

# FEDERAL HIGHWAY ADMINISTRATION (FHWA) CARBON MONOXIDE (CO) CATEGORICAL HOT-SPOT FINDING

## 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. In their most recent review of the NAAQS in August 31, 2011, EPA decided to retain the existing NAAQS for CO set in 1971. All CO areas are currently meeting the NAAQS and have approved maintenance plans<sup>1</sup>.

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

Source: [EPA's NAAQS website](#)

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

In the January 24, 2008, Transportation Conformity Rule Amendments, EPA included 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 if appropriate modeling showed that a type of highway or transit project would not cause or contribute to a new or worsened air

<sup>1</sup> EPA's "[Greenbook](#)" states that, "As of September 27, 2010, all carbon monoxide areas have been redesignated to maintenance areas"

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 4434) 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 consulted with EPA and FTA during the development of the CO categorical hot-spot finding and addressed all issues raised by them prior to issuing the finding.

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

The 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 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 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 MOVES in Project-Level Carbon Monoxide Analyses](#)" (EPA-420-B-10-041, Dec. 2010) 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 [CO Categorical Hot-Spot Finding Technical Document](#). Key modeling assumptions from the technical analysis are summarized below.

As explained in section 2 of the [CO Categorical Hot-Spot Finding Technical Document](#), the goal of the analysis was to model a large intersection operating at capacity using MOVES2010b and CAL3QHC so that projects meeting the finding's parameters would not produce a CO concentration higher than what was modeled and, when combined with background concentrations, would not violate the NAAQS for CO. It is important to note that background concentrations would be a function of the particular project

location and would be provided by the project sponsor following EPA’s “Guideline for Modeling Carbon Monoxide from Roadway Intersections.” Table 1 excerpted from section 2 of the [CO Categorical Hot-Spot Finding Technical Document](#) describes the intersection parameters that were modeled as part of the CO categorical hot-spot finding work. As discussed later, these parameters set the range of traffic data values that a project must meet to rely on the CO categorical hot-spot finding.

**Table 1: Final Geometric and Traffic Characteristics for the Intersection**

Component	Description
Lane configuration	<ul style="list-style-type: none"> <li>• 4 through lanes and 2 left turn lanes per approach and 4 departure lanes per each leg of the intersection</li> <li>• Perpendicular approach angles</li> </ul>
Lane width	12 feet
Signalization	<ul style="list-style-type: none"> <li>• Cycle length of 130 seconds with average green time length of 14 seconds for the left turn and average green time length for the right/through traffic of 41 seconds</li> <li>• Average intersection control delay is 78.5 seconds per vehicle during the peak hour</li> </ul>
Turning movements	15% left turn and 5% right turn
Median width	None
Traffic volume	<ul style="list-style-type: none"> <li>• 2640 vehicles per hour on each approach during the peak hour</li> <li>• On each approach: 2244 are through traffic or turning right; remaining 396 vehicles turn left</li> </ul>
Level of service	E
Grade	±2% on one cross street and 0% on the other cross street
Heavy-duty trucks	5%
Peak hour average approach speed	25 mph

Following the project parameters in the above table, section 3 of the [CO Categorical Hot-Spot Finding Technical Document](#) walks through each MOVES2010b<sup>2</sup> input used in the analysis. The inputs are consistent with EPA’s “Using MOVES in Project-Level Carbon Monoxide Analyses” guidance and the input files can be found on FHWA’s [CO categorical hot-spot finding website](#) in the folder titled “MOVES Files.”

Table 2 below (Table 9 in the [CO Categorical Hot-Spot Finding Technical Document](#)) lists the emissions rates for the links associated with each project scenario and used with CAL3QHC for air quality dispersion modeling. The output file can be found on FHWA’s [CO categorical hot-spot finding website](#) in the folder titled “MOVES Files.”

<sup>2</sup> The CO categorical hot-spot finding analysis does not apply to California which uses EMFAC for its emissions model.

**Table 2: MOVES Link Based Emission Rates**

linkID	Road Type	Average Speed (mph)	Grade	CO Rate (g/veh-mile)
525	Urban Unrestricted Access	25	0	9.52
5225	Urban Unrestricted Access	25	2%	12.32
50225	Urban Unrestricted Access	25	-2%	7.635
500	Urban Unrestricted Access	0	0	53.19 (g/veh-hr)

The emission rates were input into the dispersion model using the recommended CAL3QHC model, Version 2.0. The inputs to the CAL3QHC model are explained in section 4 of the [CO Categorical Hot-Spot Finding Technical Document](#) and the input files can be found on FHWA’s [CO categorical hot-spot finding website](#) in the folder title “CAL3QHC Files.” A summary of the inputs for the dispersion model runs are shown in table 3 (table 10 in the [CO Categorical Hot-Spot Finding Technical Document](#)) below.

**Table 3: Summary of CAL3QHC Inputs Used for the Intersection Modeling**

Component	Description
Traffic and Geometric Design	See Table 1
Receptor Locations	In a grid for each quadrant (see Figure 4 in <a href="#">CO Categorical Hot-Spot Finding Technical Document</a> beginning at the edge of mixing zone (10 feet from roadway edge) and extending out to 2500 along roadway for midblock location
Meteorology	Wind speed = 1 m/s Wind direction = every 10 degrees from 0 to 350 degrees Mixing height = 1000 meters Stability class = D (urban) Surface roughness = 108 cm (single family residential)
Emission Factors	12.32 grams-per-vehicle-mile for the 25 mph increasing grade (2%) and 7.635 grams-per-vehicle-mile for the down-grade. The emission factor for the level roadway was 9.52 grams-per-vehicle mile. The idle emission factor used was 53.19 grams-per-hour.
Output from CAL3QHC	Parts-per-million for 1-hour concentration 8-hour concentration estimated using a 0.7 persistence factor

Table 4 below (table 11 in the [CO Categorical Hot-Spot Finding Technical Document](#)) summarizes the predicted 1-hour and 8-hour concentrations from the intersection project without background. As mentioned in section 5 of the [CO Categorical Hot-Spot Finding Technical Document](#), background concentrations were not included in the modeling and would be determined by the project sponsor using the appropriate methodology from EPA’s guidance, “Guideline for Modeling Carbon Monoxide from Roadway Intersections”.

**Table 4: Summary of Key Modeling Results for Carbon Monoxide (CO)**

Facility Type	1-Hour Predicted Concentration (ppm)	8-Hour Predicted Concentration (ppm)
Intersection	5.5	3.9

As summarized above and fully explained in the [CO Categorical Hot-Spot Finding Technical Document](#), 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 (MOVES2010b and CAL3QHC) and consistent with EPA’s guidance: “Guideline for Modeling Carbon Monoxide from Roadway Intersections” and “Using MOVES in Project Level Carbon Monoxide Analyses”.

## APPLICATION

In order to rely on the CO categorical hot-spot finding as part of their project-level conformity determination (40 CFR 93.116(a) and 93.123(a)), a project’s parameters must fall within the acceptable range of modeled parameters. This means that for a project with multiple intersections, the project sponsors should follow section 4 in EPA’s, “Guideline for Modeling Carbon Monoxide from Roadway Intersections” to select the highest volume and worst level of service intersections for analysis. Once the intersection(s) are identified, the project sponsor will need to look at each approach within the intersection(s) separately to compare to 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 range: 1) they can use the table in the appendix, “PROJECT PARAMETERS AND ACCEPTABLE RANGES FOR CO CATEGORICAL HOT-SPOT FINDING”; or 2) they can enter their project information into FHWA’s web based tool. In either case, the acceptable ranges are the same and based on the modeling details summarized above. Each approach within the intersection and all intersections requiring analysis must fall within the acceptable range for all the parameters in order to rely on the CO categorical hot-spot finding. If one or more parameters are outside the acceptable range for any of the intersection approaches analyzed, 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 this appendix or to be entered into FHWA’s web based tool, so the tool can compare the project information to the parameters.

### Data needed for Reliance on CO categorical hot-spot finding

- Ensure the project is in a CO maintenance area
- Ensure the project is in an urban area
- Ensure the project is in a state other than California
- Determine which intersection(s) within the project would need a hot-spot analysis
- Identify traffic and geometric design data from the NEPA documentation for each approach of the intersection(s) needing to be analyzed
- Identify the analysis year when a CO hot-spot analysis would be completed for the project
- Determine the offset distance of closest receptors from the edge of pavement
- Identify the ambient temperature
- Determine CO background concentrations in the project area
- Ensure a persistence factor 0.7 or less for the project area

Reliance on the CO categorical hot-spot finding is subject to interagency consultation and the public involvement requirements under NEPA and the conformity rule (40 CFR 93.105). Even if a project falls within the acceptable range in the appendix or as shown through FHWA's web based 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.

## **DOCUMENTATION**

Documentation is an important part of showing how the CO categorical hot-spot finding applies to a particular project. The project sponsor must clearly show how their project falls within the acceptable range to rely on the CO categorical hot-spot finding for all the parameters. This should be done in the context of the project-level conformity documentation.

In the CO hot-spot portion of the project-level conformity documentation:

- Explain that instead of running a project-specific hot-spot analysis as part of the project-level conformity determination, the project sponsor 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.
- 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 web based tool showing all green checks 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 project information can be found to support data used to populate the web based tool or demonstrate that the project parameters fall within acceptable the ranges given in the appendix to this memorandum
- 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 – PROJECT PARAMETERS AND ACCEPTABLE RANGES FOR CO CATEGORICAL HOT-SPOT FINDING**

**Urban Intersection**

<b>Parameter</b>	<b>Acceptable Range</b>
Analysis year	Greater than or equal to 2015
Angle of cross streets for intersection (degrees)	90
Maximum grade for the intersection (%)	Less than or equal to 2
Maximum grade on cross street for the intersection (%)	0
Number of through lanes	Less than or equal to 4
Number of left turn lanes	Less than or equal to 2
Lane width (ft)	12
Median width (ft)	0
Peak hour average approach speed (mph)	Greater than or equal to 25
Peak hour approach volume (vph)	Less than or equal to 2640
Peak hour Level of Service	A through E
Ambient temperature (°F)	Greater than or equal to -10
Heavy-duty trucks (%)	Greater than or equal to 5
1-hour background CO concentrations (ppm)	Less than or equal to 29.5
8-hour background CO concentrations (ppm)	Less than or equal to 5.1
Persistence factor	Less than or equal to 0.7

**NOTE: All intersections requiring analysis must fall within the acceptable range 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.**