

NCHRP PROJECT 25-25 TASK 71

TEMPLATES FOR PROJECT LEVEL ANALYSIS USING MOVES, CAL3QHC/R AND AERMOD

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Executive Summary

The research objective of National Cooperative Highway Research Program (NCHRP) Project 25-25 Task (71) was to develop a project-level analysis air quality technical report template. The Project-Level Analysis Report Template is intended to reduce the time and cost necessary to complete air quality studies for proposed transportation projects, to improve the consistency and quality of these studies, and to assist transportation agencies in meeting new modeling and documentation requirements.

The process for developing the preliminary Project-Level Analysis Template began with a review of recent air quality technical reports/conformity determinations to inform the development and organization of the template. Existing templates and state-level air quality analysis guidance documents were reviewed and state Departments of Transportation (DOTs) were contacted for information.¹

The preliminary Project-Level Analysis Template was designed to address transportation conformity and National Environmental Policy Act (NEPA) requirements. The focus for the development of the Project-Level Analysis Template was on: 1) particulate matter hot -spot analysis (PM_{2.5} and PM₁₀) with MOVES2010 and AERMOD or CAL3QHCR and 2) carbon monoxide hot- spot analysis with MOVES2010 and CAL3QHC (screening) or CAL3QHCR (refined). The Project-Level Analysis Template was also designed to briefly address the topics of road dust and construction air quality impacts, Mobile Source Air Toxics (MSATs) and indirect effects and cumulative impacts to air quality. The preliminary Project-Level Analysis Template provides suggested language, guidelines and organization for air quality technical reports prepared to comply with the transportation conformity rules and guidance, and well as the National Environmental Policy Act (NEPA). At the time of this publication, it is our understanding that the US Environmental Protection Agency (EPA) and the US Department of Transportation's Federal Highway Administration (FHWA) are reviewing the templates developed as part of this project for future use.

To further assist practitioners in understanding how to tailor the preliminary Project-Level Analysis Template to the needs of their specific projects, three example reports for hypothetical transportation projects were prepared using the Project-Level Analysis Template. The example projects include a range of common transportation improvements, such as new interchanges, park-and-ride lots, bus terminals and intersection improvements.

Based on the experience preparing the preliminary Project-Level Analysis Template and example reports, the conclusions section of this final report presents recommendations on future research opportunities to further reduce the time and cost of transportation project air quality studies, including the need for agencies to work together to update the template as models, guidance, and regulations change over time.

¹ As this study was initiated within the two-year grace period for the transition to new federal models and guidance for project-level analyses, none of the states contacted had yet applied the new models and guidance and completed a project-level analysis at the time of this study.

I. Introduction

Air pollution “hot-spots” or localized areas of relatively high pollutant concentrations can occur near major roadways, intersections, intermodal freight terminals, ports and other facilities under certain meteorological conditions. The analysis of localized air pollutant concentrations at specific locations around a transportation facility requires the use of sophisticated computer models to predict the quantity and timing of pollutant emissions (emissions modeling) and how these pollutants will affect short-term and/or long-term concentrations in the area under local meteorological conditions (dispersion modeling). The resulting modeled concentrations are combined with monitored background concentrations to determine the total concentration for comparison to ambient air quality standards.

The need for hot-spot analysis of certain transportation projects located in nonattainment and maintenance areas for carbon monoxide or particulate matter is largely driven by the U.S. Environmental Protection Agency’s (EPA’s) Transportation Conformity regulations (40 CFR Part 93 Subpart A), which were developed as part of the implementation of the Clean Air Act. To provide a consistent framework for hot-spot analysis of transportation projects, EPA has also developed numerous guidance documents further specifying the recommended analysis methodologies in detail. To comply with transportation conformity requirements, transportation agencies have conducted quantitative carbon monoxide screening analyses for many years using the MOBILE6.2 emissions model (and its predecessors) and the line source dispersion model CAL3QHC. Particulate matter analyses for transportation conformity in the past have been qualitative only because of limitations in past motor vehicle emission factor models and the need for EPA guidance for quantitative analysis.² Carbon monoxide and particulate matter hot-spot analyses also have been used to ensure consideration of air quality issues in environmental assessments and environmental impact statements prepared pursuant to the National Environmental Policy Act (NEPA).

Several recent developments in hot-spot modeling tools and guidance will substantially change the way hot-spot analyses are conducted for transportation conformity and/or NEPA. On December 20, 2010, EPA approved the use of the MOVES2010a emissions model as EPA’s approved motor vehicle emission model for use in PM and CO hot-spot analyses for transportation conformity purposes.³ EPA subsequently released a minor revision in MOVES2010b in April 2012 that is also appropriate for PM and CO hot-spot conformity analyses and which enhances model performance, but does not significantly affect the criteria pollutant emissions results from MOVES2010. MOVES is EPA’s state-of-the-art tool for estimating emissions from on-road mobile sources and improves upon EPA’s previous series of mobile source emission factor models. MOVES represents a complete change in the structure, the data inputs, the methodologies, and the software for calculating on-road emissions or emission factors in comparison to the prior emissions model MOBILE6.2.⁴ In December 2010, EPA also released final guidance on quantitative PM hot-spot analyses⁵ and CO project level analyses.⁶ Due to the complex

² Transportation Conformity Guidance for Qualitative Hot-spot Analyses in PM2.5 and PM10 Nonattainment and Maintenance Areas. EPA. 2006. <http://www.epa.gov/otaq/stateresources/transconf/policy/420b06902.pdf>

³ “Official Release of the MOVES2010a and EMFAC2007 Motor Vehicle Emissions Models for Transportation Conformity Hot-spot Analyses and Availability of Modeling Guidance,” Notice of Availability, 75 FR 79370, December 20, 2010. <http://www.gpo.gov/fdsys/pkg/FR-2010-12-20/pdf/2010-31909.pdf>

⁴ Details on MOVES2010, MOVES2010a, and MOVES2010b can be found at: <http://www.epa.gov/otaq/models/moves/>.

⁵ “Transportation Conformity Guidance for Quantitative Hot-spot Analyses in PM2.5 and PM10 Nonattainment and Maintenance Areas,” EPA-420-B-10-040, U.S. Environmental Protection Agency, Office of Transportation and Air Quality, December 2010.

nature of PM emissions and PM NAAQS, the guidance for PM analysis focuses on “refined” analysis using actual meteorological data and AERMOD or CAL3QHCR for dispersion modeling, in contrast to the simpler CO screening analyses with CAL3QHC that transportation agencies are most familiar with. For transportation conformity, the use of the MOVES2010a or MOVES2010b model and associated EPA guidance for PM and CO hot-spot analyses is required for analyses started after December 20, 2012.⁷

The research objective of National Cooperative Highway Research Program (NCHRP) Project 25-25 Task 71 was to develop a project-level analysis air quality technical report template. The Project-Level Analysis Template is intended to reduce the time and cost necessary to complete air quality studies for proposed transportation projects, to improve the consistency and quality of these studies, and to assist transportation agencies in meeting new modeling and documentation requirements discussed above. The preliminary Project-Level Analysis Template meets the research objective by drafting suggested language, guidelines and organization for air quality technical reports prepared to comply with the transportation conformity rules and guidance, as well as NEPA. At the time of this publication, it is our understanding that EPA and FHWA are reviewing the templates developed as part of this project for future use.

This final report summarizes and documents the research performed as part of this project. Following this introduction, Section II describes the research on existing air quality technical report documentation practices undertaken to inform the development of the preliminary Project-Level Analysis Template. Section III describes the preliminary Project-Level Analysis Template. Section IV explains the development air quality technical reports for three example projects applying the project-level analysis template. Conclusions and recommendations for future work are presented in Section V. The preliminary Project-Level Analysis Template is included as Appendix A to this report. The hot-spot analysis reports for the three sample projects are included as Appendices B, C, and D.

II. Development of the Project-Level Analysis Template

Existing air quality templates and technical reports were gathered to inform the content and organization of the Project-Level Analysis Template. In order to ensure the latest templates and reports were gathered, environmental/air quality specialists from 11 state DOTs were contacted by email and/or phone. Table 1 summarizes the templates and state-level guidance documents reviewed. Table 2 summarizes the air quality technical reports that were received as a result of this outreach and through online research. Ultimately, the team obtained an air quality conformity analysis template report from the Caltrans, a consultant guide for preparing air quality project-level analysis from Virginia DOT, a project level air quality handbook from Pennsylvania DOT and an example of project-level analysis documentation from New York State DOT. Reports documenting hot-spot analyses were provided by Oregon DOT, Michigan DOT, Georgia DOT, and Virginia DOT. Staff from Wisconsin DOT provided information on their experience on a pilot project in which they were performing a PM hot-

⁶ “Using MOVES in Project-Level Carbon Monoxide Analyses,” EPA-420-B-10-041, U.S. Environmental Protection Agency, Office of Transportation and Air Quality, December 2010.

⁷ In California, California’s EMFAC2007 model is currently approved for emission factor modeling for quantitative PM hot-spot analyses (75 FR 79370), which will also be required for new PM hot-spot analyses after December 20, 2012. EMFAC2007 is currently used for any CO hot-spot analyses for conformity purposes (73 FR 3464, January 18, 2008).

spot analysis using MOVES. Additional air quality technical reports were obtained from Alabama DOT, Colorado DOT, Indiana DOT, and the Washington State DOT through online research.

An important objective of contacting State DOTs was to determine if any existing templates or reports were available that utilized MOVES; however no air quality technical reports utilizing MOVES were available. This finding may be attributed to the fact that MOVES2010 had only been approved by EPA for quantitative PM and CO analyses in December 2010 and the use of MOVES2010 is not required for conformity purposes for hot-spot analyses started before December 2012 due to the grace period for project-level conformity analyses. While numerous examples of quantitative CO hot-spot screening analyses are available utilizing MOBILE6.2 and CAL3QHC, the state DOTs contacted were not yet using EPA's quantitative PM hot-spot analysis guidance at the time of this research. Nevertheless, the available templates and reports based on MOBILE6.2 and CAL3QHC provided excellent insights into potential organizational approaches, boilerplate language for addressing transportation conformity requirements and sources of example text for inclusion in the Project-Level Analysis Template.

The example reports and templates listed in Tables 1 and 2 were considered in developing the outline for the Project-Level Analysis Template. The Caltrans template served as a helpful example in developing the Project-Level Analysis Template because it distinguished guidance, boilerplate text and example text through a color-coded system that was adopted for this project.

**Table 1
State DOT Air Quality Templates and Guidance Documents Reviewed**

State DOT	Document Title	Description/Notes	Document Date
California Department of Transportation	Air Quality Conformity Analysis	Template-style report for air quality conformity analyses in California, including quantitative CO hot-spot analysis and qualitative PM2.5 hot-spot analysis. Also includes boiler plate language for addressing inclusion of the project in the regional emissions analysis for an approved long-range transportation plan or for projects in isolated rural areas requiring a regional emissions analysis.	August 2007
Pennsylvania Department of Transportation	PennDOT PM2.5/PM10 Hot-Spot Project Screening Process	Provides methodology for screening projects to determine if PM10 or PM2.5 hot-spot analysis is needed, sets parameters for interagency consultation process	March 2007
Pennsylvania Department of Transportation	Project Level Air Quality Handbook	Provides guidance, procedures, and reporting requirements for CO, PM, and MSAT project level analyses and analysis for NEPA documentation	March 2008
Virginia Department of Transportation	Air Quality Project-Level Analysis Consultant Guide	Provides information and standards for preparing air quality analysis including CO hot-spot analysis methodology using MOBILE6.2 and CAL3QHC, PM hot-spot qualitative analysis methodology, and MSAT analysis methodology	May 2009
New York State Department of Transportation	Example Air Quality Report	Example air quality report/conformity determination using MOBILE5b and CAL3QHC.	June 1999

Table 2
State DOT Air Quality Technical Reports Reviewed

State DOT	Document Title	Types of Analysis Included	Document Date
Alabama Department of Transportation	Corridor X from I-65 to US 31	Qualitative PM2.5 Hot-spot Analysis/Conformity Determination	June 2007
Colorado Department of Transportation	North I-25 EIS Air Quality Technical Report Addendum	Regional emissions burden analysis (including MSATs), CO hotspot analysis with MOBILE6.2 and CAL3QHC, qualitative PM10 hotspot analysis, nitrogen deposition and visibility impact analysis for Class I areas, indirect and cumulative impacts.	August 2011
Oregon Department of Transportation	Air Quality Analysis for East Main Street—SE Baseline Street (Hillsboro) SE 10 th Avenue Section Project	CO hot-spot analysis using MOBILE6.2 and CAL3QHC and a qualitative MSAT analysis	June 2007
Oregon Department of Transportation	Air Quality Report: I-84 at 257 th Avenue/Troutdale Interchange Improvements- Multnomah County	CO hot-spot analysis using MOBILE6.2 and CAL3QHC and a qualitative MSAT analysis	January 2011
Michigan Department of Transportation	Air Quality Impact Analysis Technical Report—The Detroit River International Crossing Study	Quantitative hot-spot analysis of CO using MOBILE6.2 and CAL3QHC, qualitative hot-spot analysis of PM2.5 and PM10; quantitative analysis of MSATs using MOBILE6.2	February 2008
Indiana Department of Transportation	I-80/94 Interchange Modification at I-65	Qualitative PM2.5 Hot-spot Analysis/Conformity Determination	March 2007
Washington State Department of Transportation	Interstate 5 Columbia River Crossing- Air Quality Technical Report for the FEIS	CO hotspot analysis with MOBILE6.2 and CAL3QHC, MSAT emissions burden analysis (including sub-area effects), and construction impacts.	May 2011
Washington State Department of Transportation	Alaskan Way Viaduct Replacement Project FEIS- Air Quality Discipline Report	CO intersection screening with Washington State Intersection Screening Tool (based on MOBILE6.2 and CAL3QHC), MSAT emissions burden analysis using EMIT and MOBILE6.2, tunnel portal CO and PM2.5 dispersion modeling analysis using AERMOD, quantitative construction emissions analysis and conformity determination.	July 2011
Virginia Department of Transportation	Air Quality Analysis Update: Rt 7 Widening	Includes CO project-level analysis using MOBILE6.2 and CAL3QHC, assessment of PM2.5, qualitative MSAT analysis; includes programmatic agreements language.	June 2011

State DOT	Document Title	Types of Analysis Included	Document Date
Georgia Department of Transportation	Appendix 1: PM2.5, Traffic Flow Diagrams and CO-Data—I-75/Jodeco Road Interchange Improvement in Henry County	Includes determination of project categorization for PM2.5 hot-spot requirements plus CAL3QHC data for CO hot-spot analysis	Date not specified in appendix
Georgia Department of Transportation	Appendix 1: PM2.5, Traffic Flow Diagrams and CO-Data—Widening of Jeffersonville Road (CR727) & Millerfield Road (CS83) Bibb County	Includes determination of project categorization for PM2.5 hot-spot requirements plus CAL3QHC data for CO hot-spot analysis	Date not specified in appendix
Wisconsin Department of Transportation	Phone conversation	Discussion of pilot project performing hot-spot analysis using MOVES and AERMOD	Call on October 10, 2011

III. Using the Project-Level Analysis Template

The preliminary Project-Level Analysis Template provides suggested language, guidelines and organization for air quality technical reports prepared to comply with the transportation conformity rules and guidance, as well as the National Environmental Policy Act (NEPA). At the time of this publication, it is our understanding that EPA and FHWA are reviewing the templates developed as part of this project for future use.

The Project-Level Analysis Template is focused on the following types of project-level air quality analysis:

- Particulate Matter Hot-Spot Analysis (PM2.5 and PM10) with MOVES2010 and AERMOD or CAL3QHCR.
- Carbon Monoxide Hot-Spot Analysis with MOVES2010 and CAL3QHC (screening) or CAL3QHCR (refined)

The Project-Level Analysis Template also incorporates brief sections on road dust and construction air quality impacts, Mobile Source Air Toxics (MSATs) and indirect effects and cumulative impacts to air quality.

The Project-Level Analysis Template is focused on project-level analysis, and thus does not address regional transportation conformity analysis or documentation requirements (such as the regional transportation conformity determinations prepared for long-range transportation plans and transportation improvement programs). The Project-Level Analysis Template does not address criteria pollutants other than CO, PM2.5, and PM10; however the format and organization of this Project-Level Analysis Template may be useful as a starting point for documentation of an analysis of other criteria pollutants for a transportation project.

Given the focus of the Project-Level Analysis Template on hot-spot analysis, it does not address greenhouse gas emissions analysis. FHWA suggests greenhouse gas emissions analysis is more meaningful when conducted on a broader geographic scale and timeframe at the planning level, rather

than at the project level.⁸ Nevertheless, transportation agencies interested in conducting project-level greenhouse gas analysis or required to conduct such an analysis by state law or policy could add a section on this topic to the Project-Level Analysis Template, creating a customized Project-Level Analysis Template for their own use.

A. Purpose of the Project-Level Analysis Template

The Project-Level Analysis Template is a tool intended to make compliance with existing laws, regulations and guidance easier. The Project-Level Analysis Template is not an EPA or FHWA guidance document, although it does frequently cite official guidance documents. In addition to summarizing existing regulatory requirements and guidance, the Project-Level Analysis Template provides best practice recommendations for conducting and documenting project-level air quality analyses. These recommendations and guidelines are not binding and do not limit the flexibility of transportation agencies to determine the most appropriate methodologies and approaches based on the specific circumstances of each project and the interagency consultation process.

A representative of EPA's Office of Transportation and Air Quality was on the NCHRP 25-25 Task 71 project panel and provided valuable feedback during the development of the Project-Level Analysis Template. However, EPA has not reviewed the legal sufficiency of the Project-Level Analysis Template in detail or endorsed the Project-Level Analysis Template for any official regulatory purpose. Therefore, the preliminary Template included in this final report will be examined by EPA and FHWA for review and final release. Prior to that final release, it is suggested that state and local agencies not use the Template for official documentation.

B. Instructions for Using the Project-Level Analysis Template

The Project-Level Analysis Template needs to be modified for the specific needs of each project. The preliminary Project-Level Analysis Template uses the following types of color-coded text:

Blue Text = Instructions and guidelines to be deleted from the final document.

Red Text = Instructions to be replaced with project-specific text

Black Text = Boilerplate text that generally will not need to be modified for each project.

Purple Text = Sample text that must be modified or deleted, provided as a useful reference/example for how a particular section can be completed.

Many of the Project-Level Analysis Template sections will be useful for every project needing an air quality analysis, but other sections will only be applicable to certain projects or situations. An overview of the major sections of the Project-Level Analysis Template is provided below.

- **Section 1.0: Summary.** The summary provides a concise overview of the analysis methodology and conclusions at a level of detail appropriate for inclusion in the air quality impacts portion of a NEPA document (e.g., Environmental Assessment, Environmental Impact Statement or Documented Categorical Exclusion). The complete Project-Level Analysis Template will usually be too long and detailed to be included in NEPA documents directly, but can be incorporated by reference (40 CFR 1502.21).

⁸ http://www.fhwa.dot.gov/environment/climate_change/mitigation/q_and_a/

- **Section 2.0: Project Background.** The background section is used to provide a short project description and information on traffic forecasting for the project.
- **Section 3.0: Regulatory Requirements and Guidance.** This section provides a detailed description of project-level transportation conformity requirements, NEPA considerations and placeholders for inclusion of summaries of state-level programmatic agreements governing air quality analysis. Users of the Project-Level Analysis Template should ensure that they incorporate any relevant regulatory or guidance changes occurring after this Project-Level Analysis Template was completed (July 2012).
- **Section 4.0: Existing Conditions.** This section provides an overview of existing air quality and meteorological patterns in the project area. This section would be appropriate to incorporate in the NEPA document air quality existing conditions description.
- **Section 5.0 Project Assessment.** This is the longest and most complex section of the Project-Level Analysis Template.
 - Section 5.1 defines the project area and is applicable to all projects.
 - Section 5.2 covers all aspects of emissions modeling and dispersion modeling for PM10 and PM2.5 hot-spot analysis. Section 5.2.1 should be completed for every project to document the determination of whether or not a PM hot-spot analysis is warranted for transportation conformity and/or NEPA. If it is concluded a PM hot-spot analysis is not required for the project, then sections 5.2.2 through 5.2.7 can be deleted (e.g. section 5.2.2 through 5.2.7 only need to be completed if a PM10 and or PM2.5 hot-spot analysis is being conducted). Section 5.2.4 should be completed if AERMOD is selected as the dispersion model for the project. Section 5.2.5 should be completed if CAL3QHCR is selected as the dispersion model for the project.
 - Section 5.3 covers all aspects of emissions modeling and dispersion modeling for CO hot-spot analysis. Section 5.3.1 should be completed for every project to document the determination of whether or not a CO hot-spot analysis is warranted for transportation conformity and/or NEPA. If it is concluded a CO hot-spot analysis is not required for the project, then sections 5.3.2 through 5.3.8 can be deleted. Section 5.3 incorporates information on both screening and refined CO hot-spot analysis. Depending on whether screening or refined analysis is being conducted for a particular project, some information will need to be deleted from this section. For example, if a screening analysis is being conducted, then Section 5.3.3.3 and 5.3.6 can be deleted because these sections only pertain to refined analysis.
 - To accommodate projects where the main air quality issue is PM or CO (but not both), Section 5.2 and 5.3 contain all the documentation necessary for emissions and dispersion modeling. However, this approach may be duplicative for a project requiring both PM and CO hot-spot analysis because many of the model inputs and assumptions will be the same if a refined CO analysis will be performed using AERMOD. In such cases, if the same model inputs and dispersion models are used for both CO and PM, much of text in sections 5.3.3 and 5.3.4 can be replaced with a cross reference to information that is identical in sections 5.2.3 and 5.2.4 (AERMOD) to avoid excessively long and repetitive documentation. Sections 5.2.6, 5.2.7, 5.3.5, 5.3.7, and 5.3.8 would need to be retained for a project with both CO and PM hot-spot analyses because these sections are specific to the selection of representative background concentrations of PM (Section 5.2.6) and CO (Section 5.3.5 and 5.3.7) and evaluating the dispersion modeling results to determine if the conformity test has been met (Section 5.2.7 and 5.3.8), with each section providing unique information.

- Section 5.3.4 is a placeholder for a section of MSAT analysis using boilerplate language from FHWA’s interim guidance. This section may be appropriate to include directly in the NEPA document.
- Section 5.5 provides guidance and sample text related to indirect and cumulative impacts. This section may be appropriate to include directly in the NEPA document.
- **Section 6.0: Mitigation.** This section addresses both construction and operational mitigation. Certain construction best management practices are typically included as NEPA air quality mitigation commitments, even if a detailed analysis of construction air quality impacts was not necessary. The discussion of operational mitigation could be extensive (including modeling) in some cases, but if projects can demonstrate conformity without mitigation, a simple statement can be included that no mitigation is warranted based on the analysis results.
- **Section 7.0: Conclusions.** This section addresses the final conformity statement and NEPA air quality analysis conclusions.
- **Section 8.0: References.** This section contains all referenced documents in the Project-Level Analysis Template, with hyperlinks for easy access. Users will need to update this section to include any project-specific or state-specific documents they reference in the process of modifying the Project-Level Analysis Template for their project.
- **Appendices.** Details are provided on the documentation of inputs and outputs to include in appendices.

IV. Application of Project-Level Analysis Template to Example Projects

Once the preliminary Project-Level Analysis Template was developed, a set of three example project-level hot-spot analysis reports were prepared. One objective of developing these example reports was to help users of the Project-Level Analysis Template better understand how to tailor the template to the needs of specific projects. The example reports would also help practitioners become more familiar with the new documentation considerations associated with potentially unfamiliar models (MOVES2010, AERMOD, and CAL3QHCR) and EPA’s new quantitative PM and CO hot-spot analysis guidance documents.

Table 3 summarizes the three example projects, including a description of the projects, pollutants and NAAQS evaluated, sources included in the modeling and the models utilized.

**Table 3
Summary of Example Projects**

Name	Description	Scenarios Evaluated	Pollutants and NAAQs Evaluated	Emissions Model(s)	Dispersion Model
Project #1	New ramps to access park-and-ride lot and new roadway for bus stop (with diesel bus idling).	No Build and Build	PM _{2.5} (Annual and 24-hour NAAQS)	MOVES2010a	AERMOD
Project #2	New exit ramp and bus terminal involving construction source and road dust.	No Build and Build	PM _{2.5} (Annual and 24-hour NAAQS) and PM ₁₀ (24-hour NAAQS)	MOVES2010b (On-road sources); AP-42 (Re-entrained road dust); NONROAD Model data	AERMOD
Project #3	Realignment of an existing roadway and conversion of an existing signalized intersection into two separate intersections.	Build	CO (1-hr and 8-hr NAAQS), screening-level	MOVES2010b	CAL3QHC

In order to ensure the availability of data needed for modeling, Projects 1 and 2 were based on the example project from the EPA/FHWA 3-day Quantitative PM Hot-Spot Guidance Training course.^{9, 10} The example project from the EPA/FHWA training included widening of an existing highway, new interchange ramps, bus terminal and park-and-ride lots. To keep the example projects relatively simple, only a limited number of links out of the 75 links in EPA's PM Hot-Spot Training Class Project were used for Projects 1 and 2. These links were selected because they are representative of all road types in the training (including off network) and include different fleet mix options as well as a variety of intersection categories (intersection approach, intersection entrance, intersection queue, intersection departure, highway entrance ramp, highway, bus lane approach, terminal passenger pick up, etc.). Project 1 includes a lane expansion and the addition of an interchange to access park and ride lots. Project 2 includes the bus terminal from EPA's sample project along with the adjacent road network (but not including the road accessing the park and ride lot or the lot itself).

The EPA/FHWA training example project was designed for PM hot-spot analysis and it was concluded it was not illustrative of the types of projects CO screening analyses are typically conducted for. Therefore, Project 3 was based on data from an actual intersection reconstruction project that would be representative of the type of hot-spot analysis that would typically be performed by a state DOT.

⁹ Materials from this course are available at <http://www.epa.gov/otaq/stateresources/transconf/training.htm>

¹⁰ It should be noted that in practice, the No-Build Scenario may not need to be evaluated for a given project analysis, if requirements are met by evaluating the Build Scenario only.

A. Designing Sample Projects

The appropriate design of a hot-spot analysis, starting with the definition of the project itself, may be the most critical aspect of preparing a hot-spot analysis. This involves determining the boundaries of the project for the purposes of the hot-spot analysis, determining which roadways should be included, and dividing the affected roadways into links for modeling. For the purpose of the three example projects, the boundaries of the projects were designed to focus on a specific area of EPA's example project, to capture portions of the project that would change between a build and no-build scenario. In Project 1, the focus was on a section with ramps and additional lanes that would be built. For Project 2, the focus was on the off-network areas (the bus terminal and parking lots), along with the associated access roads. In addition, for this project, a hypothetical neighboring construction area was also included to illustrate the calculation of construction emissions.¹¹ For Project 3, the focus was on a redesigned intersection and the links that would be affected by the change in the design of intersection's signalization.

B. Developing Road Network and Traffic Data

Once the boundaries of the project and the individual links have been selected, each link must be associated with a length, a MOVES roadway type, hourly travel volumes for all hours and seasons to be analyzed, a link grade, and the average speed of vehicles traveling on the link. (If desired and if more detailed data are available, more sophisticated MOVES inputs can be developed to better define the travel operation over the link.) Most of this information should be available from traffic analyses performed for the project area. For Projects 1 and 2, the traffic data were extracted from EPA's example project. For Project 3, traffic data were based on an actual traffic study that included existing traffic counts, projection of traffic growth rates based on a regional travel demand model and intersection capacity analyses.

C. Preparing MOVES Inputs

A number of MOVES input tables were prepared for the three example projects. The data were then input to the MOVES model using the MOVES Project Data Manager. The input tables that were prepared for the MOVES modeling for the three example projects are listed below, along with information on the sources of the data used for the example projects, where applicable:

- Links—peak and off-peak, build and no-build for Projects 1 and 2; only peak, build needed for Project 3 (CO screening analysis). Link-level traffic volumes, link lengths, and average travel speeds by link for Projects 1 and 2 were obtained from the EPA sample project data. For Project 3, the data were obtained from a traffic analysis for the project.
- LinkSourceTypeHour—build and no-build for Projects 1 and 2; only build needed for Project 3. This table contains information on the fraction of travel by MOVES source type (vehicle type) on each link. For all three projects, the fractions by source type were obtained from the EPA sample project data.
- OffNetwork—Needed for Project 2 only (only with off-network sources, e.g., parking lot, bus terminal). This table contains information on the number of vehicles by source type that

¹¹ In actual practice, construction emissions would not be included in PM hot-spot conformity analyses for most projects. Construction emissions are only included where such emissions occur only during the construction phase and last more than five years at any individual site. They were included in this analysis for illustrative purposes.

experience starts or extended idling in an off-network location that is included within the project boundaries, such as a parking lot or bus terminal. The data for Project 2 were obtained from the EPA sample project data.

- OpModeDistribution—Needed for Project 2 only, and only for the off-network link, due to off-network emissions. This table includes the distribution of soak time fractions (i.e., the amount of time a vehicle rests with the engine off before starting again) for off-network links. Again, the data for Project 2 were obtained from the EPA sample project data.
- AVFT (Fuel and Technology Type Distributions in MOVES2010b)— This table includes information on the fraction of vehicles by model year of each fuel type (e.g., gasoline vs. diesel). Data were obtained from the EPA sample project data.
- SourceTypeAgeDistribution—This table includes the distribution of vehicle travel by vehicle age for each MOVES source type and each link.
- FuelSupply—This table supplies a fuel-specific reference for each month and hour being modeled. The fuel-specific reference is cross-referenced with fuel properties in the FuelFormulation table.
- FuelFormulation—This table provides fuel properties, such as Reid vapor pressure, ethanol content, and sulfur content of the fuels being used in the modeled area.
- ZoneMonthHour—This table contains the hourly temperature and humidity for the months being modeled. For CO screening projects, such as example Project 3, this table represents the worst-case meteorology conditions rather than actual conditions.

Note that for the example projects, many of the above tables were readily available from, or easily adapted from, the tables included with EPA's example project, except where otherwise specified. Further information is provided here to describe how these inputs might be developed.

If a project has a focus on a specific vehicle type or vehicle fleet that would be different than the county or nonattainment area as a whole, such as might be the case for a bus terminal, the age distribution and fuel and technology distributions should be developed to match the vehicle fleet expected within the project area.

Projects that are roadway projects only, with no parking lots, terminals, or other sources of off-network emissions, would not require the OffNetwork or OpModeDistribution files. In the case of the example projects, these two tables were needed only for Project 2 since this project included a parking lot.

Once the traffic data has been gathered and the road network divided into links, as described in the previous section, preparing the Links tables is relatively straightforward, as the data needed for this file should be developed from the traffic data. In contrast, the LinkSourceTypeHour tables may be somewhat more difficult to prepare. See EPA's guidance for further details.

To meet the specific needs of PM hot-spot analyses, the meteorological data to be included in the ZoneMonthHour table will be based on the same data set as the representative meteorological data obtained for air quality modeling. See EPA's guidance for further details. In a CO screening analysis, such as was the case for Project 3, this is much simpler in that a worse case meteorological condition should be selected.

D. MOVES Post-Processing

The post-processing of the MOVES output emission factors for use as input to either AERMOD or CAL3QHC was greatly simplified by the use of EPA tools. EPA has provided a spreadsheet that simplifies the process of converting the MOVES emission factors to the units needed, assigning the emission factors developed by link for four hours to an array in the AERMOD format needed for all 24 hours of each season on each link.¹² Similarly, the post-processing of the MOVES emission factors to the format needed for CAL3QHC was simplified using a script provided by EPA to convert MOVES output to the CAL3QHC format.¹³ There were no issues or problems encountered while post-processing the MOVES emissions for any of the three sample projects. The MOVES2010b release incorporated these post-processing scripts into the model to further simplify this step for state and local agencies.

E. Developing Additional Inputs (construction, road dust)

Of the three example projects, only Project 2 included construction emissions and road dust. Calculation of both of these sets of emissions added significant complexity to this project, in comparison with Project 1.

Road dust emissions were calculated using the emission factor equation and adjustments described in EPA's AP-42 document.¹⁴ Additional data needed for the road dust calculations include the road silt loading, the average vehicle weight traveling over the link, and a precipitation adjustment. For a PM hot-spot analysis, the site-specific silt loading data must be consistent with the data used in regional emissions analyses. In areas where anti-skid abrasives are used for removal of frozen precipitation, according to EPA's guidance, the silt loading data should be adjusted to account for the application of antiskid material. The information needed to make this adjustment is available in the AP-42 documentation. Such an adjustment was applied to the silt loading used in Project 2. For the precipitation adjustment, data on the number of days with precipitation greater than 0.01 is needed for the months of interest. This data should be available from the regional analysis of road dust emissions. The average weight can be estimated based on the mix of traffic by vehicle type and an assumption of the average weight of each vehicle type. Once all these data were gathered for Project 2, a spreadsheet was prepared in order to compute the road dust emission rates for each link, hour and month included in this project.

For input to AERMOD, it was necessary to express emissions in a rate of mass per time per area (e.g., grams per second per square meter). The road dust emissions were first calculated on an hourly basis, using the hourly traffic volumes on each link, as used in the MOVES calculations. The emission rates in grams per hour were converted to grams per second by dividing by 3,600 seconds per hour. This was then converted to a rate per area by dividing by the area of the link, calculated as the link length multiplied by the link width.

¹² This file is included in EPA's PM Hot-spot 3-Day Training (<http://www.epa.gov/otaq/stateresources/transconf/training3day.htm>) in the file named PM Hot-spot 3-Day Training Files/AERMOD Files/Class Project/MOVES_to_AERMOD.xlsx.

¹³ This file is included in EPA's PM Hot-spot 3-Day Training (<http://www.epa.gov/otaq/stateresources/transconf/training3day.htm>) in the file named PM Hot-spot 3-Day Training Files/MOVES Files/Post Processing Scripts/CO_CAL3QHC_EmissionFactors.sql.

¹⁴ "Compilation of Air Pollutant Emission Factors: Volume I: Stationary Point and Area Sources," AP-42, Fifth Edition, see chapter 13 for paved and unpaved road dust at: <http://www.epa.gov/ttn/chief/ap42/index.html>

The spreadsheets provided in the Appendix D files for Project 2 show how the paved road dust emissions were calculated and incorporated into the emission rates used as input to AERMOD .

The estimation of construction dust emissions can also be found in the Appendix D files for Project 2. For this example, data from an existing project was used, which included a list of equipment and total emissions. In an actual hot-spot analysis, the interagency consultation process would be used to determine the models, methods, and assumptions used for quantifying construction vehicle emissions. In addition, for the Build Scenario, the on-road emissions from the construction-related on-road vehicles as they traveled over the project links were accounted for by assuming a number of daily trips these various vehicles would make over the project links and applying the MOVES link-specific emission rate for that particular vehicle type. The vehicles for which these additional on-road emissions were estimated are highlighted in the Appendix D equipment listing for Project 2.

F. Dispersion Modeling- Defining Sources

For Projects 1 and 2, a graphical interface software for AERMOD was used. The map of the existing and proposed links for each project was georeferenced. This allowed the links to be digitized directly as AERMOD sources on an aerial base map. The AERMOD interface software implementation of the “polygon source” tool is useful to define curved roadways as a single AERMOD source, rather than as multiple area or volume sources.

For Project 3 (CAL3QHC), roadway links were first defined in GIS software as line features by digitizing over aerial mapping and the project plans. The line features were then converted into the points and the coordinates of each point automatically calculated. The resulting table of links and coordinates was exported to a spreadsheet format and edited to match the “start point x, y” and “end point x, y” format needed for CAL3QHC. Sometimes this requires subdividing MOVES links into multiple CAL3QHC links. A similar GIS-based work flow could be used to define source coordinates for AERMOD if interface software was not available to a particular agency.

G. Dispersion Modeling- Receptors

For project 1 and 2, receptors were initially placed using a Cartesian grid, which was then converted into discrete receptors to allow receptors within the right-of-way and other areas not accessible to the public to be deleted. Removing inappropriate receptors at the start of the process can reduce the total number of receptors needed. The placement of receptors was an iterative process that involved several test runs and viewing of concentration plots to gain an understanding of the areas where the highest concentrations occur.

For Project 3, receptors were manually placed near the intersections and along the approach roadways as point features in GIS software. The coordinates of the points were calculated for input into CAL3QHC. Ensure that the units of input coordinates are in the same units as the CAL3QHC measurement unit selected (feet or meters).

H. Dispersion Modeling- Meteorological Data

For Projects 1 and 2, five years of pre-processed representative meteorological data was obtained from the state air agency. However, the meteorological data had been processed with an outdated version of AERMET, resulting in a fatal error when attempting to use the meteorological data in AERMOD (Message # 395 Met. Data Error; Incompatible Version of AERMET). The AERMET version number can be manually

modified in the met data files and this was the solution selected for this project due to resource limitations.

I. Compiling Background Concentration Data

The first step in determining background concentration is to select a representative monitoring site. The EPA's AirData web site¹⁵ maps the monitor locations for each criteria pollutant which is helpful in this task, as the site allows the analyst to quickly measure distances from the project area to each potential monitor, zoom in to view the land use surrounding each monitor and view the years that data is available at each monitor. Preparing the example project reports demonstrated the tradeoffs that are frequently encountered in selecting a representative monitor site. For example, for Project 1 and 2, the nearest upwind monitor was 24 miles away and would not be representative of the PM background concentrations in the Ann Arbor, Michigan metropolitan area in which the hypothetical project was located. As a result, a downwind monitor 10 miles from the project area and possessing similar land use was selected. For the example project area in Ann Arbor Michigan, the active monitoring network for CO was particularly sparse. The number of judgments involved in selecting a representative monitor emphasizes the importance of 1) documenting the monitor sites considered and the rationale for the selected monitor, and 2) using the interagency consultation process to ensure concurrence on the selected monitor.

J. Calculation of Design Values

The application of EPA's guidance for calculation of design values for the example projects did not result in any issues. The guidance is clearly written and the mechanics of the design value calculation process can be best understood by reading the guidance in conjunction with study of the EPA/FHWA PM hot-spot analysis training slides on this topic (see Module 7 "Calculating Design Values and Determining Conformity" of the training materials). Note that there is no reason to conduct a Tier I design value calculation for the PM2.5 24-hour standard because EPA's PM2.5 24-hour post-processing script greatly simplifies the Tier II design value calculation.¹⁶

V. Future Updates to the Project-Level Analysis Template

A number of changes in regulations, guidance and models affecting hot-spot analyses are anticipated in the near future. These potential future changes include:

- Categorical Findings for CO and PM hot-spot conformity requirements that could greatly reduce the need for emissions and air quality modeling for the projects covered by any such finding under 40 CFR 93..
- Continuous updates and improvements to the MOVES model. MOVES2013 is anticipated to be a major update incorporating new research and emissions standards.¹⁷
- Continuous updates and improvements to AERMOD.

¹⁵ <http://www.epa.gov/airdata/>

¹⁶ This file is included in EPA's PM Hot-spot 3-Day Training (<http://www.epa.gov/otaq/stateresources/transconf/training3day.htm>) in the file named PM Hot-spot 3-Day Training Files/MOVES Files/Post Processing Scripts/24Hr_PM2.5_DV.sql. The directions for using the script are found in the file PM Hot-spot 3-Day Training Files/MOVES Files/Post Processing Scripts/Supplemental text.docx.

¹⁷ <http://www.epa.gov/oar/caaac/mstrs/apr2012/koupal.pdf>

- Roll out of near-road NO₂ monitoring and possible future designation of nonattainment areas for the 1-hr NO₂ standard. This could require new EPA regulations and guidance on transportation conformity hot-spot analysis considerations specific to NO₂.

These changes will facilitate the need for a process to update the Project-Level Analysis Template to prevent it from becoming obsolete over time. As described above, it would be beneficial for EPA and FHWA to review and release updates to the Project-Level Analysis Template in the future as needed to reflect such changes as described above, so that state and local agencies can continue to use the template for official conformity and NEPA purposes. In addition, a collaboration website could be created and hosted by an interested agency or group such as EPA, FHWA, the AASHTO Center for Environmental Excellence or the Transportation Research Board Air Quality Committee (ADC20)¹⁸ to share customized versions of the final Project-Level Analysis Template reviewed by EPA and FHWA. Such a website could include a clearinghouse of examples of implementing the final Template as adapted by different state DOTs, applications of the Project-Level Analysis Template to different projects and to “crowd source” the task of updating various sections of the Project-Level Analysis Template as new models, guidance and regulations are released.

¹⁸ See: <http://www.trbairquality.org/projectpage/>. This report and associated files are planned for addition to the webpage, with updates and examples added over time.