



U.S. Department
of Transportation
**Federal Highway
Administration**

Memorandum

SENT VIA ELECTRONIC MAIL

Subject: **INFORMATION:** Federal Highway
Administration (FHWA) 2023 Carbon
Monoxide (CO) Categorical Hot-Spot
Finding

Date: January 31, 2023

From: Gary Jensen
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In Reply Refer To:
HEPN-10

To: Division Administrators
Federal Lands Highway Division Engineers

The purpose of this memorandum is to announce the availability of the Federal Highway Administration's (FHWA's) updated 2023 carbon monoxide (CO) categorical hot-spot finding. This 2023 CO categorical hot-spot finding updates the finding to MOVES3, U.S. Environmental Protection Agency's (EPA) latest version of the MOVES emissions model, and supersedes the 2017 finding. It also makes several enhancements to allow for wider application of the finding to more projects, such as including 4 project scenarios varying by road grade and truck percentages. Project sponsors may be able to rely on the categorical hot-spot finding in place of doing an independent CO hot-spot analysis as part of a project-level conformity determination in CO maintenance areas outside of California. Please note that project sponsors must rely on the 2023 CO categorical hot-spot finding based on MOVES3 after January 9, 2023 if they choose to use the CO categorical hot-spot finding to satisfy the hot-spot analysis requirements for a project-level conformity determination.

The FHWA consulted with the EPA and the Federal Transit Administration (FTA) during the development of this CO categorical hot-spot finding with MOVES3 and addressed all issues raised prior to issuing this finding.

Detailed instructions for applying this new finding can found below. This document also includes additional background information and details about the enhancements made for this updated version of the finding. A detailed and comprehensive discussion of the modeling to support the finding is documented in FHWA's 2023 CO Categorical Hot-Spot Finding Technical Report. In addition, the 2023 CO categorical hot-spot finding includes a new spreadsheet tool, which is one of two options for applying the finding. This spreadsheet tool replaces the previous web-based tool and will make it easier for users to apply the finding.

Attachments:

[FHWA 2023 CO Categorical Hot-Spot Finding Technical Report](#)
[FHWA 2023 CO Categorical Hot-Spot Finding Spreadsheet Tool](#)

BACKGROUND

In 1971, the U.S. Environmental Protection Agency (EPA) first set National Ambient Air Quality Standards (NAAQS) for CO. EPA set an 8-hour primary NAAQS at 9 parts per million (ppm) and a 1-hour primary NAAQS at 35 ppm (see Table 1 below).¹ All CO areas are currently meeting the NAAQS and have approved maintenance plans.²

Table 1. National Ambient Air Quality Standards (NAAQS) for Carbon Monoxide³

Pollutant [final rule cite]	Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide [76 FR 54294, Aug 31, 2011]	primary	8-hour	9 ppm	Not to be exceeded more than once per year
		1-hour	35 ppm	

A CO hot-spot analysis has been required as part of all project-level conformity determinations in CO nonattainment and maintenance (40 CFR 93.116 and 93.123(a)) since the initial conformity rule in 1993. As defined in the conformity regulations (40 CFR 93.101):

A hot-spot analysis is an estimation of likely future localized CO, PM10, and/or PM2.5 pollutant concentrations and a comparison of those concentrations to the national ambient air quality standards. Hot-spot analysis assesses impacts on a scale smaller than the entire nonattainment or maintenance area, including, for example, congested roadways intersections and highway or transit terminals, and uses an air quality dispersion model to determine the effects of emissions on air quality.

The CO hot-spot analysis must show that non-exempt FHWA/FTA projects do not cause any new violations of the CO NAAQS, increase the frequency or severity of existing violations or delay timely attainment of any NAAQS or any interim milestones (40 CFR 93.116(a) and Clean Air Act section 176(c)(1)(B)).

The procedures for conducting a CO hot-spot analysis are explained in 40 CFR 93.123(a) and (c). For those projects requiring a quantitative analysis per 40 CFR 93.123(a)(1), the analysis must use applicable air quality models, databases and other requirements specified in 40 CFR part 51, Appendix W (Guideline on Air Quality Models), unless other procedures have been developed through interagency consultation and approved by the EPA Regional

¹ EPA retained the existing CO NAAQS in its 2011 review of the CO NAAQS.

² EPA's "[Greenbook](#)" states that: "As of September 27, 2010, all Carbon Monoxide areas have been redesignated to maintenance."

³ Source: [EPA's NAAQS website](#). Accessed May 29, 2020.

Administrator. All other non-exempt projects have the choice between a quantitative or qualitative analysis per 40 CFR 93.123(a)(2).

In its January 24, 2008, final rule amending the transportation conformity regulations, EPA added a provision at 40 CFR 93.123(a)(3) to allow the U.S. Department of Transportation (DOT), in consultation with EPA, to make categorical hot-spot findings in CO nonattainment and maintenance areas. A categorical finding could be made if appropriate modeling showed that a type of highway or transit project would not cause or contribute to a new or worsened air quality violation of the CO NAAQS or delay timely attainment of the NAAQS or required interim milestone(s), as required under 40 CFR 93.116(a).

DOT, in consultation with EPA, may also choose to make a categorical hot-spot finding that §93.116(a) is met without further hot-spot analysis for any project described in paragraphs (a)(1) and (a)(2) of this section based on appropriate modeling. DOT, in consultation with EPA, may also consider the current air quality circumstances of a given CO nonattainment or maintenance area in categorical hot-spot findings for applicable FHWA or FTA projects. (40 CFR 93.123(a)(3))

PROCESS FOR DEVELOPING CO CATEGORICAL HOT-SPOT FINDING

The preamble to the January 24, 2008 final rule (73 FR 4420) described the general process DOT would follow in order to make a CO categorical hot-spot finding. The process included:

- 1) FHWA or FTA would develop modeling, analyses and documentation to support the finding in consultation with EPA;
- 2) FHWA or FTA would provide EPA an opportunity to review and comment on the complete categorical hot-spot finding documentation and resolve any issues in a manner acceptable to EPA prior to issuing the finding; and
- 3) FHWA or FTA would make the final categorical hot-spot finding in a memorandum or letter, which would be posted on both EPA and DOT's websites.

Once complete, project sponsors with a particular project that falls within the acceptable ranges covered by the CO categorical hot-spot finding would reference the finding in their project-level conformity determination, which would be subject to interagency consultation and the public involvement requirements under the National Environmental Policy Act (NEPA) and the conformity rule (40 CFR 93.105). The existing interagency consultation and public involvement processes would be used to consider the CO categorical hot-spot finding for a particular project.

FHWA's original finding was completed on February 12, 2014 and an updated finding was completed on July 17, 2017 to use the latest version of the MOVES model, which was MOVES2014 at the time. Both findings followed provisions in the transportation conformity rule at 40 CFR 93.123(a)(3) for highway projects that include one or more intersections in CO

maintenance areas. This 2023 CO categorical hot-spot finding updates the finding using MOVES3 and supersedes the previous findings. It also includes several enhancements to allow for wider application of the finding to more intersection projects (see bullets in Section 3 below). This finding does not apply to California, which uses EMFAC for its emissions model. The FHWA consulted with the U.S. Environmental Protection Agency (EPA) and the Federal Transit Administration (FTA) during the development of this 2023 CO categorical hot-spot finding and addressed all issues raised prior to issuing this finding.

Project sponsors may be able to rely on the categorical hot-spot finding in place of doing an independent, project-specific CO hot-spot analysis as part of a project-level conformity determination in CO maintenance areas. Project sponsors may rely on this updated CO categorical hot-spot finding for applicable hot-spot analyses in CO maintenance areas effective immediately. The finding can also be used for NEPA purposes to replace a microscale CO analysis. When applying the finding for NEPA purposes, it may be necessary to apply the finding to several alternatives that are being compared in the NEPA document.

The FHWA expects that many highway projects that include one or more intersections and are subject to the conformity hot-spot analysis requirements for CO will be able to rely on this CO categorical hot-spot finding, outside of California. State DOTs and project sponsors can rely on the CO categorical hot-spot findings to demonstrate that the projects would not cause or worsen violations for the CO NAAQS.

MODELING AND TECHNICAL ANALYSIS TO SUPPORT CO CATEGORICAL HOT-SPOT FINDING

The 2023 CO categorical hot-spot finding meets all the requirements under Clean Air Act section 176(c)(1)(B) and the transportation conformity rule at 40 CFR Part 93, Subpart A by showing that the project modeled would not cause or contribute to new or worsened air quality violations for the CO NAAQS or delay timely attainment or any required interim emission reductions or milestones. Project sponsors should evaluate if this finding is applicable to a particular project, as explained in the “Application” section below. The modeling, analysis, documentation, and coordination activities to support the CO categorical hot-spot finding were conducted following the conformity rule's requirements at 40 CFR 93.123(a)(1) and (c) as well as EPA's guidance documents “[Using MOVES3 in Project-Level Carbon Monoxide Analyses](#)” (EPA-420-B-21-047, December 2021) and “[Guideline for Modeling Carbon Monoxide from Roadway Intersections](#)” (EPA-454-R-92-005, Nov. 1992). A detailed and comprehensive discussion of the modeling and analysis is documented in FHWA's 2023 CO Categorical Hot-Spot Finding Technical Report. As fully explained in the technical report, the analysis met all the requirements for a CO hot-spot analysis including 40 CFR 93.110, 93.111, 93.116(a), and 93.123 by using the latest versions of appropriate models (MOVES3 and CAL3QHC).

The 2014 and 2017 CO categorical findings were completed for a single large urban intersection of perpendicular roadways (i.e., forming right angles). This 2023 CO categorical finding updates and supersedes the previous findings and includes several enhancements:

- The finding is for a single intersection under four scenarios, which include high and low conditions for grade and truck percentage as shown in Table 2. The acceptable ranges for these two parameters, which are the most sensitive to changes in CO concentrations, have been expanded by adding the additional scenarios.
- The acceptable ranges for other parameters (such as intersection angle, speed, lane width, median width, and persistence factor) have been expanded to include additional acceptable values.
- Modeling for the four scenarios under rural area conditions (i.e., using rural unrestricted road type in MOVES, and rural dispersion characteristics in CAL3QHC) has been added so that the finding can be applied to both rural and urban areas.

The above enhancements allow for wider application of the finding to more highway projects. An additional enhancement is the introduction of a spreadsheet tool, which will make it easier for users to apply the finding. This spreadsheet tool replaces the previous web-based tool and assists users in selecting the scenario that corresponds to the project conditions. It also allows users to input an exact persistence factor instead of using a worst-case persistence factor to represent a range of values.

Table 2. 2023 Categorical Finding Scenarios

Scenario	Road Grade*	Truck Percentage**
High Grade High Truck Percentage	1% < upgrade ≤ 6%	2% < trucks ≤ 20%
Low Grade High Truck Percentage	0% ≤ upgrade ≤ 1%	2% < trucks ≤ 20%
High Grade Low Truck Percentage	1% < upgrade ≤ 6%	0% ≤ trucks ≤ 2%
Low Grade Low Truck Percentage	0% ≤ upgrade ≤ 1%	0% ≤ trucks ≤ 2%

*The highest grade from all upgrade roadway links at the project intersection should be used.

**The highest truck percentage (single unit and combination trucks) from all links at the project intersection should be used.

APPLICATION

In order to rely on the CO categorical hot-spot finding as part of a project-level conformity determination (40 CFR 93.116(a) and 93.123(a)), a project's parameters must fall within the acceptable ranges of modeled parameters. This means that for a project with multiple

intersections, the project sponsors should follow Section 4 in EPA's 1992 CO Guideline⁴ to select the intersection(s) with the highest volume and worst level of service for analysis. Once the intersection(s) are identified, the project sponsor will need to look at each approach within the intersection(s) separately to ensure their parameters are within the acceptable ranges to rely on the CO categorical hot-spot finding.

Project sponsors have two options for determining if their project falls within the acceptable ranges:

Option 1: Use the tables in the Appendix of this document to determine if the project parameters are within the acceptable ranges for using the CO categorical hot-spot finding. Table 3 contains the parameters common to all scenarios and should be used first. If local 1-hour and 8-hour background concentrations exceed the values in this table (which correspond to the worst-case scenario), then Table 4 should be used to see if a different scenario with less restrictive background concentrations can be used. Table 4 includes two lines of allowable 8-hour CO background concentrations that correspond to two default persistence factors:

- a. 0.7 as a worst-case persistence factor to represent values between 0-0.7, and
- b. 1.0 as a worst-case persistence factor to represent values between 0.7-1.0.

Option 2: Enter the project information into FHWA's 2023 CO categorical hot-spot finding spreadsheet tool, which is available on [FHWA's website](#). The spreadsheet tool assists project sponsors in applying the finding to a project by selecting the appropriate scenario, ensuring all parameters fall within the acceptable ranges, and ensuring the sum of background concentrations and project contributions do not exceed the NAAQS for CO. In addition, the spreadsheet tool uses one of the following persistence factors:

- a. 0.7 as a default persistence factor to represent values between 0-0.7, and
- b. The exact persistence factor entered by the user for values between 0.7-1.0.

When all input cells become shaded green, the values provided fall within the acceptable ranges and thus the project sponsor can rely on the CO categorical hot-spot finding.

Under either option, the acceptable ranges are the same and are based on the modeling details found in the 2023 CO Categorical Hot-Spot Finding Technical Report. Each approach within the intersection and all intersections requiring analysis must fall within the acceptable ranges for all the parameters in order to rely on the CO categorical hot-spot finding. **If one or more parameters of any of the four intersection approaches are outside the acceptable range**

⁴ U.S. Environmental Protection Agency, Guideline for Modeling Carbon Monoxide from Roadway Intersections, EPA-454/R-92-005, Office of Air Quality Planning and Standards, November 1992.

for that parameter, then the project sponsor will not be able to rely on the CO categorical hot-spot finding.

Below is a list of data needed to compare a project to the parameters in the Appendix or to be entered into FHWA's spreadsheet tool, so the tool can compare the project information to the parameters. These data requirements are discussed in more detail in the Technical Document.

To rely on the CO categorical hot-spot finding you will need to:

- Ensure the project is in a state other than California
- Determine which intersection(s) within the project would need a hot-spot analysis (see Section 4 in EPA's 1992 CO Guideline⁴)
- Identify traffic and geometric design data from the NEPA documentation for each approach of the intersection(s) to be analyzed
- Identify the analysis year or years when a CO hot-spot analysis would be completed for the project
- Identify the population of the area (for area type of “urban” or “rural”)
- Identify the ambient temperature
- Obtain CO background concentrations in the project area
- Determine the persistence factor for the project area

Reliance on the CO categorical hot-spot finding for a project-level conformity determination is subject to interagency consultation and the public involvement requirements under the conformity rule (40 CFR 93.105). Interagency consultation must be used to develop a process to evaluate and choose models and associated methods and assumptions to be used in CO hot-spot analyses (40 CFR 93.105(c)(1)(i)). This process includes review of the decisions in the list above, such as which intersections need a hot-spot analysis, the analysis year, traffic data, and the appropriate background concentration to use. Even if a project falls within the acceptable ranges in the appendix or as shown through FHWA's spreadsheet tool, the existing interagency consultation and public involvement processes would still be used to consider the CO categorical hot-spot finding for a particular project.⁵

DOCUMENTATION

Documentation is an important part of showing how the CO categorical hot-spot finding applies to a particular project. To rely on the CO categorical hot-spot finding, the project sponsor must clearly show that all of their project's parameters fall within the acceptable ranges. The project sponsor would reference the finding in their project-level conformity determination, which would be subject to interagency consultation and the public

⁵ For more information about interagency consultation for CO hot-spot analyses, please refer to EPA's *Using MOVES3 in Project-Level Carbon Monoxide Analyses*, EPA-420-B-21-047, December 2021, found on EPA's website at: <https://www.epa.gov/state-and-local-transportation/project-level-conformity-and-hot-spot-analyses#guidance>.

involvement requirements under the conformity rule (40 CFR 93.105). The existing interagency consultation and public involvement processes would be used to determine if the use of this CO categorical hot-spot finding is appropriate for the project.

If the project-level conformity determination relies on the CO categorical hot-spot finding to satisfy the CO hot-spot analysis requirements, project sponsors should include the following information in the CO hot-spot portion of the project-level conformity documentation:

- Explain that the project-level conformity determination relied on FHWA's CO categorical hot-spot finding which has met all the requirements for a CO hot-spot analysis including 40 CFR 93.110, 93.111, 93.116(a), and 93.123. No additional project specific CO hot-spot analysis was conducted.
- Clearly show how the project sponsor was able to rely on FHWA's CO categorical hot-spot finding, such as:
 - Include or reference the results from FHWA's spreadsheet tool showing all green shading for each approach for the intersection(s) analyzed; OR
Include or reference the appendix to this memorandum with a demonstration that the project parameters fall within the acceptable ranges given in the appendix
 - Include references for where the project information relied on for the finding can be found
- Document that the existing interagency consultation and public involvement process required by 40 CFR 93.105 was used to determine that the use of the CO categorical hot-spot finding is appropriate for the project

APPENDIX: ACCEPTABLE RANGES

NOTE: All intersections requiring analysis must fall within the acceptable ranges for all the parameters in order to rely on the CO categorical hot-spot finding. Reliance on the CO categorical hot-spot finding is still subject to existing interagency consultation and the public involvement requirements under NEPA and the conformity rule (40 CFR 93.105) for this project.

Table 3. Acceptable Ranges for Parameters Common to All Scenarios

Parameter	Description	Acceptable Range
Analysis Year	The year when peak emissions are expected from the project when considered with background.	≥ 2022
Area Type	An urban area has a population of 5,000 or greater within the FHWA adjusted urban area boundary. ⁶ All other areas are rural.	Urban or Rural
Road Grade (%)	The maximum grade along the approach, as measured from the stop line to a point 100 feet before the stop line along a line parallel to the direction of travel. Enter the maximum grade among the four approaches.	$\leq 6\%$
Truck Percent (%)	The percentage of the total traffic volume that is made up of single unit and combination trucks. Enter the highest truck percentage from all links at the project intersection.	$\leq 20\%$
Temperature (°F)	Section 4.7.1 of EPA's 1992 CO Guideline allows two methods: 1) temperature corresponding to each of the ten highest non-overlapping 8-hour CO monitoring values for the last 3 years, or 2) average January temperature	$\leq 70^{\circ}\text{F}$

⁶ A map of FHWA Adjusted Urban Areas can be found at <https://hepgis.fhwa.dot.gov/fhwagis/ViewMap.aspx?map=MPO+Boundaries|FHWA+Adjusted+Urban+Area>. More information on the FHWA definition of urban area can be found at https://www.fhwa.dot.gov/planning%20processes/statewide/related/highway_functional_classifications/section06.cfm

Parameter	Description	Acceptable Range
Speed (mph)	The average speed approaching the intersection during the peak hour. All intersection approaches must be within the acceptable range.	$15 \text{ mph} \leq \text{speed} \leq 45 \text{ mph}$
Peak Hour Approach Volume (veh/hr)	The volume approaching the intersection during the peak hour. Enter the maximum among the four approaches.	≤ 2640
Peak Hour Level-of-Service (LOS)	During the peak hour, the letter representing the quality of service for the entire intersection measured on an A-F scale, with LOS A representing the best operating conditions from the traveler's perspective and LOS F the worst.	A-E
Intersection Angle	Enter the smallest angle between the two cross-streets of the intersection (90 degrees is perpendicular).	$\geq 75^\circ$ ⁷
Number of through lanes (one direction)	The number of lanes approaching the intersection available for vehicles traveling through the intersection without turning. Enter the maximum among the four approaches.	≤ 4
Number of left turn lanes (one direction)	The number of lanes approaching the intersection that are designated for use only by vehicles making left turns. Enter the maximum among the four approaches.	≤ 2
Lane Width (feet)	The lateral distance between stripes for a single lane. Enter the minimum among all lanes at the intersection.	$\geq 10 \text{ ft.}$
Median Width (feet)	The width of the area in the middle of a roadway separating opposing traffic flows.	Any ($\geq 0\text{ft}$)
Persistence Factor	The factor used to calculate 8-hour concentration estimates from 1-hour concentration estimates, as determined by following Section 4.7.2 of EPA's 1992 CO Guideline.	Any (0.0-1.0)

⁷ See Technical Report Section 2 "Intersection Design" for an explanation why the intersection angle acceptable range was changed from exactly 90 degrees in the 2017 finding to greater than or equal to 75 degrees for this 2023 finding.

Parameter	Description	Acceptable Range
1-Hour CO Background Concentration (ppm)	1-hour average concentration in the project area due to other local sources, determined in most cases from local monitoring data as described in Section 4.7.3 of EPA's 1992 CO Guideline.	≤ 27.7 or use Table 4 for less restrictive values
8-Hour CO Background Concentration (ppm)	8-hour average concentration in the project area due to other local sources, determined in most cases from local monitoring data as described in Section 4.7.3 of EPA's 1992 CO Guideline.	≤ 1.7 or use Table 4 for less restrictive values

Table 4. Acceptable Ranges for Parameters that Vary by Scenario

Intersection Scenario	High Grade High Truck		Low Grade High Truck		High Grade Low Truck		Low Grade Low Truck	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Grade	$1\% < \text{upgrade} \leq 6\%$		$0\% \leq \text{upgrade} \leq 1\%$		$1\% < \text{upgrade} \leq 6\%$		$0\% \leq \text{upgrade} \leq 1\%$	
Truck Percentage	$2\% < \text{trucks} \leq 20\%$		$2\% < \text{trucks} \leq 20\%$		$0\% \leq \text{trucks} \leq 2\%$		$0\% \leq \text{trucks} \leq 2\%$	
Allowable 1-Hour CO Background (PPM)	≤ 29.8	≤ 27.7	≤ 31.3	≤ 29.6	≤ 30.8	≤ 28.9	≤ 32.0	≤ 30.3
Allowable 8 Hour CO Background Concentration (PPM) – Persistence Factor ≤ 0.7	≤ 5.36	≤ 3.89	≤ 6.41	≤ 5.22	≤ 6.06	≤ 4.73	≤ 6.90	≤ 5.71
Allowable 8 Hour CO Background Concentration (PPM) – Persistence Factor ≤ 1.0	≤ 3.80	≤ 1.70	≤ 5.30	≤ 3.60	≤ 4.80	≤ 2.90	≤ 6.00	≤ 4.30