH-3 generators, and 115 hours per year for CH-5 generators.

- For SO_2, Routine testing utilized the daily average emission rate for 1 and 3-hours of operation.

- For CO, Routine testing utilized the daily average emission rate for 1 and 8-hours of operation.

See **Table 2** for the average emission rates of the Equinix site:

Table 2
Average Emission Rates Based on Operating Scenarios

Facility			CH-3	CH-5	Cooling Towers
Average Emission Rates (g/s)	NO_x	Routine (1-hr)	1.29E-01	1.43E-01	-
		PTP (1-hr)	3.53E-04	7.04E-04	-
		SBM (1-hr)	1.40E-03	2.82E-03	-
		Annual	6.00E-02	9.26E-02	-
	CO	1-hr, 8-hr	8.58E-01	1.12	-
	PM_{10}	Routine (1-hr)	5.72E-03	4.08E-03	4.91E-03
		PTP (1-hr)	1.00E-02	9.38E-03	4.91E-03
		SBM (1-hr)	5.00E-02	3.40E-02	4.91E-03
	$PM_{2.5}$	Routine (1-hr)	5.72E-03	4.08E-03	4.91E-03
		PTP (1-hr)	1.00E-02	9.38E-03	4.91E-03
		SBM (1-hr)	5.00E-02	3.40E-02	4.91E-03
		Annual	1.71E-03	9.34E-04	4.90E-03
	SO_2	1-hr, 3-hr	5.04E-03	1.71E-03	-

Source Impact Analysis

ALL4 performed a source impact analysis to determine if more detailed modeling would be required for SO_2, $PM_{2.5}$, PM_{10}, and CO averaging period. ALL4 omitted performing a source impact analysis for NO_2 instead opting to perform a NAAQS analysis for NO_2. ALL4 modeled the average allowable emission from the project, including the new units in the CH-5 Facility

and the existing cooling towers from the CH-3 Facility. The results of this analysis are compared against significant impact levels for each pollutant and averaging period. The results of this analysis can be found in **Table 3** below.

Table 3
Source Impact Analysis Results

Pollutant	Scenario (If applicable)	Averaging Period	Maximum Modeled Impact ($\mu g/m^3$)	Significant Impact Level ($\mu g/m^3$)
SO_2	100% Load - Routine Maintenance and Testing (ALL)	1-hour	7.47	7.8
		3-hour	6.14	25
$PM_{2.5}$	100% Load - Routine Maintenance and Testing, Daily Average Emissions	24-hour	1.92(1)	1.2
	50% Load - 2-hour, once-annual, Pull-the-Plug Test, Daily Average Emissions		7.01 (1)	1.2
	50% Load - 8-hour, once-annual, Switchboard Maintenance		24.55 (1)	1.2
	100% Load - Routine Maintenance and Testing, 5 year Annual Average Emissions	Annual	0.07 (1)	0.13
PM_{10}	100% Load - Routine Maintenance and Testing, Daily Average Emissions	24-hour	2.35	5
	50% Load - 2-hour, once-annual, Pull-the-Plug Test, Daily Average Emissions		7.99	5
	50% Load - 8-hour, once-annual, Switchboard Maintenance		29.15	5
CO	100% Load - Routine Maintenance and Testing (ALL)	1-hour	1148.66	2000
		8-hour	731.02	500

(1) The maximum model impact also includes secondary $PM_{2.5}$ concentrations.

Ozone and Secondary $PM_{2.5}$ Formation

Illinois EPA considered the precursor emission increases of NOx, SO_2, and VOM to evaluate the impact on the NAAQS from secondarily formed O_3 and $PM_{2.5}$. Results from the analysis were compared against SILs for O_3 and $PM_{2.5}$ to determine if further analysis should be completed.

To estimate the O_3 and secondary $PM_{2.5}$ formation, a Tier 1 demonstration was performed following guidance[2,3,4] from USEPA on modeled emission rates for precursors (MERPs). This approach utilizes air quality modeling results from hypothetical sources with precursor emission estimates to evaluate the project's impacts against SILs for O_3 and $PM_{2.5}$.

Illinois EPA elected to use a representative hypothetical source located in Stephenson County, Illinois at approximately 145 kilometers away from the Equinix site. The Equinix site and Stephenson County are also near an airport, therefore electing Stephenson County as a representative is appropriate for the MERPs analysis. Illinois EPA concluded that impacts were less than significant for all averaging periods of $PM_{2.5}$ and O_3.

Table 4 shows Illinois EPA's estimated secondary $PM_{2.5}$ impacts. The calculated concentrations were based on project emissions of 90.4 tpy of NOx and 0.08 tpy of SO_2.

Table 4
MERPs Analysis for Secondary $PM_{2.5}$

Pollutant	Averaging Period	Concentration (µg/m^3)	SIL (µg/m^3)
$PM_{2.5}$	24-hour	0.012659	1.2
	Annual	0.000388	0.13

Table 5 shows Illinois EPA's estimated O_3 impacts compared to the SIL. The calculated concentrations were based on project emissions of 90.4 tpy of NOx and 3.51 tpy of VOCs.

Table 5
MERPs Analysis for Ozone

Pollutant	Averaging Period	Concentration (ppb)	SIL (ppb)
O_3	8-hour	0.310	1.0

The project is not significantly impacting concentrations of O_3 or $PM_{2.5}$ from secondary formation estimated in the MERPs analysis tables above.

[2] USEPA (2024). *Clarification 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*. Office of Air Quality Planning and Standards, Research Triangle Park, NC.
[3] USEPA (2019). *Guidance on the Use of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program*. Publication No. EPA 454/R–19–003. Office of Air Quality Planning and Standards, Research Triangle Park, NC.
[4] USEPA (2022). *Guidance for Ozone and Fine Particulate Matter Permit Modeling*. Publication No. EPA 454/R–22–005. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

NAAQS Analysis

Based on the results from the source impact analysis, ALL4 conducted a NAAQS analysis for CO (8 hour averaging period), $PM_{2.5}$ (24-hour averaging period), and PM_{10} (24-hour averaging period). For NO_2 (both 1-hour and annual averaging periods), ALL4 conducted the NAAQS analysis based on the full receptor grid. For $PM_{2.5}$ and PM_{10}, ALL4 utilized the worst-case scenario receptor grid from the SIL analysis that represents the switchboard maintenance scenario with a 50% load on the generators and 8-hours of operation, shown in **Table 2**. ALL4 developed a cumulative modeling analysis that incorporated background concentrations based on nearby monitoring data as well as a nearby emission inventory sources not represented by the background monitor concentration.

ALL4 utilized representative background data collected from Illinois's air monitoring network. Background values include:

- NO_2 data for use in the 1-hour and annual NO_2 modeling were obtained from the air quality monitor located in Schiller Park, Illinois (AQS ID: 17-031-3103). ALL4 utilized data from 2020 to 2022, as 2023 data was incomplete at the time of their analysis. Schiller Park was chosen due to its proximity at approximately 7 km away from the site. The monitor is also in an urban region where concentrations are expected to be representative of background for the site location. ALL4 used hourly by season values from 2020 to 2022 to represent the 1-hour NO_2 background concentration[5]. The Modeling Unit audit used the more recently available NO_2 data from the period of 2021 to 2023.

- CO data for use in the 8-hour CO modeling was collected from the monitor station located at Kingery Road, Lansing, Illinois (AQS ID: 17-031-0119) for 2021 to 2023. This monitor was chosen based on the relative proximity to the Equinix site at approximately 57 kilometers. This was the closest CO monitor, and it is near an interstate highway where concentrations are expected to be a conservative representation of background for the site location.

- $PM_{2.5}$ data for use in the 24-hour $PM_{2.5}$ modeling was collected from the monitor station located in Des Plaines, Illinois (AQS ID: 17-031-4007) for years 2021 to 2023. This monitor was chosen based on the relative proximity to the Equinix site at approximately 10 kilometers. This was the closest $PM_{2.5}$ monitor and is similar to the area surrounding the site and contains a mix of residential, commercial, and industrial facilities, as well as mixed vegetation. The monitoring site and the site are both near a large state highway route and interstate. The monitoring site is representative of the conditions at the site. For

[5] The Modeling Unit audit determined that the values calculated by ALL4 were incorrect for the hourly by season background concentration, resulting in a lower average background concentrations values for the year 2020 to 2022. The hourly by season background values were correctly recalculated by the Modeling Unit for both the 2020 to 2022 and 2021 to 2023 period.

the 24-hour $PM_{2.5}$ analysis, ALL4 utilized U.S. EPA's $PM_{2.5}$ Exceptional Events Tiering Tool [6] for the development of the 24-hour $PM_{2.5}$ background concentration.[7]

- PM_{10} data for use in the 24-hour PM_{10} modeling was collected from the monitor station located at Northbrook Water Plant (AQS ID: 17-031-4201) for 2021 to 2023. This monitor was chosen based on the relative proximity to the Equinix site at approximately 20 kilometers. The monitor is less than 1 km from a large interstate highway (I-94) to the north and east and is also located off a large state route (Highway 68). The site is located approximately 2 km from a large interstate highway (I-90) and is within 1 km of other large state routes (Highway 83 and 72). Additionally, the monitor is located 9 km northeast of the Chicago Executive Airport, and 20 km northeast of the Chicago O'Hare airport and the heavily industrialized Elk Grove Village area of Chicago. Therefore, the monitor can be considered representative of conditions at the site.

ALL4 was provided an inventory of sources from the Modeling Unit that included sources located within a 10 km radius from the center of the site.

- For CO and PM_{10}, the nearby sources were included in the NAAQS analysis.

- For $PM_{2.5}$, ALL4 decided to exclude nearby sources in the NAAQS analysis due to the prevailing winds from the southwest direction transporting pollution from nearby sources to the monitor located in the northeast,. The monitor has an "urban" spatial scale that can be considered representative of conditions between 4km and 50km[8]. The spatial scales are used to categorize siting areas and link them to specific monitoring objectives.

- For NO_2, ALL4 decided to exclude nearby sources in the NAAQS analysis due to the dispersion of air pollutants from the nearby sources to the monitor, along with the monitor being east of the Chicago O'Hare airport. The nearby sources' pollution is transported from the southwest to the selected monitor. The wind pattern was analyzed using the hours of the day that typically have the poorest dispersion. This monitor is representative because it was analyzed with the primary objective that it has the highest concentration of NO_2 in the given area[12].

The modeled concentrations included impacts from the site and nearby emission inventory sources. The total concentrations are the summation of the modeled concentrations and background concentrations, and these impacts are compared to the respective NAAQS, as shown in **Table 6**. The results shown in the following table display the NO_2, CO, $PM_{2.5}$, and PM_{10}

[6] USEPA. (2024). *$PM_{2.5}$ Tiering Tool for Exceptional Events Analysis.* Retrieved from: https://www.epa.gov/air-quality-analysis/pm25-tiering-tool-exceptional-events-analysis.
[7] With certain days being flagged as Exceptional Events (EE) due to atypical air quality conditions from events such as wildfires, ALL4 has decided to exclude the EE days in the 24-hour $PM_{2.5}$ background concentration in accordance with Appendix W Section 8.3.2(ii).
[8] Illinois EPA. (2023*) State of Illinois Ambient Air Monitoring 2024 Network Plan*

modeling results conducted by IEPA. The modeling analysis indicated emissions would be below their respective NAAQS values.

Table 6
NAAQS Modeling Results

Pollutant	Scenario (If applicable)	Averaging Period	Modeled Concentration (µg/m^3)	Background Concentration (µg/m^3)	Total Concentration (µg/m^3)	NAAQS (µg/m^3)
NO_2	100% Load, Max Individual Generator (EGA3)	1-Hour	105.09(1)	SEASHR(a)	105.09	188.14
	50% Load, Pull the Plug Test (All Generators)	1-Hour	94.61(1)		94.61	188.14
	50% Load, Switchboard Maintenance (All Generators)	1-Hour	95.52(1)		95.52	188.14
	5-Year Annual Average 100% Load	Annual	10.37(2)	32.38(b)	42.75	100
CO	100% Load with offsite sources	8-Hour	1084.47(3)	3435.60(c)	4520.07	10,000
PM_{10}	100% Load with offsite sources	24-Hour	37.66(4)	59.00(c)	96.66	150
$PM_{2.5}$	100% Load with offsite sources	24-Hour	6.43(1)	21.00(d)	31.46	35

(1) Highest eighth high over five years.
(2) Highest annual average over five years.
(3) Highest second high over five years.
(4) Highest sixth high over five years.

(a) Seasonal hourly values from 2021-2023.
(b) Highest annual concentration over three years of monitoring data.
(c) Highest second high over three years of monitoring data.
(d) Average of the 98th percentile per year over three years of monitoring data

ALL4 opted to model $PM_{2.5}$ and PM_{10} as the fourth highest and the second highest, respectively [9]. Since the special operating scenarios of, SBM and PTP, only occur one day per year at both facilities, ALL4 concluded the NAAQS thresholds for both $PM_{2.5}$ and PM_{10} would not be exceeded due to the special operating scenarios. ALL4 opted to apply the NAAQS analysis to the routine maintenance and testing scenarios that occur once per week and to model for the highest 2nd-highest 24-hour modeled concentration in the PM_{10} analysis, and the highest 4th-highest 24-hour modeled concentration in the $PM_{2.5}$ analysis.. The results presented by ALL4 were below the NAAQS for both 24-hour $PM_{2.5}$ and PM_{10} and provides further confirmation that the site will not exceed applicable NAAQS.

Summary

[9] ALL4's reported results with the background concentration were 28.0 µg/m^3 for 24-hour $PM_{2.5}$ and 119.2 µg/m^3 for 24-hour PM_{10}.

The Modeling Unit has reviewed the air quality analysis provided by ALL4 on behalf of Equinix. The Modeling Unit audit of this analysis confirms that Equinix's proposed operations do not exceed the NAAQS for any NO_2, CO, PM_{10}, and $PM_{2.5}$ averaging times. Equinix's proposed operations do not exceed the NAAQS when modeling for the special operating scenarios that were previously listed in **Table 1**, including Pull-the-Plug and Switchboard Maintenance, as they were applied to their respective averaging periods. The audit also confirms that emissions of VOM, NO_2, and SO_2 will not have significant impacts on $PM_{2.5}$ and ozone formation.

cc: Bill Marr, Section Manager, Permits/BOA
Azael Ramirez, FESOP/State Permits Unit Manager/BOA
German Barria, Working Supervisor, FESOP/State Permits/BOA
Tamara Stewart, Modeling Unit, Permits/BOA