Survey of Screening Procedures for Project-Level Conformity Analyses

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Jeffrey Houk
Air Quality Specialist
Resource Center at San Francisco
Federal Highway Administration
555 Zang Street, Room 259
Lakewood, CO 80228
(303) 716-2291 (v)
(303) 969-5498 (f)
Jeff.Houk@fhwa.dot.gov

Michael Claggett, Ph.D. (corresponding author)
Air Quality Modeling Specialist
Resource Center at San Francisco
Federal Highway Administration
555 Zang Street, Room 259
Lakewood, CO 80228
(303) 716-2286 (v)
(303) 969-5498 (f)
Michael.Claggett@fhwa.dot.gov

Abstract. The transportation conformity rule establishes project-level analysis requirements that apply in carbon monoxide (CO) nonattainment and maintenance areas. These include a requirement for quantitative CO hotspot modeling at all locations affected by a proposed project operating or expected to operate at a level-of-service D or worse. Transportation agencies, aware of declining ambient CO levels and lower idle emission factors in MOBILE6, are concerned that this is no longer an efficient use of their limited resources. This presentation provides a summary of project-level screening procedures developed and adopted by transportation agencies throughout the nation, highlights several innovative practices, and offers recommendations for developing refined screening protocols.

INTRODUCTION

State and local transportation agencies conduct air quality modeling to satisfy transportation conformity project-level analysis requirements in CO nonattainment and maintenance areas and for National Environmental Policy Act (NEPA) documents. Regulatory guidance for conducting air quality modeling near roadway intersections, where motor vehicle emissions can be high due to increased congestion and engine idling at a traffic signal, has been developed by the U.S. Environmental Protection Agency (EPA) (*1*). The CAL3QHC model was developed by the EPA (*2*) and adopted as their guideline model (*3*) for such applications. CAL3QHC uses information about traffic characteristics, signal timing, roadway configurations, vehicle emission factors, and meteorology to predict CO concentrations at various user-defined locations (receptors) near an intersection. It is relatively simple to use, but gathering the necessary input data and reaching agreement with other agencies on appropriate input assumptions can be time-consuming and costly.

Since the requirements and guidance for use of CAL3QHC were developed in the early 1990's, the carbon monoxide air quality situation in the United States has improved dramatically. This is largely due to improvements in motor vehicle emissions brought about by national control programs, and by additional emission reductions achieved by state control measures in Clean Air Act-mandated State Implementation Plans (SIPs). Given the decreasing likelihood that new roadway projects will result in violations of the National Ambient Air Quality Standards (NAAQS) for CO, it seems appropriate to revisit existing practice for CO hotspot modeling and pursue opportunities to eliminate unnecessary modeling. This is especially true given the current high level of interest nationwide in streamlining the environmental review process for new projects.

Screening methodologies are one method for reducing the modeling workload, and directing CAL3QHC modeling efforts toward only those projects that have some likelihood of generating excessive CO concentrations. Many states have policies or "rules-of-thumb" to guide decisions on when hotspot modeling should be performed for a particular project. For example, some states perform hotspot modeling for all projects over a certain traffic volume, or for all projects for which an Environmental Impact Statement (EIS) is prepared. However, a few states have adopted advanced screening protocols that look more closely at the characteristics of each project, and attempt to guide more informed decisions about whether or not to perform hotspot modeling using CAL3QHC. In this paper, we examine several of these methodologies, highlight innovative practices, and provide recommendations for other states interested in pursuing such an approach.

CARBON MONOXIDE TRENDS

In the decade since the EPA's modeling guidance was developed, there has been a huge decrease in ambient CO concentrations nationwide. From a project-level conformity perspective, of particular interest are the changes in the highest measured ambient CO concentrations and the numbers of locations where ambient CO concentrations exceed the NAAQS. With this in mind, the maximum 1-hour average ambient CO concentrations measured at each monitoring station across the U.S. were compiled. A similar distribution was compiled for the maximum 8-hour average ambient CO concentrations. As an index of concentration extremes, the tenth highest (or 98th percentile) value in the distribution was used. This means only 9 monitoring stations reported maximum CO levels that were higher; but the majority (i.e., 98%) of the stations reported maximum CO levels that were lower than the tenth highest value. And as an index of the typical maximum ambient CO concentration, the median value or the 50th percentile value of the distribution was used. This means that 50% of the monitoring stations reported maximum CO levels that were higher and 50% reported maximum CO levels that were lower than the median value. Data for 1990 and 1997 through 2002 were obtained from the EPA for study (*4*).

Since 1990, there has been a decrease in maximum CO concentrations measured across the U.S. For maximum 1-hour average ambient CO concentrations, the tenth highest value reported to the EPA in 1990 was 21.9 ppm; by 1997, it was 17.7 ppm; and by 2002, it was 14.4 ppm – a 34% reduction from 1990 levels. The median values of the distributions were 10.0 ppm, 6.9 ppm, and 4.6 ppm in 1990, 1997, and 2002, respectively. This represents a 54% reduction in the median value of the 2002 distribution compared to 1990. For maximum 8-hour average ambient CO concentrations, the tenth highest value was 13.6 ppm in 1990; by 1997, it was 10.3 ppm; and by 2002, it was 6.7 ppm – a 51% reduction from 1990 levels. The median values of the distributions were 5.9 ppm, 4.1 ppm, and 2.9 ppm in 1990, 1997, and 2002, respectively. This also represents a 51% reduction in the median value of the 2002 distribution compared to 1990.

With the decline in the magnitude of maximum ambient CO concentrations nationwide, there has been a subsequent decline in the number of stations reporting observations that exceed the National Ambient Air Quality Standards. In 1990, there were 63 stations reporting a total of 285 observations that exceeded the 8-hour NAAQS. In 1997, this was reduced to 16 stations reporting 46 observations that exceeded the 8-hour NAAQS and by 2002, this was further reduced to 5 stations reporting 12 observations that exceeded the 8-hour NAAQS. Reflecting this drop in the number of monitors recording excessive levels, many areas formerly designated as nonattainment of the NAAQS for CO have been able to successfully demonstrate compliance. In the Clean Air Act Amendments of 1990, there were 49 areas originally classified as nonattainment of the standards. Since then, 39 of these have been re-designated as attainment or maintenance areas and the remaining 10 appear to have collected the necessary data to qualify for re-designation (*4*,*5*).

Further evidence of the lessening concern over CO problems nationwide is provided in the EPA’s revised draft National Ambient Air Monitoring Strategy, released for public review in September 2002 (*6*). The purpose of this document is to examine the existing nationwide air monitoring network, and refocus it on current and emerging priorities. One finding of this report is that the nationwide CO monitoring network should be greatly scaled back. The U.S. CO monitoring network currently includes 470 individual monitoring sites, down from a high of 684 sites in 1981. The draft monitoring strategy recommends that the present network be reduced by more than 80%, to a minimum target level of 75 sites, with a small number (less than 10) to be retained in existing NAAQS violation areas. The report notes that less than 5% of current monitoring sites measure concentrations that are greater than 60% of the NAAQS.

Even with these notable reductions, some unexpected problem areas have been documented. In Birmingham, Alabama, high CO concentrations have been measured at a station located near one of the largest industrial sources of CO in the state. During 2001, 44 observations in excess of the 8-hour NAAQS were recorded there, out of 53 total nationwide. High CO concentrations have also been measured in Calexico, California. Monitors recorded 14 observations above the 8-hour NAAQS in 1997 (12 at one station and 2 at another) and four years later (2001), excess levels were recorded 6 times at one station and none at the other. The California Air Resources Board attributes the high CO levels observed in Calexico to cross-border traffic from Mexico, which has a higher emitting vehicle fleet (*7*). Of the observations that exceeded the 8-hour NAAQS across the nation during 2002, half were recorded at a single monitor in Weirton, West Virginia, which was established to monitor a large industrial source of CO. This appears to be an isolated event at only 1 monitor in Weirton. In contrast to the levels recently measured in Birmingham, Calexico, and Weirton, none of the 49 originally classified CO nonattainment areas violated the standard in 2001 or 2002 – not even Los Angeles, the one area originally classified as serious.

The observed decline in ambient CO concentrations is linked to a decline in CO emissions from highway traffic. As a case in point, consider the relative decrease in CO emissions from vehicular traffic operating through a signalized intersection. There are two components of vehicle operation generally tracked to estimate emissions in such situations: queuing and free-flow. Typical decreases in queuing and free-flow emissions for an urban arterial intersection are provided in Figure 1. These trends were predicted using the EPA’s mobile source emission factor model, MOBILE6.2 (*8*). Assumptions used to generate these curves include an ambient wintertime temperature of 0 °C (32 °F); a fuel Reid vapor pressure of 15.0 psi; no inspection/ maintenance (I/M) program; low altitude; an arterial roadway scenario with average free-flow traffic speeds of 40 mph and 2.5 mph (to represent idle); no contribution from vehicle starts (i.e., running emissions only); and the national yearly growth in vehicle-miles traveled (VMT) for urban principal arterials. The forecast of future growth in VMT for urban principal arterials was based on the historical average growth between 1990 and 2001.

For the case intersection, the predicted decline in vehicle queuing and free-flow CO emissions from 1990 to 1997 is 37% and 23%, respectively, while the measured decline in the typical maximum 1-hour and 8-hour average ambient CO concentrations was 31%. From 1990 to 2002, the predicted decline in vehicle queuing and free-flow CO emissions is 53% and 34%, respectively, while the measured decline in the typical maximum 1-hour and 8-hour average ambient CO concentrations was 54% and 51%, respectively. A couple of decades will pass before the decline in CO emissions is expected to level off.

MOBILE6 characterizes EPA’s latest understanding of CO emissions from on-road motor vehicles, which recently superseded MOBILE5 (*9*) for regulatory applications. There are big differences in the CO emission factors predicted using MOBILE6 versus MOBILE5 methodologies. For the case intersection described, consider the annual predicted decline in queuing and free-flow CO emission factors, with no contribution from vehicle starts (refer to Figure 2). Overall, MOBILE6 provides lower running CO emission factors for queuing vehicles in past, current, and future years as depicted in the top graph of Figure 2. It provides higher running CO emission factors for free-flow vehicles in current and past years, but lower running CO emission factors in future years (beyond 2003) as depicted in the bottom graph of Figure 2. So, for future project-level conformity determinations, MOBILE6 will provide dramatically lower CO emission estimates than previously projected with MOBILE5.

CONTEXT FOR HOTSPOT MODELING

The requirements of the transportation conformity rule (*10*) and NEPA drive almost all hotspot modeling for projects. A few states have NEPA-like laws that require environmental documentation, and thus air quality analysis, for state projects as well. In nonattainment and maintenance areas subject to conformity, the conformity rule's requirements generally dictate the level of air quality analysis performed, and the project-level conformity determination is documented as part of the NEPA process.

The transportation conformity rule requires a project-level analysis and conformity determination for all federally funded or approved projects in CO and PM10 nonattainment and maintenance areas. A quantitative analysis (using CAL3QHC) is required for projects: 1) in or affecting locations identified in the SIP as sites of potential or actual violations of the CO NAAQS; 2) affecting intersections that are at or will be at Level of Service (LOS) D or worse; or 3) affecting intersections identified in the SIP as having the three highest volumes or three worst levels of service in the nonattainment or maintenance area. The rule spells out several additional general requirements for hotspot modeling. The conformity rule allows the use of alternative modeling methodologies, on the condition that they be developed through the interagency consultation process and approved by the EPA Regional Administrator (*10*).

Project-level air quality analysis is also performed as part of the NEPA process, for purposes of identifying and disclosing significant impacts, and to evaluate possible mitigation. CAL3QHC is commonly used for this purpose even though it is not strictly required. State practices for NEPA air quality analysis vary widely. FHWA issued two guidance documents in the 1980's that guide NEPA air quality analysis (*11*,*12*). Generally speaking, these guidance documents recommend hotspot modeling for projects that are being evaluated through an EIS, recommend against hotspot modeling for projects that receive a Categorical Exclusion (CE), and indicate that hotspot modeling may be appropriate for projects that are being evaluated through an Environmental Assessment (EA). FHWA is currently in the process of revising the NEPA project-level guidance, with completion expected sometime in 2004.

OVERVIEW OF EXISTING STATE PROJECT-LEVEL SCREENING PROTOCOLS

Elements of existing state project-level screening protocols are highlighted in this section. Table 1 provides a summary of the main components of the project-level screening procedures used in states that have CO nonattainment and/or maintenance areas and are thus subject to conformity for CO. This list serves as a representative sample of the range of the practice as compiled in late-2002/early-2003. As noted, some states do not specify any additional screening procedures beyond the requirements of the conformity rule. But most states have adopted policies (formal or informal) whereby certain screening factors are considered before committing resources for hotspot modeling. These factors include location of project, exempt/non-exempt project, level of service, and average daily traffic volume, among others. Some states have more-advanced policies that are detailed in referenced air quality guidance. And a few states have even developed calculation procedures (either manual or computer-based) that consider the interaction of numerous factors.

INNOVATIVE PRACTICES

In this section, the elements of several advanced project-screening protocols are highlighted. These states have gone beyond standard practice and adopted more innovative screening procedures in an attempt to reduce the hotspot modeling workload. Not all of these states have areas that are subject to conformity. In the states with areas that are subject to conformity, these procedures have been reviewed and accepted by EPA.

California

The University of California Davis developed the "Transportation Project-Level Carbon Monoxide Protocol" for the California Department of Transportation (Caltrans) (*13*). The Protocol involves a tiered approach and establishes a cap on the number of intersections that need to be analyzed for any one project. For projects involving multiple intersections, only the three intersections with the worst Level of Service, and to the extent they are different, the three highest volumes need to be analyzed using the Protocol's procedures. For each intersection that fails one of the steps of the Protocol, an additional intersection must be analyzed.

California presently has one CO nonattainment area and ten CO maintenance areas (*5*). The procedures for the nonattainment area and the maintenance areas are substantially the same. Once the attainment status of the area is established (Level 1), Level 2 screening involves examining the project intersections for potential increases in emissions. This includes evaluating the intersections for significant increases in the percentage of vehicles operating in cold start mode (e.g., a 2%), significant increases in traffic volume (e.g., 5%), or significant degradation of traffic flow (e.g., any reduction in free-flow speed or increase in intersection delay). In the nonattainment area, the project also must not move traffic closer to a receptor.

In Level 3, the project intersections are compared to intersections modeled in the area's attainment SIP or maintenance plan (if applicable). There are eight comparison criteria: distance of receptors from the intersection, intersection geometry, meteorology, traffic volumes, percentage of vehicles in cold start mode, percentage of heavy-duty gas trucks (HDGT), delay and queue length, and background concentration. The project is deemed satisfactory if the intersections are "better" in all respects than the cases modeled in the applicable SIP.

Level 4 involves a calculation procedure, using look-up tables built on worst-case assumptions. This procedure only applies to intersections with less than 50% of vehicles in cold start mode, less than 1.2% HDGT, volumes of less than 1000 vehicles per hour per lane (vphpl), and a January temperature greater than 35 °F. It involves looking up a base case contribution for the type of intersection, applying volume and intersection performance (free-flow speed and delay) correction factors, and then applying additional factors for wind speed and angle, cold start percentage, analysis year, and I/M. An appropriate default background concentration and persistence factor are applied, and the resulting calculated concentration is compared to the CO standards (Federal and California). If this procedure indicates a violation of one of the standards, or if it does not apply, then formal hotspot modeling (Level 5) is required. If the impacts of the project are still found to be unacceptable, the project is referred to a standing inter-agency review committee to evaluate model inputs and potential revised modeling or modifications to the project (Level 6).

For attainment and maintenance areas, the same general process applies, as described in Level 7 of the Protocol. Under Level 7, projects are examined using procedures similar to Levels 2 and 3 for nonattainment areas, described above. If a project fails those levels, Level 4 screening analysis is performed for projects involving intersections that are or will be at LOS E or F. Level 4 screening also can apply to LOS A-D intersections in areas with a higher potential of experiencing violations of the CO standard, including urban street canyons, areas with a high percentage of cold starts or HDGTs, locations near a significant stationary source of CO or with high CO background levels, and to LOS D intersections which experience adverse meteorology and operation cycles conducive to CO formation. Projects in attainment and maintenance areas that require Level 4 screening and fail must also be modeled.

Florida

Florida includes a project-level screening procedure as part of its Project Development and Environment Manual (*14*). Florida does not have any nonattainment or maintenance areas for CO (*5*); so all CO project-level analysis is conducted in the NEPA context. Florida has also developed a computerized screening tool called CO-SCREEN (*15*).

Florida's procedures apply in all areas of the state. All Type 2 CE, EA/FONSI and EIS projects must be analyzed. Type 1/Programmatic CE and projects of the types listed in section 93.126 of the transportation conformity rule are exempt from hotspot analysis, unless they have characteristics that could negatively impact air quality (i.e., increases volumes or reduced speeds). The screening procedures themselves are based on a series of curves developed using conservative assumptions in MOBILE6 and CALINE3. First, the worst-case intersection associated with a project is identified, based on traffic volume, speed, and closeness of receptors. Next, the main link of this intersection (the link with the highest volume and lowest speed) is identified. The analyst determines the volume in vehicles per hour and the free-flow speed for this link, and the curves are used to identify the closest permissible receptor to this intersection. This may be done manually, using the tables in the procedure, or by running the CO-SCREEN model. If there are existing receptors closer than the minimum permissible distance, the intersection fails the screening test and must be modeled using CAL3QHC. By virtue of the assumptions built into the screening procedure, any intersection with a link having over 10,000 vehicles per hour or a free-flow speed less than 12.5 miles per hour will fail the screening procedure. Florida's procedures also include instructions for hotspot modeling for projects that must proceed to this step.

Idaho

Idaho adopted its project level analysis guidance in September 2001 (*16*). Its screening guidance exempts projects from hotspot modeling based on three criteria: 1) the project is listed in section 93.126 of the transportation conformity rule as an exempt project; 2) the project has a design year LOS C or better; or 3) the design year two-way traffic volume for any roadway in or directly affected by the project does not exceed 20,000 vehicles per day for the Northern Ada County CO maintenance area (Boise) or 15,000 vehicles per day elsewhere in the state. (The allowable traffic volume is higher in the maintenance area due to the presence of an I/M program, which reduces the idle emission rates and resulting concentrations.) If a project meets any of these three criteria, hotspot modeling is not required. The Idaho guidance also includes instructions for hotspot modeling for projects that require it.

Illinois

Like Florida, Illinois has no nonattainment or maintenance areas for CO, so all project-level analysis is conducted in the NEPA context. Illinois conducts the air quality analysis on new projects in the planning stage, before the type of NEPA document (CE, EA/ FONSI, EIS) is chosen.

Illinois employs a two-stage process for project screening (*17*) using a software program called COSIM-2.0 (*18*). IDOT and the University of Illinois in cooperation with IEPA developed COSIM-2.0. The program has a graphical user interface and is based on CAL3QHC, with a number of simplifying assumptions that tend to result in conservative concentration estimates. COSIM-2.0 provides both a pre-screening analysis and a complete screening analysis. In a pre-screening analysis, the user enters the county in which the project is located, the ADT on the busiest leg of the intersection, and the distance to the closest receptor. If the project fails this level of screening, a complete screening analysis is required. COSIM-2.0 uses three input steps for the complete analysis. First, the user enters the IDOT district and county in which the project is located and selects the type of surrounding land use/terrain. Second, the user enters information on the intersection geometry (a list of default designs is provided), traffic volumes and speeds for each leg of the intersection, and the signal timing (a default option is available). Finally, the user sets the distance of receptors from the intersection (10 feet is the default). COSIM-2.0 selects the appropriate MOBILE6 emission factors based on the chosen location and runs CAL3QHC to estimate CO concentrations. COSIM-2.0 analyses are performed for present conditions, and for project and no-action scenarios for the completion year, completion year plus ten years, and the design year. Projects that fail the COSIM-2.0 screening analysis must undergo conventional hotspot modeling.

Minnesota

Minnesota's procedure (*19*) applies in lieu of the transportation conformity rule's procedures in Minnesota's three CO maintenance areas. Each of the maintenance plans for these areas included hotspot modeling of selected intersections, and the procedure involves comparison of proposed project intersections with the intersections that were modeled for the maintenance plans. Since the maintenance plan intersections have already demonstrated compliance with the CO NAAQS, the procedure uses these intersections as benchmarks. If a project intersection has lower volumes, better LOS or greater distance to a receptor than the SIP intersections, then hotspot modeling is not required for project-level conformity determinations. The procedure also requires that the list of intersections covered by the maintenance plans be reviewed every three years, and revised if necessary based on the criteria in EPA's guidance (*1*), to ensure that the methodology is always based on the intersections with the highest traffic volumes and worst LOS for each area.

New York

A three-step procedure is used in New York (*20*) for NEPA/SEQR project-level analysis and for project-level conformity determinations in its two CO maintenance areas (*5*). Projects are analyzed for the completion year, and the completion year plus 10 and 20 years. All roadway segments are analyzed, not just intersections.

The first step is LOS screening. Project intersections that will be at LOS C or better in all years are not subject to further analysis unless there are sensitive receptors (such as schools, hospitals or retirement communities).

The next step is “Capture Criteria Screening”. The project may be screened out of further analysis based on five criteria: 1) less than a 10% reduction in source/receptor distance; 2) less than a 10% increase in traffic volume; 3) less than 10% increase in emissions; 4) no increase in the number of queued lanes; and 5) less than a 20% reduction in speed, when the build speed is 30 mph or less. The emissions increase in criterion 3) is evaluated using lookup tables that account for the effects of changes in speed, cold starts, and vehicle mix. For projects within one half mile of any intersection analyzed in the SIP (a list of 41 SIP intersections is provided), the criteria are slightly different. For the first three criteria, the thresholds are reduced to 5%; the fourth criterion remains the same, and the threshold for the fifth criterion is reduced to 10%. However, *intersections* within one half mile of a SIP intersection are not eligible for screening and must be modeled (that is, if they fail the LOS screen in step one).

The third step is “Volume Threshold Screening”. The MOBILE model is used to develop free-flow emission rates in grams/mile, and idle/queue emission rates in grams/hour, for each leg of each failing intersection. The emissions rates reflect local conditions; including speed, thermal states, and emissions control strategies. The highest emission rates are then used in conjunction with look-up tables provided in the procedure to determine the allowable volume on any single approach to the intersection. NYSDOT developed the tables using conservative inputs to CAL3QHC; there are tables for one-way streets, two-way streets and intersections. No hotspot modeling is required if the highest approach volume is below the threshold identified in the intersection table for a given pair of emission rates. The highest allowable approach volume in the intersection table is 4000 vehicles per hour.

If a large number of intersections and free-flow links fail all three screening steps and require hotspot modeling, the procedure allows them to be ranked; analysis is initially required only for the three highest volume and three worst LOS locations. The procedures provide state-specific input instructions for the use of CAL3QHC and CAL3QHCR. New York has also developed and made available on its web site a graphical user interface for CAL3 known as “ROADMAP.”

Pennsylvania

Pennsylvania’s general NEPA air quality procedures are spelled out in the PennDOT Project Level Air Quality Handbook (*21*). Like Florida and Illinois, Pennsylvania has developed a computer model, known as InterAir, that performs automatic worst-case screening of project intersections (*22*). The PennDOT’s Bureau of Environmental Quality developed this model, with the assistance of FHWA, EPA, and the state Department of Natural Resources. InterAir serves as a shell program for MOBILE and CAL3QHC, and automatically operates those models using inputs provided by the user. The user provides the location (county) of the project, analysis year, the setting (urban or non-urban), and the maximum traffic volume, number of lanes and approach speed for the intersecting roadways. The choice of location influences the MOBILE I/M inputs and temperatures employed by the model. The model provides user-changeable defaults for percentage of left turns, signal cycle length, lost time, and background CO concentration. Based on these inputs, and further defaults that are written into the software, InterAir runs MOBILE to obtain appropriate emission factors, and then runs CAL3QHC to generate worst-case 1-hour and 8-hour CO concentrations. If the resulting concentrations are higher than the CO NAAQS, the project requires a detailed CAL3QHC analysis.

EXAMPLES OF PROJECT-SPECIFIC SCREENING PROTOCOLS

States that do not have general project-level screening protocols may still apply screening methodologies to individual projects, especially complex projects. Two examples are discussed below, for the I-25 Southeast Corridor project in Denver and the State Route 400 extension project in Atlanta.

Denver’s Southeast Corridor project (the “T-REX” project)

This project involves the reconstruction and improvement of approximately 20 miles of I-25 and I-225 in the southeast portion of the Denver metro area. The project includes reconstruction and widening of the interstates, reconstruction of seven interchanges, replacement of 11 bridges, and construction of 19.7 miles of double-tracked light rail transit. The air quality scoping process for this project revealed that a literal application of the conformity rule’s hotspot modeling requirements (analysis of all locations at or expected to be at LOS D or worse) would necessitate modeling of 54 intersections. Modeling each of these locations for the 2008 opening day and the 2020 design year, for the Preferred Alternative and No-Action, and for a.m. and p.m. peak hours would have resulted in over 400 model runs.

The Colorado Department of Transportation (CDOT) and its consultants worked through the interagency consultation process to identify an alternative analysis approach that would capture the worst-case intersections without the need for modeling all of them (*23*). First, the project corridor was separated into a northern section, with high volumes and congestion, and a very narrow right-of-way bordered by residential development; and a southern section, with less congestion and a wider right-of-way. In the northern section, the four most congested interchanges were selected for modeling, for 2008 and 2020. In the southern section, a "worst-case" interchange was selected for modeling, based on congestion, roadway geometry and traffic volumes. A single worst-case model run for this location combined 2008 CO emission rates with 2020 traffic volumes. As a further refinement, only the Preferred Alternative in the EIS was modeled. Since this did not result in violations of the CO NAAQS, the No-Action alternative was not modeled. EPA's Region 8 office in Denver approved this methodology in May 1999. Taken together, CDOT (unpublished data) estimated that this methodology reduced the modeling workload by 50 to 75%. No violations of the NAAQS for CO were predicted using the adopted screening procedure.

Georgia

The State Route 400 extension project (*24*) in Atlanta consisted of the construction of a 6-lane limited access toll way on new right-of-way of over 6 miles in length. Traffic studies identified 20 intersections that may be affected by the project. As a streamlining measure, a screening analysis was developed and implemented to determine which intersections where ambient CO concentrations have the potential to increase for the build alternatives versus no-build.

The total approach CO emission rate for each intersection was calculated for peak hour traffic. The intersections were evaluated for the no-build and 2 build alternatives. All intersections and all alternatives were evaluated for the estimated time of completion of the project when CO emissions for the build alternatives would be highest. The potential effects of the project on ambient CO concentrations near the intersections were separated into 3 categories:

- Category 1 – Ambient CO levels had a low potential for change. Total peak hour traffic volumes and approach CO emission rates were expected to change by less than 5% and less than 10%, respectively.
- Category 2 – Ambient CO levels had a potential to decrease. Traffic would be diverted from these intersections by the proposed project. Total peak hour traffic volumes and approach CO emission rates were expected to decrease by more than 5% and more than 10%, respectively.
- Category 3 – Ambient CO levels had a potential to increase. New intersections that would be constructed and existing intersections that would be re-constructed as part of the project. Total peak hour traffic volumes and approach CO emission rates were expected to increase by more than 5% and more than 10%, respectively.

As a result of the screening analysis, 7 intersections were identified as Category 3 intersections where ambient CO concentrations had a potential to increase in the future for the build versus no-build. All of these intersections were selected for a more detailed line source modeling analysis. No violations of the NAAQS for CO were predicted using this screening approach.

DEVELOPING AN ADT SCREEN FOR PROJECT EVALUATION

As described above, several states have adopted innovative practices to screen projects and reduce the CAL3QHC modeling workload. While these advanced procedures result in substantial time savings, they are not without up-front costs. Areas that are interested in reducing their modeling workload, but are concerned about the level of effort involved in developing a sophisticated screening tool, would do well to start by adopting and using an ADT threshold as a simple screening tool.

An ADT screen can be developed through the application of the CAL3QHC model for representative worst-case conditions in the state. EPA prescribes (*1*,*2*) many of these worst-case conditions, including receptor locations and meteorology. However, link data involve a lot of variability and offer the most challenge for developing a representative set of worst-case conditions.

Start with the classic configuration of two, perpendicular intersecting 4-lane urban arterials. Model a range of volume-to-capacity ratios (V/C) and be sure to include cases representative of an intersection operating at over-capacity (e.g., V/C > 1.0). Pick the representative signal cycle timing for such an over-capacity condition.

Typically, the higher the total signal cycle length, the longer the delay, the longer the queue length, and the higher the CO emissions.

In computing the mobile source CO emission factor, use only the running portion since most of the effects of an engine start on exhaust emissions will occur in the first minute (*25*). MOBILE6 provides several mechanisms for segregating running and start emissions. When using MOBILE6 to compute CO emission factors, use the average speed command and specify the arterial roadway scenario. Also, bear in mind that MOBILE6 computes a daily average emission factor based on a diurnal variation of ambient temperatures, while it is the worst-case hourly CO emission factor that is more appropriate for use in a hot-spot analysis. To specify a single ambient temperature for the worst-case hour, set the maximum temperature equal to the minimum temperature.

Multiple screens can be developed to account for different intersection configurations; signal cycle timings; project locations (urban versus rural); and emission factor characteristics (e.g., calendar year, temperatures, I/M and no-I/M programs, and vehicle mixes and speeds). States should focus their efforts on the types of projects most commonly modeled in their nonattainment and maintenance areas.

SUMMARY AND RECOMMENDATIONS

Given the drastic improvement in carbon monoxide air quality since 1990, and the fact that all of the original CO nonattainment areas appear to be meeting the standard, there is clearly some room for disinvestments in CO hotspot modeling. The carbon monoxide health concern that led to the creation of the conformity rule's hotspot modeling requirement has largely ceased to exist. The MOBILE CO emission rates have decreased significantly as well. And in light of the proposed downsizing of the nationwide CO monitoring network, one must really wonder about the value of routinely conducting CO hotspot modeling in locations where EPA and the state air agency no longer consider it worthwhile to even monitor for CO.

More states should avail themselves of the opportunity to implement alternative project-level analysis procedures, provided for by section 93.123(a) of the transportation conformity rule. While EPA may revisit the entire hotspot modeling requirement in some future revision to the conformity rule, 93.123(a) provides a mechanism that transportation agencies can use immediately to streamline the hotspot modeling workload and focus only on the projects that have any likelihood of generating an exceedance of the CO standard.

At a minimum, states can adopt an ADT screen developed using the CAL3QHC model, as previously described. As a further refinement, states facing a significant potential modeling workload even after an ADT screen is implemented can develop a computerized screening tool or interface, similar to CO-SCREEN, COSIM-2.0, or InterAir. These tools greatly simplify the task of analyzing projects. However, they need to be designed properly; if the simplifying assumptions used are too conservative, they will "fail" many projects that would not demonstrate an exceedance of the CO NAAQS under a full CAL3QHC analysis.

Finally, it is recommended that states maintain a clearinghouse of projects that do receive a full CAL3QHC analysis, and implement a project comparison approach as a last screening step. Projects that "fail" an ADT screen and/or a computerized screening tool can still be compared to other previously modeled projects to determine the likelihood of a NAAQS exceedance. The nature of the comparison should be clearly defined through the interagency consultation process.

For projects that fail all of these screens and require a full CAL3QHC analysis, there are still refinements that states should consider. For example, this is a good opportunity to revisit background concentrations; given the changes in monitored CO values and MOBILE emission rates, the default background concentrations developed more than 10 years ago are likely not valid for many areas. States can adopt a method for estimating future background concentrations, and for calculating area-specific persistence factors.

Even though the title of the paper implies that its focus is on project-level analysis procedures for conformity, the recommendations provided are equally valid for analyses conducted in the NEPA context. As noted above, FHWA is currently in the process of revising the NEPA project-level guidance. States may want to consider the recommendations in this paper as they begin to implement the revised NEPA guidance.

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List of Table and Figures

TABLE 1 Project-level screening procedures used in areas subject to conformity for carbon monoxide

FIGURE 1 Typical CO Emission Trends at an Urban Arterial Intersection.

FIGURE 2 Comparison of MOBILE5 and MOBILE6 Emission Factors Representative of an Urban Arterial Intersection.

TABLE 1 Project-level screening procedures used in areas subject to conformity for carbon monoxide

State	Type of Procedure	Factors Considered
Alaska [A]	None	Conformity rule requirements
Arizona [B]	Policy	Speed, average daily traffic (ADT) volume, vehicle-miles traveled (VMT)
California (*13*)	Manual calculations	LOS, % cold start, volume, speed, delay, receptor distance, geometry, % heavy-duty gas trucks (HDGT), queue length, meteorology, background concentration
Colorado [C]	None	Conformity rule requirements
Connecticut [B]	Policy	Non-exempt project, LOS
Idaho (*16*)	AQ guidance	ADT screen
Indiana [B]	Policy	Location of project
Maryland [B]	Policy	Volume, distance to receptors
Massachusetts [B]	Policy	Location of project, non-exempt project
Michigan [B]	Policy	Location of project
Minnesota (*19*)	AQ guidance	Location of project, ADT, LOS
Missouri	Unknown	
Montana [B]	Policy	Non-exempt projects
Nevada [B]	Policy	Location of project, capacity increase or new signal in nonattainment area
New Hampshire [B]	Policy	Non-exempt project, LOS
New Jersey [B]	Policy	Peak-hour volume
New Mexico [D]	Policy	Conformity rule requirements, interchange projects
New York (*20*)	AQ guidance	LOS, receptor distance, volume increase, # of queued lanes, speed, proximity to SIP intersection
North Carolina [B]	Policy	Major roadway improvement
Ohio [E]	Policy	New ADT or ADT increase
Oregon [B]	Policy	Type of NEPA document
Pennsylvania (*22*)	Model	InterAir model for preliminary screening
Tennessee [F]	None	Conformity rule requirements
Texas [G]	AQ guidance	ADT, type of NEPA document
Utah [H]	None	Location of project, LOS
Virginia [I]	Policy	ADT screen
Washington [J]	None	Conformity rule requirements

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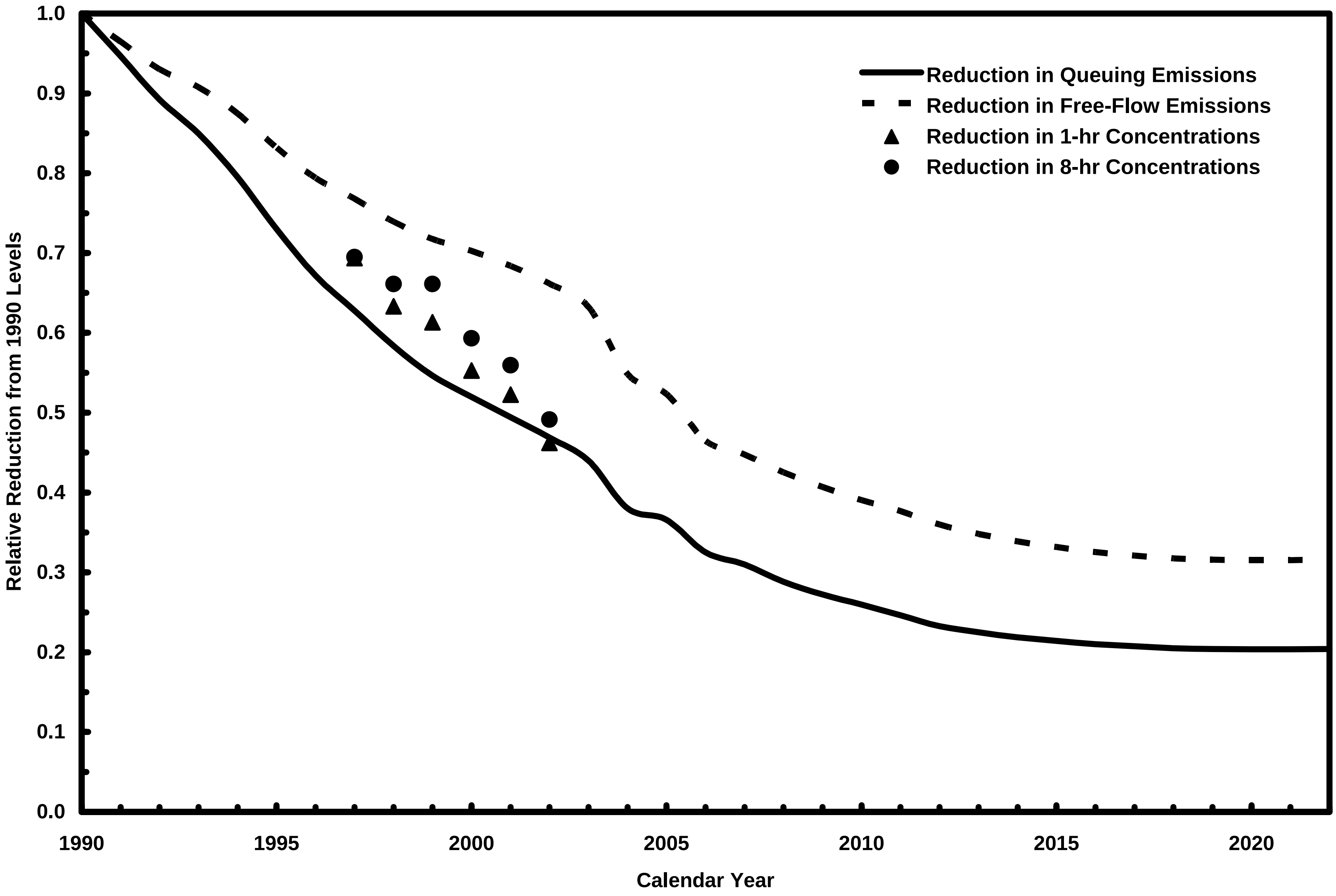
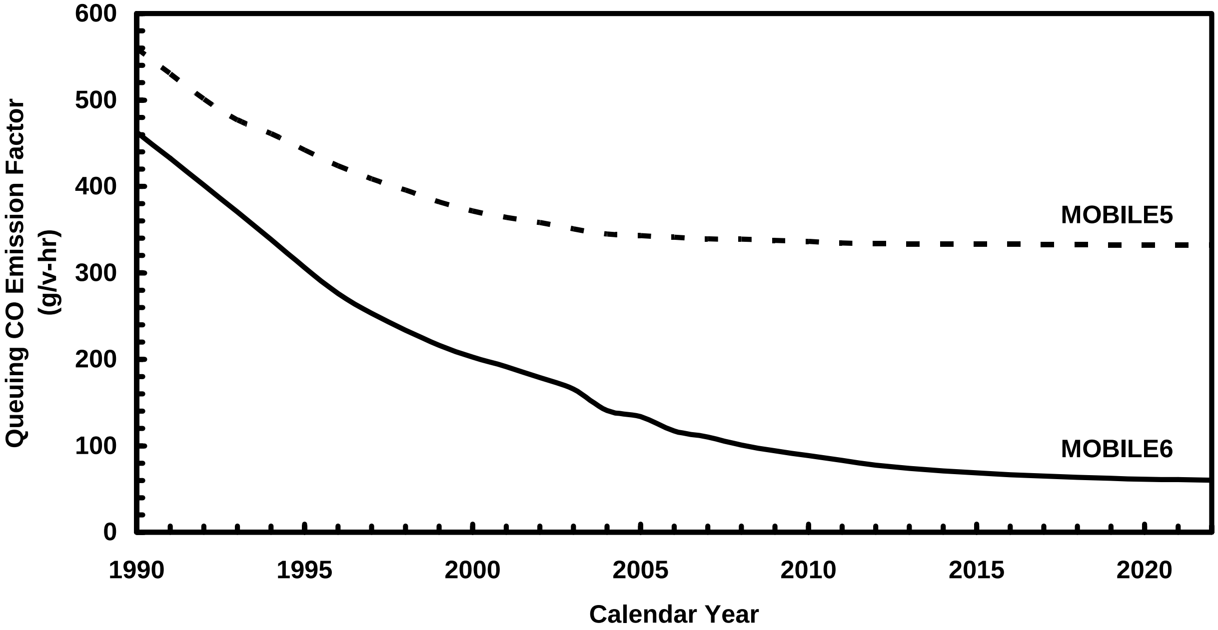


FIGURE 1 Typical CO Emission Trends at an Urban Arterial Intersection.



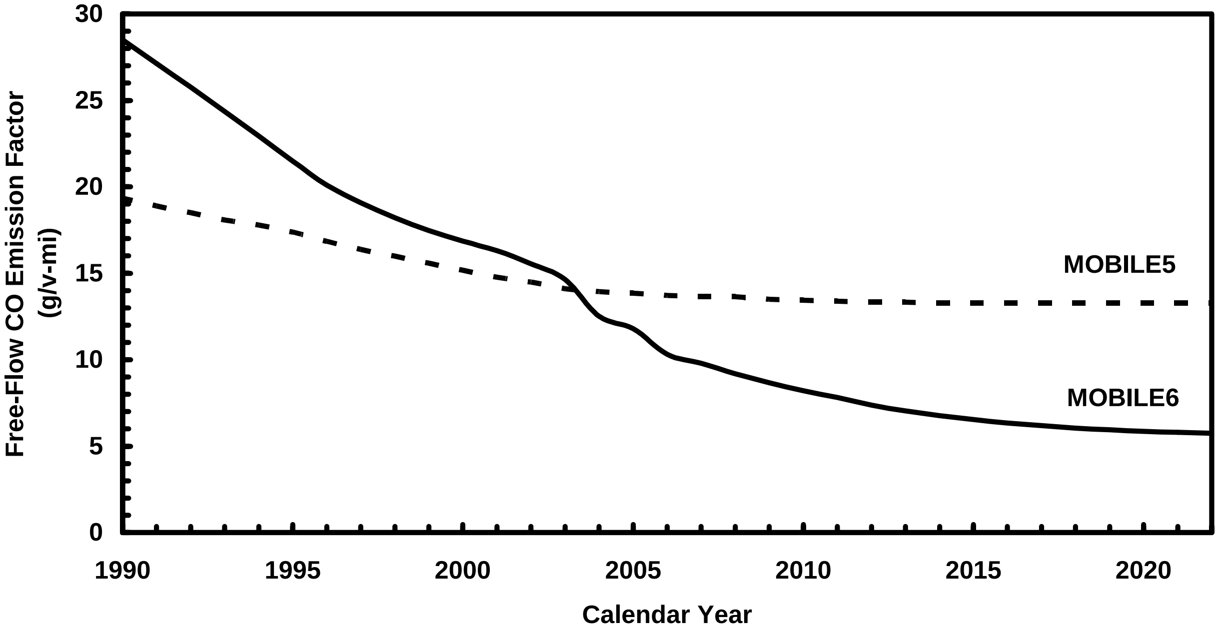


FIGURE 2 Comparison of MOBILE5 and MOBILE6 Emission Factors Representative of an Urban Arterial Intersection.