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PROCEEDINGS OF THE PARTICULATE MATTER HOT SPOT ANALYSIS PEER EXCHANGE MEETING

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Particulate Matter (PM) 2.5 and PM10 Hot Spot Analysis:
A Midwest Peer Exchange

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16. Abstract

On October 23-24, subject matter experts on particulate matter (PM) gathered at Allerton Park in Monticello to exchange ideas and experiences in project level hotspot analysis of PM, including monitoring and compliance. The attendees included staff from five Midwestern state Departments of Transportation (DOTs), metropolitan planning organizations, the U.S. EPA, the Illinois EPA, University faculty, and the FHWA. Particulate matter is a generic term for a broad class of chemically and physically diverse substances that exist as discrete particles (liquid droplets or solids) over a wide range of sizes. It is emitted into the air through combustion exhausts or mechanical wear-and-tear from cars and trucks, power plants and factories, and construction sites. A hot-spot analysis is an estimation of likely future localized pollutant concentrations and a comparison of those concentrations to the National Ambient Air Quality Standards (NAAQS) set by the U.S. EPA.. In general, the peer exchange participants are concerned with making sure their new transportation projects in compliance with the recently released U.S. EPA regulations for performing PM hot-spot analyses in non-attainment and maintenance areas for transportation conformity and NEPA reporting purposes. The meeting offered the attendees opportunities to identify hot-spot requirements, discuss PM modeling uncertainties and monitoring of PM, and learn about how other states are documenting the analyses in reports. Outcomes of the meeting included documented challenges in practice, research needs, and practical guidelines which will be useful to all state DOTs. This report includes the proceedings of this meeting.

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The contents of this report reflect the view of the participants of the peer exchange, who is (are) responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Illinois Center for Transportation, the Illinois Department of Transportation, or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

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Executive Summary

On October 23-24, subject matter experts on particulate matter (PM) gathered at Allerton Park in Monticello to exchange ideas and experiences in project level hotspot analysis of PM, including monitoring and compliance. The attendees included staff from five Midwestern state Departments of Transportation (DOTs), metropolitan planning organizations, the U.S. EPA, the Illinois EPA, University faculty, and the FHWA. Particulate matter is a generic term for a broad class of chemically and physically diverse substances that exist as discrete particles (liquid droplets or solids) over a wide range of sizes. It is emitted into the air through combustion exhausts or mechanical wear-and-tear from cars and trucks, power plants and factories, and construction sites. A hot-spot analysis is an estimation of likely future localized pollutant concentrations and a comparison of those concentrations to the National Ambient Air Quality Standards (NAAQS) set by the U.S. EPA. In general, the peer exchange participants are concerned with making sure their new transportation projects in compliance with the recently released U.S. EPA regulations for performing PM hot-spot analyses in non-attainment and maintenance areas for transportation conformity and NEPA reporting purposes. The meeting offered the attendees opportunities to identify hot-spot requirements, discuss PM modeling uncertainties and monitoring of PM, and learn about how other states are documenting the analyses in reports. Outcomes of the meeting included documented challenges in practice, research needs, and practical guidelines which will be useful to all state DOTs. This report includes the proceedings of this meeting.

Proceedings of the
Particulate Matter Hot Spot Analysis Peer Exchange Meeting

October 23-24, 2007
Allerton Park and Retreat Center
Monticello, Illinois

Sponsored by:
Illinois Department of Transportation
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Facilitated by:
University of Illinois at Chicago

Edited and Coordinated by:
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Proceedings of
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April, 2008

Table of Contents

INTRODUCTION

By Jie (Jane) Lin and Walt Zyznieuski

On March 10, 2006, the U.S. Environmental Protection Agency (USEPA) promulgated new regulations in the Federal Register, for performing $PM_{2.5}$ and PM_{10} hot-spot analyses and transportation conformity determinations for transportation projects located in $PM_{2.5}$ and PM_{10} non-attainment and maintenance areas. Under the new guidance, any PM_{10} hot-spot analysis that started prior to the release of the new guidance may be completed with the 2001 guidance; any $PM_{2.5}$ hot-spot analysis that started prior to the new guidance must meet the new guidance (EPA, 2006). More specifically, for $PM_{2.5}$ areas or PM_{10} areas without approved conformity State Implementation Plans (SIPs), this guidance would be used for qualitative $PM_{2.5}$ (or PM_{10}) hot-spot analysis only for "projects of air quality concern", which are specified in the final rule by 40 CFR 93.123(b)(1) as:

> "(i) *New or expanded highway projects that have a significant number of or significant increase in diesel vehicles;*
> (ii) *Projects affecting intersections that are at Level-of-Service D, E, or F with a significant number of diesel vehicles, or those that will change to Level-of-Service D, E, or F because of increased traffic volumes from a significant number of diesel vehicles related to the project;*
> (iii) *New bus and rail terminals and transfer points that have a significant number of diesel vehicles congregating at a single location;*
> *(iv) Expanded bus and rail terminals and transfer points that significantly increase the number of diesel vehicles congregating at a single location; and*
> (v) *Projects in or affecting locations, areas, or categories of sites which are identified in the $PM_{2.5}$ or PM_{10} applicable implementation plan or implementation plan submission, as appropriate, as sites of violation or possible violation.*"

For PM_{10} areas with approved conformity SIPs from previous conformity rulemakings, this guidance will be effective only when a state either withdraws, with EPA's approval, the existing provisions from its approved conformity SIP, or includes the revised PM_{10} hot-spot requirements in a SIP revision approved by EPA.

There are three $PM_{2.5}$ non-attainment areas in Illinois: Cook, DuPage, Kane Lake, McHenry, Will Counties (District 1); Aux Sable and Goose Lake Townships in Grundy County and Oswego Township in Kendall County (District 3); and Madison County, Monroe County, and St.Clair County and Baldwin Township in Randolph County in the Metro East Area (District 8). In addition, there are a few PM_{10} Maintenance Areas in the state that these regulations also cover. The Illinois Department of Transportation is required to undertake PM Hot Spot Conformity determinations for projects that are classified as "projects of air quality concern", as part of their project-level NEPA report.

Given the importance of the issue to the State of Illinois and other states, the Illinois Department of Transportation (IDOT) successfully convened a Particulate Matter Peer Exchange Meeting of five Midwestern states (Illinois, Indiana, Michigan, Ohio, and Wisconsin) on October 23-24, 2007 at Allerton Park, Monticello, Illinois. The meeting was organized by Mr. Walt Zyznieuski of IDOT and facilitated by Dr. Jie (Jane) Lin of the University of Illinois at Chicago (UIC). The Illinois Department of Transportation and the Illinois Center for Transportation (ICT) sponsored the event.

The meeting participants included state DOT staff from six midwestern states (IL, WI, OH, IN, MI, KY), the FHWA's Headquarter Resource Center and three FHWA Division offices (IL, IN, MO), the Chicago Metropolitan Agency for Planning (CMAP), the East-West Gateway Council of Governments, USEPA Region 5 and Illinois EPA, as well as university researchers (Washington University in St. Louis and University of Illinois at Chicago). Invited speakers included staff from FHWA (Kevin Black and Michael Claggett), USEPA (Frank Acevedo and Michael Leslie), Washington University in St Louis (Jay Turner), CMAP (Ross Patronsky), and Kentucky Transportation Cabinet (Jesse Mayes). In addition, Mr. David Lippert, Engineer of Materials and Physical Research at the Illinois Department of Transportation, gave the welcome speech and an overview of the Illinois Center for Transportation (ICT) and supported research.

The meeting topics covered a wide-range of PM-related issues, including regulatory requirements for PM hot spot analyses (Kevin Black), implications of revised National Ambient Air Quality Standards (NAAQS); to designation of nonattainment areas (Michael Leslie); clean diesel programs (Frank Acevedo); modeling and scientific understanding of PM (Michael Claggett and Jay Turner); potential PM health effects (Kevin Black); and innovations and practical experiences in PM analyses (Ross Patronsky and Jesse Mayes). There was excellent dialog during and after all presentations, and separate roundtable discussion sessions initially planned, were integrated with the presentation sessions to accommodate the schedule. The meeting received positive feedback from all participants and was a success.

Finally, we would like to take this opportunity to thank Imad L. Al-Qadi, Director of The Illinois Center for Transportation (ICT), and David Lippert, of IDOT, for their support for the project. We also thank David King of ICT, Patty Broers of IDOT, and Matt Fuller, Jeff Houk and Cecilia Ho of FHWA for their assistance in the success of the meeting.

More information about the PM peer exchange meeting is available on website http://www.uic.edu/depts/cme/conferences/msat/index_pm.html.

QUALITATIVE PROJECT-LEVEL HOTSPOT ANALYSIS IN PM10 AND PM2.5 NONATTAINMENT AND MAINTENANCE AREAS

By Kevin Black, Federal Highway Administration,

Introduction

The topic of the 2007 Midwest Peer Exchange Meeting covered Particulate Matter issues including USEPA's PM Hotspot Rule issued in March of 2006. The initial presentation established the background for PM hotspots and the basis for regulation including transportation conformity and implications for addressing hotspots in NEPA project analysis requirements, projects subject to analysis, roles that agencies play, analysis approaches and some examples. Also included in the introductory remarks was the issue of project level analysis requirements for highway projects in general. Over the past two years, PM2.5 and mobile source air toxics (MSATs) compounds were added to the list of pollutants previously requiring analysis for highway projects including PM10 and CO. The caveat offered in the opening remarks were that the basis used in deciding analysis requirements, criteria used to determine appropriate analysis when deciding about performing analysis, and the analysis method itself varied by the pollutant – PM, CO, or MSATs. This brief digression was inserted to rhetorically ask the question as to whether analysis of impacts resulting from air pollutants emitted by vehicles shouldn't be consistent. Without answering the question, the presentation continued discussing the background of the pollutant noting it is a pollutant defined by its size and mass, not by a particular chemical compound. Of particular interest to the presentation was a description of PM hotspots including the illustration of one as shown in Figure 1.

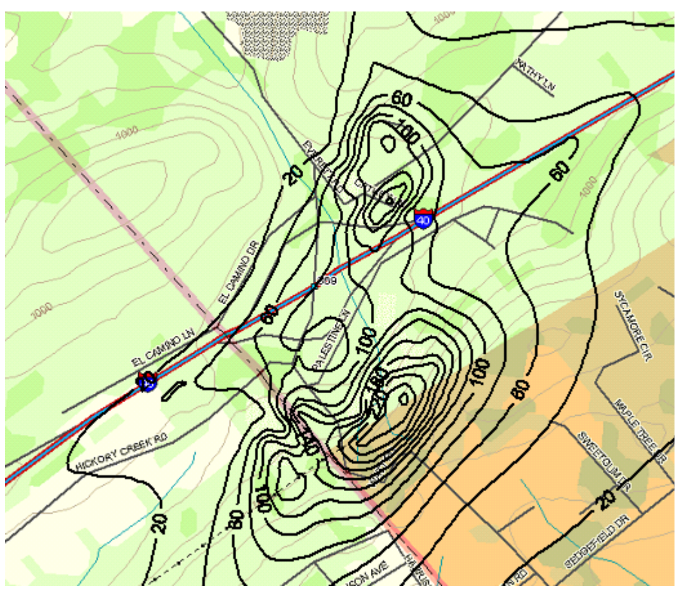


Figure 1. Illustration of Two PM Hotspots.

Basis for Analysis Requirement: Transportation Conformity and NEPA

Analysis for PM hotspots is required due to the conformity rule and NEPA. In March of 2006, USEPA released a new hotspot rule that replaced the earlier PM10 hotspot rule which only covered PM10. The new rule was issued to address the new PM2.5 standard (which did not exist when the PM10 analysis requirement was enacted) and to continue the requirement for

PM10 analysis. As in the case of requirements for PM10, analysis requirements for PM2.5 only pertain to nonattainment areas for PM2.5. Both USEPA and FHWA issued joint guidance to assist areas meet the PM analysis requirements.

Transportation Conformity is the primary driver behind the PM hotspot analysis requirement. Generally, for projects in PM nonattainment or maintenance areas, the project sponsor needs to determine if a project will require an analysis. Projects "exempt" under the transportation conformity rule do not require analysis. Other projects not classified as "exempt" (i.e., those classified as categorical exclusions under NEPA) may also be excluded from analysis requirements and these are discussed in the joint FHWA and USEPA PM Hotspot Analysis Guidance.

Projects requiring analysis are categorized as "project of air quality concern" (POAQC). These projects usually involve either large traffic volumes or significant diesel vehicle traffic. The Guidance lists five categories of POAQC and four of these involve diesel vehicles. Higher levels of diesel truck traffic are considered to be hazardous to health in some studies and thus this is the basis for this criteria. Projects **not** of air quality concern are those with lower diesel truck volumes and those generally considered to reduce emissions such as traffic signal synchronization and public transit projects.

Although POAQC are generally analyzed by the project sponsor, interagency consultation is encouraged to determine both which projects should be analyzed and what form the analysis should take. Figure 2 illustrates the roles that agencies can play in deciding these issues and in the cooperative group process. It should be noted that unlike the regional transportation conformity process required for approving long-range transportation plans and the shorter term transportation improvement plans, hotspot analysis is a requirement of the project sponsor (typically a department of transportation (DOT)) and does not require any action by either the USEPA or MPO. Although no action is required, coordination with other agencies is recommended.

Analytical Requirements

Analysis of PM hotspots impacts is performed using qualitative approaches as outlined in the FHWA and USEPA guidance document "Transportation Conformity Guidance for Qualitative Hot-spot Analyses in PM2.5 and PM10 Nonattainment and Maintenance Areas" issued in March of 2006. Quantitative methods including calculating the mass of emissions (tons/day or tons/year) or concentrations ($\mu g/m^3$) is not required until better modeling tools are available. Only directly emitted PM (emitted from the tailpipe, brakes, or tires – not resulting from chemical reactions in the atmosphere) is considered in qualitative hotspot analyses. PM resulting from temporary conditions such as construction are not required unless the project will be under construction and generate emissions for more than five years.

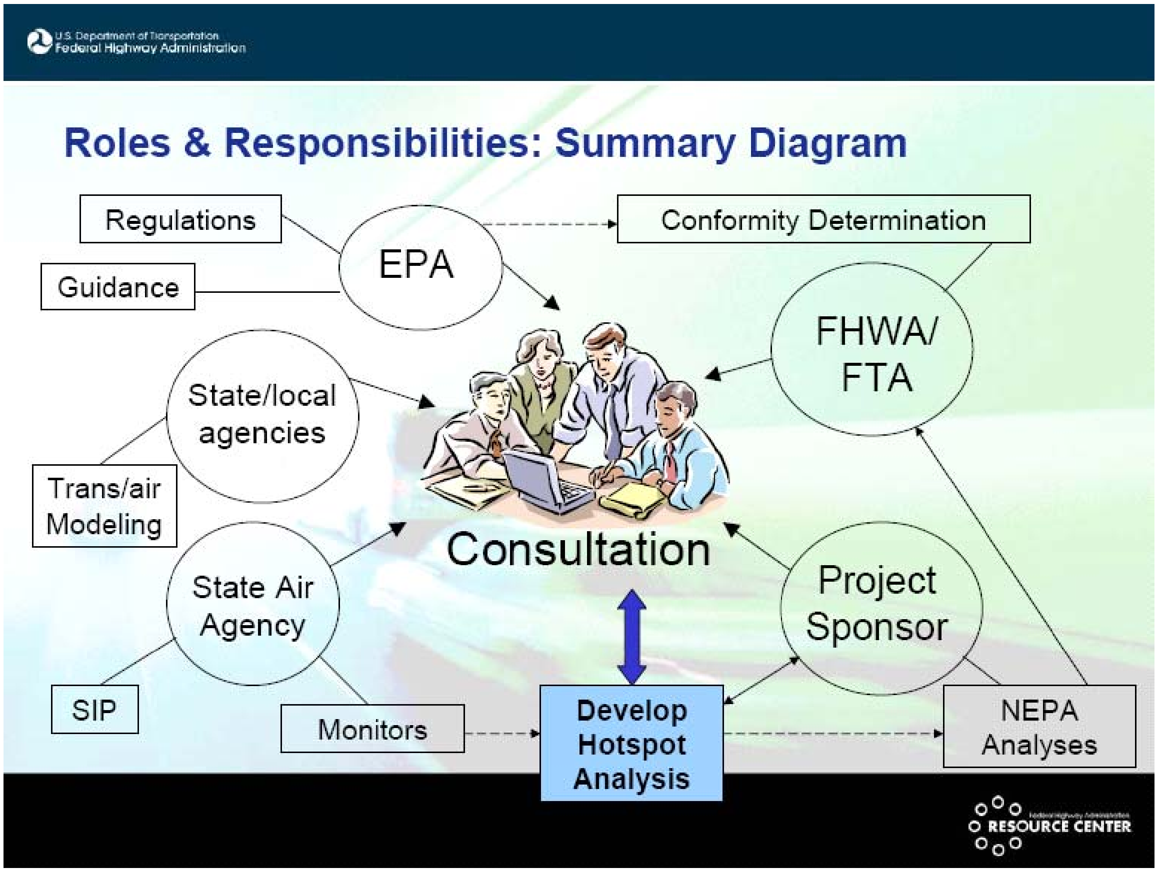


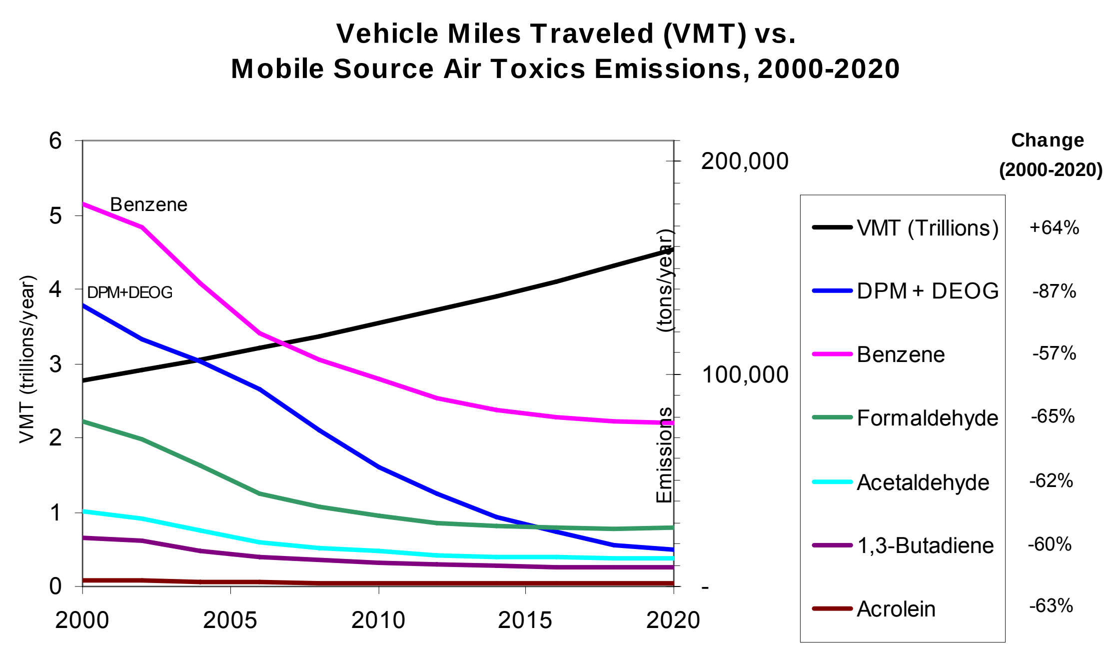
Figure 2. Illustration of the agency roles and interagency consultation process.

The two general approaches used to perform qualitative analysis were discussed including the ***comparative*** approach and an ***air quality study*** approach. **Comparative approaches use existing projects** that are similar to the project (project of air quality concern) being considered. This approach uses "surrogate" projects which are considered one method of estimating the impact that a proposed project of similar scope in a similar area will have on the environment.

The other qualitative approach is the **air quality study approach**. In this qualitative assessment process, an **air quality study that has been conducted can be cited as estimates** of the impact of the proposed study. These studies should provide sufficient information capable of defining the general impacts of the project.

Information that should be contained in both approaches should include **air quality data.** Air quality information should include the information from the local PM monitors near the site or at least for the city of region, transportation and traffic conditions, current and projected **land use** (built and natural environment), **meteorological conditions** and any **local ordinances** (such as anti-idling restrictions, diesel retrofit programs, etc.) that might influence the emissions from a project.

It was noted that due to current USEPA regulations, air quality in the future should be better than current air quality, a trend confirmed and cited by the USEPA in its various rule-makings. Figure 3 illustrates this decline in which diesel particulate matter (DPM) can be seen as a surrogate for PM10 and PM2.5.



Notes: For on-road mobile sources. Emissions factors w ere generated using MOBILE6.2. MTBE proportion of market for oxygenates is held constant, at 50%. Gasoline RVP and oxygenate content are held constant. VMT: *Highway Statistics 2000*, Table VM-2 for 2000, analysis assumes annual grow th rate of 2.5%. "DPM + DEOG" is based on MOBILE6.2-generated factors for elemental carbon, organic carbon and SO4 from diesel-pow ered vehicles, w ith the particle size cutoff set at 10.0 microns. 1 short ton = 907,200,000 mg.

Figure 3. Illustration of decline in trends of mobile source air toxic compounds

Examples

Several examples were presented including one comparative approach, and one air quality study approach. One example using the comparative approach analyzed a highway project providing access for transit buses. It was determined that this would be a “project of air quality concern” since it would involve significant number of diesel buses. A comparison was made with an existing transit bus facility with similar traffic conditions. At this “surrogate” site, the daily PM10 standard was not exceeded but the annual standard was slightly exceeded. The analysis concluded that although the annual standard was slightly exceeded, ordinances enacted such as a “no idling” ordinance, would reduce the emissions significantly enough to prevent any violations at the proposed facility.

In an example using the “air quality study” approach, a new highway interchange was being proposed. When evaluating the project, an air quality study had been performed in the area by the State air agency showed that this location was not likely to have a problem since site specific monitoring data indicated the site was already well below the standards.

The two examples noted above are considered illustrative of the general approaches to PM hotspot analysis. Although many situations will be encountered that may not “fit” easily into either of these qualitative approaches, the Guidance document and assistance from FHWA Offices will be available to meet the needs of project sponsors.

Conclusion

This presentation covered the basic reasons for doing project level analysis. It explained the basis for doing the analysis, the criteria for determining if an analysis is required, and the approaches that can be used to assess the PM impacts of a project. Methods to mitigate potential impacts were also noted as was the guidance document issued jointly by FHWA and

USEPA covering this material. Trend data suggests that PM will decline significantly in the future limiting likely analysis requirements. Other future analysis methods may include quantitative approaches once emission factor and emission dispersion models are available with proven accuracies at the project level, but current requirements are limited to the qualitative methods noted above.

IMPROVING PUBLIC HEALTH - REVISION OF THE PM10 AND PM2.5 STANDARDS

By Kevin Black, Federal Highway Administration

Introduction

The topic of the Midwest Peer Exchange on Particulate Matter highlights the continuing interest in this subject. Particulate matter, or PM, has seen several changes over this current decade including a new standard (PM2.5), a new requirement for PM analysis for highway projects (the PM Hotspot Rule) and most recently, a revision to the standards which are more stringent then the current standard and are likely to result in additional nonattainment areas for PM2.5.

Nonattainment areas are the result of an area's failure to meet air quality standards established by the Clean Air Act (CAA). These standards, in the form of ambient air concentrations, have been established by health studies linking health impacts to concentrations of pollutants in the air. The CAA requires an examination of these standards every five years to see if they are improving both air quality and human health. In December 2006, USEPA revised the PM standard to reflect new health study information. The result of the revision was a significant tightening of the PM2.5 24-hour standard as well as less significant modifications to the PM10 standard. Figure 1 illustrates the old and new standards.

EPA's PM Standards: Old and New

	Previous Standards		2006 Standards	
	Annual	24-hour	Annual	24-hour
$PM_{2.5}$ (Fine Particles)	15 μg/m³ Annual arithmetic mean, averaged over 3 years (established in 1997)	65 μg/m³ 24- hour average, 98th percentile, averaged over 3 years (established in 1997)	15 μg/m³ Annual arithmetic mean, averaged over 3 years	35 μg/m³ 24- hour average, 98th percentile, averaged over 3 years
PM_{10} (Coarse Particles)	50 μg/m³ Annual average (established in 1987)	150 μg/m³ 24-hr average, not to be exceeded more than once per year on average over a three year period (established in 1987)	Revoked	150 μg/m³ 24-hr average, not to be exceeded more than once per year on average over a three year period

Figure 1. Table of old and new PM ambient air quality standards.

Health Study Research and Standards

Health studies are the foundation of the standards and newer health studies conducted since the last PM standards changed in 1997 were the basis of the standards revision. These studies are based on both short term exposure and long term exposures to particulate matter. Short term exposures can be the basis of "acute" health responses such as asthmatic attacks.

Long term exposures can result in “chronic” health problems such as emphysema and lung cancer. Because of these different health responses, short term “exposure” standards are established based on the average 24-hour concentration and long term “exposure” standards are based on the average annual ambient air concentrations.

PM standards, unlike the other **criteria** pollutants, are based on particle size as opposed to the chemical nature of the pollutant since the size determines its impact on a human’s health. The larger particles, which are particles 10 μm in diameter or smaller, and referred to as PM10, are trapped in the upper respiratory system and cause health problems associated with the upper respiratory system. The smaller particles, particles 2.5 μm or smaller, and referred to as PM2.5, penetrate more deeply into the lung and can pass into the circulatory system causing respiratory and cardio-vascular illnesses. During the PM standards revision in 1997, PM2.5 was added as a standard to address health studies conducted in the 1990s. These studies showed health problems created by finer particles which were not trapped in the upper respiratory system but which penetrated deeper into the respiratory system and human organs. This “finer” pollutant was consider more injurious to human health than the “coarser” PM10 particles, and therefore required establishing a newer, “fine” particle standard. The PM2.5 standard was established in 1997 to address the findings of health studies.

Review of standards is required by law, and USEPA must review the National Ambient Air Quality Standards (NAAQS) every five years to determine whether they are adequate to protect human health and the environment. In the most recent review, additional studies conducted over the past decade since the last revision suggested that the two particle size “indicators” defining the PM standard, PM10 and PM2.5 correctly identified the causes of PM induced health impairment, but the health studies also concluded that the current permissible concentrations were insufficient in reducing PM induced illness. Figure 2 illustrates a summary table of the increased risk potential associated with **long term** exposures for the health studies reviewed by USEPA in its efforts to revise the PM standards. The x-axis (top) contains the risk factors and the y-axis lists the individual studies. In this summary table, a “relative” risk of 1.0 would generally support the current standards. As can be seen, most studies have a relative risk in excess of 1.0 and constitute a range between 1.0 and 2.0 indicating that the current standards are probably resulting in excess health impacts. Also important to know is the “error” or uncertainty” range associated with each study. For most studies, the entire “uncertainty range” is to the right of (greater than) 1.0 suggesting that the current standards are insufficient; an uncertainty range centered at 1.0 would suggest that the current standards are reasonable. Thus, EPA concluded that the standards should be changed.

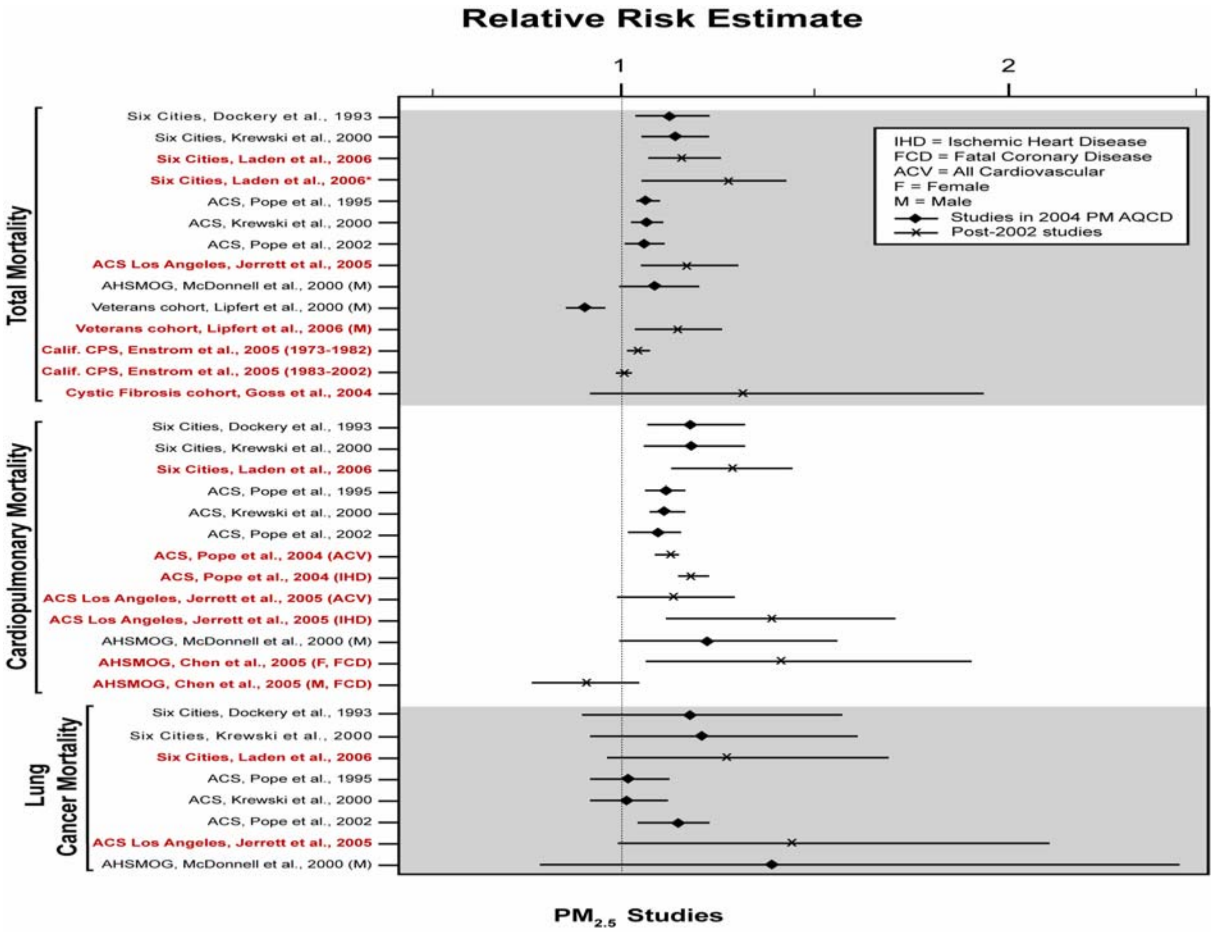


Figure 2. Illustration of Increased risk of illness based on health studies.

To correct this, the PM2.5 24-hour standard was tightened (see Figure 1). Under the old standards, virtually no monitor violated this standard, yet epidemiological and toxicological tests showed positive correlations with illness at lower daily ambient air concentrations. To address this, USEPA reduced the permissible PM2.5 daily concentration to 35 standard µg/m^3 to meet the conclusions of the health studies. The PM2.5 annual standard was not changed although some studies suggested that it too should be tightened. USEPA has been sued for not tightening the annual standard but it is unclear whether this will result in a newly revised PM2.5 annual standard. Since the review process must be reinitiated every five years, it is possible that any revision to the PM2.5 annual standard may not occur until the next PM standards review.

Standards and the Regulations

In the establishment of the PM2.5 standard in 1997, the USEPA was sued by groups questioning its (USEPA) authority in establishing a new standard. It was believed by some that the ability to establish standards was the prerogative of Congress in writing the environmental laws. Congress was the source of previous standards when they were established in the Clean Air Act and its later amendments. On review of USEPA's authority by the District Court and the Supreme Court, USEPA's authority was upheld and the 1997 PM2.5 NAAQS standards were enacted. This then lead to the need to collect 3 years of PM2.5 data and determine the monitors (and therefore areas) failing to meet the standards. This data was collected and areas were designated as non-attainment. Currently, states are in the process for developing State Implementation Plans (SIPs) outlining how they will bring the area into attainment of the standards. Figure 3 illustrates the time tables for complying with the law. It should be noted that these dates were correct for early 2007 however, they may be modified based on other USEPA actions or lawsuits since the September 2006 promulgation of the revised standard.

Milestone	1997 $PM_{2.5}$ Primary NAAQS	2006 $PM_{2.5}$ Primary NAAQS
Promulgation of Standard	July 1997	Sept. 2006
State Recommendations to EPA	Feb. 2004 (based on 2001-2003 monitoring data)	Dec. 2007 (based on 2004-2006 monitoring data)
Final Designations Signature	Dec. 2004	Dec. 2009
Effective Date of Designations	April 2005	April 2010
SIPs Due	April 2008	April 2013
Attainment Date	April 2010 (based on 2007-2009 monitoring data)	April 2015 (based on 2012-2014 monitoring data)
Attainment Date with Extension	Up to April 2015	April 2020

Figure 3. Schedule for implementing and attaining PM2.5 standards.

Conclusion

Health studies are the basis of regulating the air quality throughout the United States. Standards which define the thresholds at which PM air pollution has adverse effects have been modified several times since the standard's initial development in 1970 to address the finding of epidemiological and toxicological studies. Both long term and short term adverse health effects can result from PM exposures and the studies are designed to evaluate exposure impacts and the risks associated with exposure. USEPA's review of health studies establishes the rationale for changes to the standard and provides information needed to develop a schedule for implementing the changes to the standard.

STATE OF THE MODELING SCIENCE

By Michael Claggett, Federal Highway Administration, Resource Center

Introduction

One of the challenges currently faced as part of the transportation planning process is to reliably forecast potential adverse air quality impacts from proposed highway projects for particulate matter (PM). The U.S. Environmental Protection Agency (USEPA) has not recommended a quantitative hot-spot analysis methodology for particulate matter, primarily due to the shortcomings of current regulatory emission factor models. Emission factors from the USEPA's MOBILE6.2 model are typified by high emissions at slow vehicle speeds for all pollutants except for particulate matter. In the more recent EMFAC2007 model, developed by the California Air Resources Board (CARB) and yet to be approved for regulatory applications in that state[1], emission factors for particulate matter do exhibit the more intuitive association of highest emissions with slowest vehicle speeds. So, it follows, a critical factor affecting air quality differences among available highway alternatives is the extent that a project may mitigate traffic congestion. This presentation examines and compares some of the analytical tools for forecasting vehicle speeds, emissions, and concentrations. The model comparisons provide a realistic measure of uncertainty, especially with respect to the future outlook for motor vehicle emissions.

Vehicle Speed Forecasting

The de facto standard for computing travel speeds is the Highway Capacity Manual (HCM). However, the HCM techniques require detailed, facility-specific information that is unlikely to be available at the planning level. In its most recent update in 2000, the Highway Capacity Manual provides recommended procedures for forecasting highway performance measures for area-wide planning applications, including speed estimation. Because of the recognized practical considerations, these procedures are simplifications of the more elaborate techniques provided elsewhere in the HCM. An alternative technique is also provided in the Highway Capacity Manual based on the traditional Bureau of Public Roads (BPR) formula. The USEPA recommends that the BPR formula be applied to forecast vehicle speeds on a regional basis for typical urban areas. A third technique, based on methodology developed by the Texas Transportation Institute (TTI) for the National Highway Institute, is also widely used for sketch-planning purposes. Vehicle speeds were computed as a function of changes in the volume-to-capacity ratio using the three methods for conditions representative of small urbanized area interstates and other principal arterials. Substantially lower speeds are predicted with the TTI method for overcapacity conditions compared to the HCM approach and BPR formula. The speed estimates for highly congested traffic conditions were compared to USEPA's test cycles used for developing speed correction factors in MOBILE6.2.

Current Emission Factor Models

Our reliance on mobile source emissions modeling is growing in an attempt to understand and mitigate potential adverse air quality effects of ever-increasing vehicle travel on the nation's highways. The origin of such modeling is to predict episodic emission events of carbon monoxide and ozone precursors due to motor vehicle activity. The design of the two regulatory mobile source emission factor models used today was predicated on fulfilling this purpose. It is essential that a consensus understanding of on-road motor vehicle emissions be

[1] EMFAC 2007 has now been approved for regulatory applications in California after this peer exchange meeting.

developed. In the present regulatory structure, potential changes in mobile source emissions among transportation alternatives are evaluated using the MOBILE6.2 model for most of the nation or the CARB's EMFAC model in that state. Emission factor predictions obtained from the models are based on empirical measurements, generally conducted in laboratory settings, with numerous adjustments made to account for locale-specific circumstances, including external conditions, vehicle fleet characteristics, vehicle activity, vehicle fuel specifications, and state programs. However, key correction factors are missing from the MOBILE6.2 model for particulate matter and, as a result, the USEPA deems it unsatisfactory for use in quantitative hot-spot analyses for PM. CARB completed an update of their EMFAC model late last year. It is expected that it will be approved by the USEPA for regulatory applications in California, but that hasn't happened yet. Nevertheless, some insights may be gained concerning the evaluation of PM emissions among highway project alternatives by comparing predictions using the nation's two regulatory mobile source emission factor models for a current and future condition.

The USEPA is working on a replacement to the MOBILE6.2 model. Their *Mo*tor *V*ehicle *E*mission *S*imulator (MOVES) is expected to be released in draft form toward the end of 2008. An overview of what's expected from the MOVES model is provided.

Neither MOBILE6.2, EMFAC2007, nor MOVES includes a component for estimating particulate matter due to resuspended road dust. The current regulatory method for estimating such emissions is a procedure developed by the USEPA as distributed in their "Compilation of Air Pollutant Emission Factors", AP-42. The AP-42 procedure is a rudimentary method for emulating a multifaceted process. There are multiple deposition and removal elements simulated by a single, simple equation sensitive only to changes in the road surface silt loading and the average weight of the vehicle fleet traveling the road. The equation has significant limitations, applicable only for freely flowing vehicles, constant speed, no stop and go traffic, and relatively level roads. For limited access roadways with significant traffic volumes (i.e., > 10,000 annual average daily traffic), the baseline annual average PM-2.5 emission factor computed by the equation is zero.

Highway Air Dispersion Models

Highway air quality models have been used for years to fulfill the requirements of the National Environmental Policy Act (NEPA) and transportation conformity regulations. The USEPA's current regulatory models, CALINE3 and CAL3QHC, were developed primarily to predict episodic concentrations of carbon monoxide to determine compliance with the National Ambient Air Quality Standards (NAAQS). Subsequent to the development and validation of these two models more than a decade ago, traffic and mobile source emission factor models have been updated considerably. Alternatives to the CALINE3 and CAL3QHC model are being used to predict short- and long-term concentrations of particulate matter of 10 μm diameter and less (PM-10), PM-2.5, and mobile source air toxic compounds near highways. These models include EPA's ISCST3 model and the California Department of Transportation's CALINE4 model. Each one of the highway air quality models mentioned here are based on Gaussian dispersion theory. The presentation describes and compares the predictions produced by the different highway air quality models. The comparative analysis highlights the similarities and differences among the models.

Concluding Thoughts

There is little consensus among the available analytical tools for predicting vehicle speeds, emissions, and concentrations. Mitigating persistent congestion on highways may reduce PM emissions from motor vehicles on a unit vehicle-mile of travel basis. The degree of mitigation depends on the speed forecasting approach used; the manner in which the speed forecasting approach is applied; and emission correction factors used to account for on-road vehicle use. Different results are obtained with different assumptions.

EMFAC2007 predicts substantially higher PM emission factors compared to MOBILE6.2. PM emission factors from EMFAC2007 vary with speed – with MOBILE6.2 they do not.

An intensive highway air quality modeling study funded by the National Cooperative Highway Research Program (NCHRP) found that CAL3QHC paired with MOBILE5a substantially over-predicts carbon monoxide (CO) concentrations at signalized intersections with considerable vehicle queuing, but substantially under-predicts CO concentrations at signalized intersections with minimal vehicle queuing. MOBILE6.2 predicts substantially higher relevant CO emission factors than either MOBILE4 (used in the development of CAL3QHC) or MOBILE5a (used in the NCHRP study).

Idle emission factors, a critical input parameter for air quality modeling near signalized intersections, are not calculated by the MOBILE6.2 or EMFAC2007 models.

OVERVIEW OF CLEAN DIESEL REQUIREMENTS AND VOLUNTARY PROGRAMS

By Frank Acevedo, U.S. Environmental Protection Agency, Region 5

This presentation focused primarily on an overview of the regulatory requirements of mobile source emissions on diesel engines and strategies of voluntary programs associated with diesel vehicles that are not impacted by the regulations.

In recent years, USEPA has established holistic fuel and emission standards for new diesel engines. The Tier 2 standards adopted in 1999 equalized the light-duty diesel and gasoline vehicles' emission standards starting in 2004. Later in 2000, the Heavy-Duty 2007 Standards (see Table 1) required a 90% reduction of diesel sulfur (maximal 15 ppm sulfur content in diesel fuel) in heavy-duty vehicles (HDVs) beginning in 2006. There are two steps to achieve that goal. That is, ultra low sulfur diesel fuel will be phased in 80% of the entire diesel fuel market between 2006 and 2010; after 2010 ultra low sulfur diesel will be phased in 100%.

Table 1. Heavy-Duty 2007 Standards

	2006	2007	2008	2009	2010	2011	2012
PM		100% at 0.01 g/hp-hr					
NOx		50% at 0.20 g/bhp-hr			100% at 0.20 g/bhp-hr		
Fuel		80% at 15 ppm maximum (under temporary compliance)				100% at 15 ppm maximum	

Figure 1 shows the tightening of on-road heavy-duty emission standards (both PM and NOx) over the years.

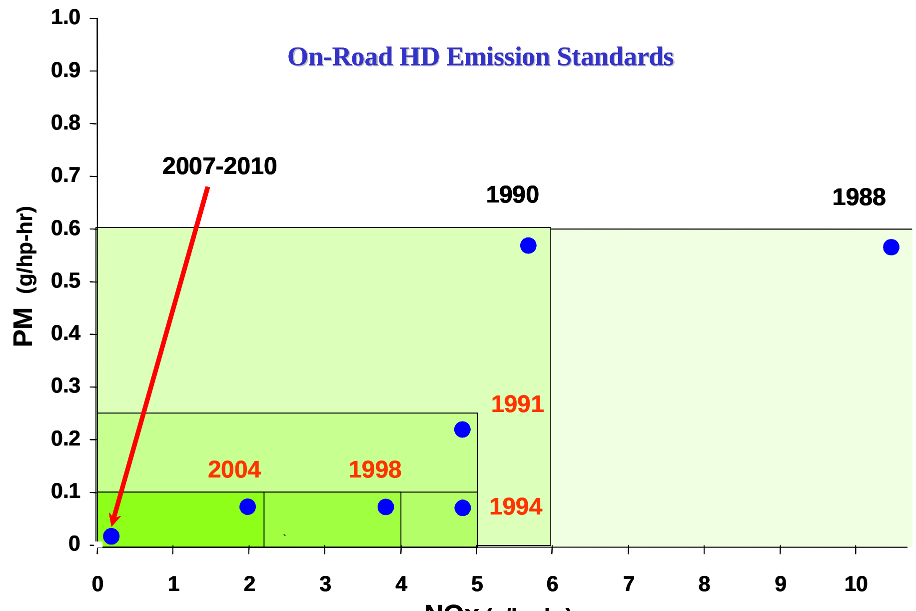


Figure 1. On-road heavy-duty engine emission standards

On the nonroad diesel side, the 2004 Clean Air Nonroad Diesel Rule required a cap of 500 ppm sulfur content in 2007 and 15 ppm in 2010, which is expected to result in 99% reduction from pre-2007 levels (~3,400 ppm). Table 2 lists the time table for the implementation of nonroad programs. There are rulemakings underway for new locomotive and marine vessel diesel engines. The 2004 Clean Air Nonroad Diesel Rule also required that locomotive and marine diesel sulfur be capped at 15ppm in 2012, equivalent to the Tier 3 and 4 Standards for on-road engines. In March 2007, USEPA proposed a three part program that would dramatically reduce emissions from diesel locomotives of all types; line-haul, switch, and passenger rail. The proposal aims to cut PM emissions from these engines by 90 percent and NOx emissions by 80 percent**.**

Table 2. Nonroad program requirements*

Rated Power	**First Year that Standards Apply**	**PM (g/hp-hr)**	**NOx (g/hp-hr)**
hp < 25	2008	0.30	-
25 ≥ hp < 75	2013	0.02	3.5
75 ≥ hp < 175	2012-2014	0.02	0.30
175 ≥ hp < 750	2011 - 2013	0.01	0.30
hp > 750	2011 - 2014	0.01	0.30

*excluding diesel engines used in locomotives and marine vessels

Table 3 summarizes the diesel fuel standards and their implementation timelines for motor vehicles (highway), nonroad engines, locomotives, and marine vessels (MVNRLM).

Table 3. MVNRLM Diesel Fuel Standards

	Engine Type	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
	Highway Diesel	80% 15 ppm / 20% 500 ppm				100% 15 ppm (including small refiner fuel)				
Large Refiner & Importer	Nonroad		500	500	500	15	15	15	15	15
Large Refiner & Importer	Loco and Marine		500	500	500	500	500	15	15	15
	NRLM with Credits (Not in NE or AK)		HS	HS	HS	500	500	500	500	15
Small Refiner	NRLM (Not in NE, w/ approval in AK)		HS	HS	HS	500	500	500	500	15
Transmix Processor & In-use	Nonroad (Not in NE or AK)		HS	HS	HS	500	500	500	500	15
Transmix Processor & In-use	Loco and Marine (Not in NE or AK)		HS	HS	HS	500	500	500	500	500

MV diesel fuel dates for 2006: *June 1 for refiners/importers, September 1 for downstream parties except retailers & WPCs, October 15 for retailers &* wholesale purchaser-consumers *(WPCs)*

MV diesel fuel dates for 2010: *June 1 for refiners/importers, October 1 for downstream parties except retailers & WPCs, December 1 for retailers & WPCs*

NRLM diesel fuel dates: *June 1 for refiners/importers, August 1 for all downstream parties other than retailers & WPCs, October 1, 2010 for retailers & WPCs, December 1 for all*

locations/in-use

In addition to regulatory requirements on new diesel engines, there are ongoing efforts by EPA, thought the National Clean Diesel Campaign and the Midwest Clean Diesel Initiative, to reduce emissions from the legacy (in-use) fleet, which consists of about 11 million vehicles currently in operation that are not impacted by the aforementioned regulatory rules, by 2014. These are voluntary programs primarily focusing on voluntary diesel retrofit and SmartWay Transport Partnership, a voluntary partnership between USEPA and the freight industry to reduce both fuel consumption and mobile source emissions.

The Voluntary Diesel Retrofit Program involves projects to (1) retrofit – installation of exhaust aftertreatment devices (e.g., diesel oxidation catalyst, diesel particulate filters, etc.), (2) refuel – use of cleaner diesel fuels, (3) repair/rebuild – regular engine maintenance, (4) repower – replacing older engines with newer ones, (5) replace – replacing the entire equipment, and (6) utilize various strategies to reduce idling. The Midwest Clean Diesel Initiative is one such example.

SmartWay Transport Partnership is a voluntary partnership developed jointly by USEPA and 15 Charter partners. Trucking companies represented include: Schneider, Swift, Yellow Roadway, UPS, Fedex. Freight shippers included: Coca Cola, Home Depot, and IKEA. CSX represented the railroad industry. The Partnership works with carriers, shippers and logistics companies. Carriers join the partnership and agree to work toward improved fuel efficiency and reduced emissions over a 3 year period. Shippers enter the Partnership toward shipping more of their product with SmartWay Carrier Partners and improving their operations over a 3 year period. This in turn provides incentives for carriers to join the partnership. For freight logistics companies, they join the Partnership and agree to work toward shipping more freight with SmartWay Carrier Partners, as well as bringing more of their contracted carriers into the Partnership.

Finally, there are available technologies to improve diesel engine performance and reduce diesel emissions. Their costs and benefits are summarized in Table 4.

Table 4. Technologies to Affect Diesel Engines

Technology	Description	Cost	Benefits[1]
Idle Reduction Device- **Bunk Heater**	 Small, lightweight, diesel fuel-fired device mounted in the cab that provides heat for cab comfort. Does not include any air conditioning capabilities.	Approx. $1,000	Approx. 6% fuel savings assuming 1,200 hours idling per year. Additional reduction in engine wear and tear.
Idle Reduction Device- **Auxiliary Power Unit**	 Small diesel powered generator mounted outside the cab that provides heat, air conditioning, and electrical power to run appliances.	Approx. $6,000 to $8,000	Approx. 10% fuel savings assuming 2,400 hours idling per year. Additional reduction in engine wear and tear
Fuel Saving Device- **Single-wide Tires**	 Traditional tires are replaced with one single-wide tire and aluminum wheel. Can be applied to all tractor and trailer tire positions except for the steer tires	Approx. $3,000 to $4,000	Approx. 4-10% fuel savings.
Fuel Saving Device- **Trailer Aerodynamics**	 Fairings added to the front, underside, and rear of the trailer to reduce drag.	Approx. $3,200	Approx. 5-7% fuel savings.
Fuel Saving Device- **Advanced Truck Stop Electrification (ATSE)**	 HVAC is provided by equipment in the truck stop, eliminating the need for idling. ATSE systems also provide phone, internet, and TV services in addition to heating and air.	Approx. $16,000 per space	1 gallon of diesel fuel is saved for every 75 minutes spent at an ATSE-equipped truck stop.

[1]All savings assume a Class 8B tractor trailer traveling approximately 100,000 miles per year

AMBIENT PARTICULATE MATTER RESEARCH - SELECTED TOPICS

By Jay Turner, University of Washington, St. Louis[2]

This presentation presented a synopsis of current ambient PM research, especially concentrating on particle dynamics and behavior on the micro- (~10 m) and middle- (~0.1 – 1km) scales of emission source influence (i.e., directly related to hot spot issues), as well as discussing the mobile source contributions to ambient $PM_{2.5}$ burdens. The presentation focused on both particle number and mass concentrations.

[The following is a synopsis of the presentation. For more detailed information please refer to Dr. Turner's presentation slides in Appendix A.5]

(1) Evolution of Particle Number Distributions Near Roadways

Particle number distribution evolves as particles are emitted from the tailpipe (~2-3 m), mixed in the plume (~50-100 m), and eventually dispersed into the ambient air (>100m). The zone of influence is typically about 100 meters from the source (tailpipe). There are complex, dynamical processes that can alter PM physical and chemical properties, especially within the first 90 meters from the roadway. In particular, high concentrations of particles smaller than 6 nm are emitted from the roadways and subsequently grow to about 10 nm within 30 – 90 meters downwind. Subsequently, some of these particles shrink or completely evaporate while other particles continue to grow into the accumulation mode.

Strong seasonal effects are present with winters exhibiting more dynamic processing of the exhaust aerosol than summers. There is also clear time of day (daytime versus nighttime) effect on downwind particle number gradients when daytime mixing height can be 10 times higher than that of nighttime and therefore downwind number concentrations drop much more quickly to the upwind background level after 200 meters from the roadway.

Steep gradients are also observed for CO, elemental carbon (EC) and ultrafine particle number distributions within the first 100 m when heavy-duty diesel vehicle (HDDV) fraction on the roadway is high.

(2) PM Mass Gradient Near Roadways

Studies have shown that sometimes the PM2.5 and PM10 mass increments (roadway contributions) decay to upwind values within 100 m and other times they persist over larger distances. Coarse PM contributions are likely to be quite variable and local silt loading data (spatially and temporally resolved) would be helpful in providing insight to such variability. Near roadway gradients studies would also greatly benefit from more detailed traffic characteristic data.

Studies have shown elevated black carbon (BC) mass concentrations in urban areas as compared to suburban and rural, suggesting an influence from mobile sources.

In addition, it is worth noting that it has been found that CALINE4 model estimates of PM2.5 and PM10 mass concentrations are systematically low at near roadway locations and high farther away, when compared with the field measurement data. On the other hand, MOBILE6 PM2.5 and PM10 emission factors agree well in general with the values derived from air pollution field measurements.

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[2] This section was summarized from a transcript of Dr. Turner's presentation at the Particulate Matter Hot Spot Analysis Peer Exchange meeting. The proceedings editors take responsibility for the interpretation of the transcript.

(3) PM2.5 Source Apportionment

There are available tools to assign emission source contributions to measured PM2.5 mass: (1) basic data analysis as the important first step and should be carried through the entire analysis effort; (2) Chemical Transport Modeling (CTM), such as CMAQ and CAMx, which requires detailed emissions and meteorology data; and (3) receptor modeling, including Chemical Mass Balance (CMB) which requires emission inventories and source profiles, and APCA, UNMIX and Positive Matrix Factorization (PMF) which requires large ambient monitoring data sets for PM composition.

With the observational data at various sites in St. Louis as an example and innovative data analysis techniques, it was demonstrated in this presentation the PM emission composition and source contributions at those sites. In particular, the intraurban variability in PM2.5 and its source apportionment were investigated and presented. The monitoring sites were selected as follows. Two sites were selected in St. Louis, one in downtown St. Louis near the city center (on the Missouri side) and the other in a Supersite about 400 meters upwind of a major intersate in East St. Louis. They were 10 kilometers apart. A third monitoring site 100 kilometers upwind[3] of St. Louis was selected to draw rural and upwind contrasts from the two St. Louis site.

With regard to intraurban variability in PM2.5, the two urban sites in St. Louis showed different Organic carbon (OC) and nitrate compositions. The St. Louis city center had a higher percentage of nitrate and a lower percentage of OC than the Supersite in East St. Louis. The following factors are thought to typically contribute to the spatial variability within urban areas:

- Local sources of primary PM (or fast-reacting precursors)
- Topographic barriers separating sites
- Transient emissions events
- Meteorological phenomena
- Differences in the behavior of semi-volatile components
- Measurement error

Furthermore, it was found in East St. Louis:

- OC, sulfate, and nitrate are the top three species in PM2.5 mass
- Insignificant local contribution to sulfate and no clear day of week trends in sulfate concentration levels, indicating sulfate are mostly from regional transport
- On the other hand, nitrate showed large variation across sites and significant day of week trends, indicating urban scale contributions, probability from motor vehicle emissions, to nitrate
- For OC, urban is higher than the rural on a daily basis. Moreover, roughly half of the total carbon (EC plus blank-corrected OC) is from urban contributions and the other half is from regional transport

PM2.5 mass apportionment of East St. Louis sites found that roughly 70% of PM was transported to St. Louis from other areas; mobile sources accounted for about 10% and soil/resuspended road dust accounted for another 6% or so; and the rest was from industrial sources. Moreover, in OC source apportionment, the top two source categories were resuspended soil (21.8%) and mobile sources (20.7%), which translated to the mobile source contributions to PM2.5 mass in roughly the same range as that directly derived from the PM2.5 mass apportionment for mobile sources. Compared to the majority of the metro areas, St. Louis sites have relatively low mobile source impacts and relatively high point source impacts. This may have been due to monitoring location (e.g., low annual average daily traffic on the nearby roadways) and meteorological conditions (e.g., upwind of roadway). The locations were chosen

[3] Predominant wind direction is from south

purposefully for testing specific hypotheses other than transportation effects. Thus, caution must be taken in extrapolating results to other settings, even within the St. Louis metropolitan area.

In summary, receptor modeling is a useful tool to determine mobile source contributions to ambient PM burdens. Results have shown consistent mobile source contributions for St. Louis. On the other hand, there are challenges with the interpretation of some factors. In particular, three issues have been raised in past studies, as summarized in the following:

(i) Diesel factor conundrum:
In the East St Louis source apportionment, diesel factor has higher OC loading than EC, which does not resemble "typical" diesel emissions, which are commonly believed to have higher EC. However, recent emission testing data suggests higher OC than EC for idling and low load operating conditions. More research is needed.

(ii) What fraction of the soil factor is from resuspended road dust?
The role of resuspended road dust may have been downplayed in its contribution to ambient PM2.5. The common wisdom is that resuspended soil is not an issue to PM2.5 because it is mostly coarse particles. On the other hand, soil has organic compounds, which may have non negligible contributions to OC in PM2.5.

(iii) And lastly, a larger database of source profiles for motor vehicle emissions and fugitive road dust is in need to support future research.

PARTICULATE MATTER RESEARCH - SELECTED DATA ANALYSES

By Jay Turner, University of Washington, St. Louis[4]

The implications of current PM research (presented in the previous presentation by Dr. Turner) to PM hot spot analysis are two-fold: for annual PM standards, a regional baseline can be defined relatively easily for each city and even for a specific site with some additional effort, however, for the 24-hour standards, more effort is needed in defining a baseline. That may involve high time resolution (e.g., hourly or less) measurements and analyses, which are not usually seen or used in routine monitoring data and past ambient air quality studies. Therefore, this presentation presented two examples of either using high time resolution measurements to identify contributions from proximate sources or using sensible measurement design coupled with innovative statistical analysis tools to identify drivers for daily contribution differences between proximate monitoring sites.

Example One: Deconvoluting Black Carbon Time Series in East St. Louis

This example demonstrated the "hidden" information in the high time resolution BC data that is otherwise not seen in daily average data.

Using an Aethalometer high quality 5-minute BC observations were obtained at a St. Louis site about 400 meters away from an interstate highway and about 150 meters away from coal train rail line. As an illustrative example, one week of hourly average BC time series data between June 22nd and 29th, 2001 were plotted (Figure 1). While the daily average BC showed little variation, the hourly BC displayed high variability, with large spikes during the morning rush hours consistently every day of the study week. In contrast, evening rush hours did not exhibit high BC. Those phenomena could be explained by higher mixing height during the afternoon hours than that in the morning.

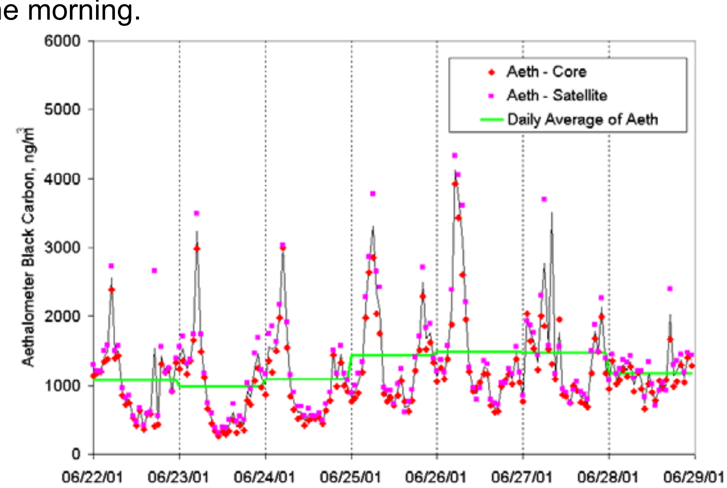

Figure 1. One week hourly-average PM2.5 black carbon in East St. Louis.

Furthermore, the time series was decomposed into a low frequency signal and a high frequency signal (see Figure 2). The low frequency signal represented the baseline – urban/regional sources – that is the same from site to site. The high frequency signal was attributed to local sources that would vary from site to site, referred to as the "middle scale". It

[4] This section was summarized from a transcript of Dr. Turner's presentation at the Particulate Matter Hot Spot Analysis Peer Exchange meeting. The proceedings editors take responsibility for the interpretation of the transcript.

was found that the baseline signal had mid-day and afternoon minimum consistent with atmospheric ventilation (growing mixing layer depth). The middle-scale signal climbed to the peak in the morning rush hours and then remained relatively high throughout the day, indicating short transport time relative to changes in mixing height. The middle scale component contributed roughly 15% of total BC.

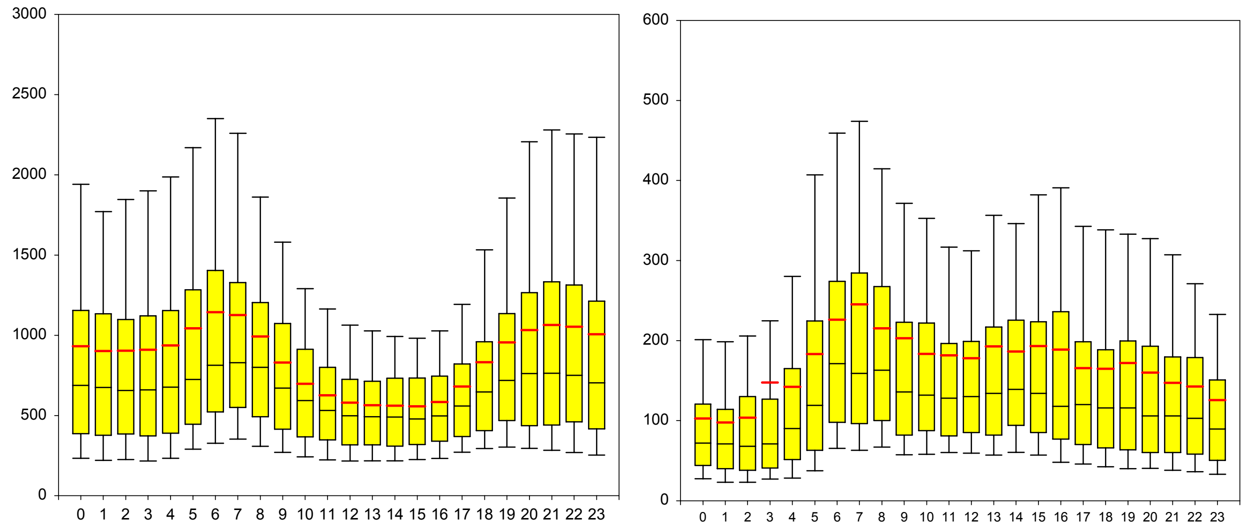

Figure 2. Baseline (low frequency, left) and middle scale (high frequency, right) components of BC.

There is more that can be done with the data. For example, using sophisticated spatial regression techniques (e.g., two-dimensional nonparametric wind regression), it was possible to identify the local prominent sources for BC in East St Louis.

Example Two: Speciation of Major Chemical Components of PM2.5 in Cleveland

This example demonstrated innovative analyses that capitalize on routine measurement data (i.e., for compliance monitoring purposes) by choosing sensible measurement sites coupled with innovative statistical analysis tools.

By comparing three-year average speciation data from a far suburban site (35 km from downtown Cleveland) and two closely situated urban sites (1.7 km apart) in downtown Cleveland, it was found that the urban sites had significantly higher loadings of sulfate, nitrate, OC and EC, not surprisingly. At the same time, the two urban sites showed good agreements in most of the species except EC. That difference in EC could signal impacts of local transportation sources. More importantly, were the good agreements in other species truly due to no difference between the two sites or simply due to cancellation of positive and negative effects after averaging the data?

By scaling the *observed d*aily concentration differences to the *expected* difference from the precision estimate, it was found that day-to-day differences in OC could be explained by measurement error and that was not the case for sulfate (see Figure 3).

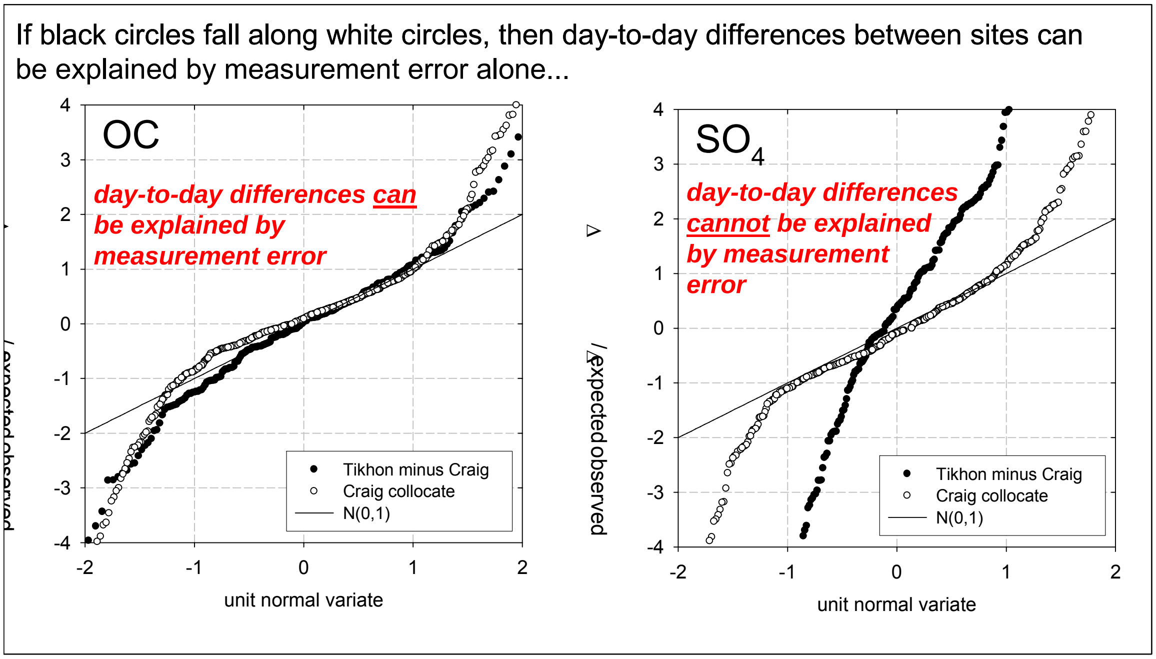

Figure 3. Intersite comparisons between the two urban sites in Cleveland for OC and sulfate.

Again, by using sophisticated spatial regression techniques (e.g., one-dimensional nonparametric wind regression), it was possible to identify the local prominent sources for sulfate in Cleveland.

In summary, high time resolution particle concentration data can be used to identify contributions from local (micro- and middle-scale sources):

- Black carbon micro- and middle-scale sources at East St. Louis likely dominated by motor vehicles and trains
- Together with local surface winds data, potential emission source regions can be identified

There are also opportunities to extract more information about emissions sources from the routine monitoring data, for example,

- Examine spatial gradients in PM mass and components
- Consider concentration differences in light of measurement precision
- Observed cases, such as sulfate, where there was no average concentration difference between site but daily differences were real, and could identify the likely source location

HOT SPOT ANALYSES IN NORTHEASTERN ILLINOIS

By Ross Patronsky, Chicago Metropolitan Agency for Planning

As a metropolitan planning organization, the Chicago Metropolitan Agency for Planning (CMAP) does not conduct PM hot spot analyses per se. Rather, it facilitates the process. It has participated in eight hot spot analyses since the requirement went into effect. At least seven other projects were reviewed by IDOT and FHWA and found not to be of air quality concern. All of the projects were state highway projects. Most of them were on existing facilities.

In facilitating the process, CMAP helps to identify which projects, among 2000 or so projects in Transportation Improvement Programs (TIP), are of potential air quality concern. Each project in the TIP is assigned one or more “work types” (see Table 1 for examples). Projects of various work types have been classified through the consultation process as of potential air quality concern or not. As a result, about 700 projects are identified as possible air quality concern.

Table 1. Example TIP Work Types

Chicago Area Transportation Study

TIP Work Types - Codes and Definitions

Type Code	Definition	Program Group	Exempt Status	Hot Spot Candidate Type	# in TIP
A-BAR	SAFETY - BARRIERS	SAFETY PROJECTS	EXEMPT	No Concern	0
A-BEA	SAFETY - BEACONS	SAFETY PROJECTS	EXEMPT	No Concern	0
A-FNC	SAFETY - FENCING	SAFETY PROJECTS	EXEMPT	No Concern	1
A-GRD	SAFETY - GUARDRAILS	SAFETY PROJECTS	EXEMPT	No Concern	1
A-LTS	SAFETY - LIGHTING	SAFETY PROJECTS	EXEMPT	No Concern	27
A-MED	SAFETY - MEDIAN PROJECTS	SAFETY PROJECTS	EXEMPT	No Concern	1
A-OPT	SAFETY - OPTICOM EQUIPMENT	SAFETY PROJECTS	EXEMPT	No Concern	1
A-PMRK	SAFETY - PAVEMENT MARKING	SAFETY PROJECTS	EXEMPT	No Concern	1
A-RRXING	SAFETY - RAILROAD CROSSING IMPROVEMENTS	SAFETY PROJECTS	EXEMPT	No Concern	31
A-SHDR	SAFETY - SHOULDER IMPROVEMENTS	SAFETY PROJECTS	EXEMPT	No Concern	1
A-SKIDT	SAFETY - SKID TREATMENTS	SAFETY PROJECTS	EXEMPT	No Concern	0
B-NEW	BRIDGE/STRUCTURE - NEW	No Group - Non-Exempt	NOT EXEMPT	New or Expanded Highway	34
B-PNT	BRIDGE/STRUCTURE - PAINT	BRIDGE PROJECTS (EXCEPT TRANSIT)	EXEMPT	No Concern	11
B-RECNFG	BRIDGE/STRUCTURE - RECONST/REHAB CHNG IN LANE USE/WIDTHS	BRIDGE PROJECTS (EXCEPT TRANSIT)	EXEMPT	New or Expanded Highway	25
B-REPAIR	BRIDGE/STRUCTURE - RECONST/REHAB NO CHNG IN #, WDTH, OR LANE	BRIDGE PROJECTS (EXCEPT TRANSIT)	EXEMPT	No Concern	124
B-REPLACE	BRIDGE/STRUCTURE - REPLACE	BRIDGE PROJECTS (EXCEPT TRANSIT)	EXEMPT	No Concern	23
C-IMP	STATION - IMPROVE WITH CHANGE IN SERVICE	STATIONS - MAINTAIN/REHAB COMMUTER/RAPID TRANSIT	EXEMPT	Expanded Bus or Rail	1
C-MAINT	RAIL STATIONS - MAINTAIN, REHABILITATE, REPLACE	STATIONS - MAINTAIN/REHAB COMMUTER/RAPID TRANSIT	EXEMPT	No Concern	32
C-NEW	STATION - NEW	No Group - Non-Exempt	NOT EXEMPT	New Bus or Rail Terminal	9
C-RELOC	STATION - RELOCATE	STATIONS - MAINTAIN/REHAB COMMUTER/RAPID TRANSIT	EXEMPT	Expanded Bus or Rail	0

The process could be refined. For example, certain CMAQ (Congestion Mitigation and Air Quality) projects, primarily intersection improvement projects, have been identified as of potential air quality concern even though they have been shown to have air quality benefits through the CMAQ evaluation process. CMAP currently does not have clear next steps for determining which projects should be evaluated; this is a task for future consultation.

After the projects of potential air quality concern were identified, CMAP generated and distributed the lists to project sponsors and implementers. The lists contained the project TIP ID, description, work type information and classification of potential hot spot concern. Table 2 is a sample listing distributed to an implementer. There has been minimal response from the implementers upon finding that some of their projects may require a hot spot analysis.

Table 2. Sample Implementer Listing

TIP ID	Description	Work Type Information		Hot Spot Concern
IDOT-DOH DISTRICT 3				
09-00-0043	US 34 AT IL 47 BRIDGE ST (KENDALL/YORKVILLE)	H-INTIMP	HIGHWAY/ROAD - INTERSECTION IMPROVEMENT	Intersection LOS D E or F
09-02-0001	IL 71 FROM ORCHARD RD (CO HWY 9A) (KENDALL/OSWEGO) TO US 34 CHICAGO RD/WOLF'S CROSSING (KENDALL/OSWEGO)	H-AL	HIGHWAY/ROAD - ADD LANES	New or Expanded Highway
09-02-9033	PRAIRIE PARKWAY FROM I- 88 (KANE/KANEVILLE TWP) TO I- 80 (GRUNDY/AUX SABLE TWP)	H-COR	HIGHWAY/ROAD - CORRIDOR IMPROVEMENT	New or Expanded Highway
		H-NEW	HIGHWAY/ROAD - NEW ROAD	New or Expanded Highway
09-05-0008	IL 71 AT IL 126 (KENDALL/YORKVILLE)	H-INTIMP	HIGHWAY/ROAD - INTERSECTION IMPROVEMENT	Intersection LOS D E or F
09-94-0036	IL 47 BRIDGE STREET FROM US 34 (KENDALL/YORKVILLE) TO IL 71 (KENDALL/YORKVILLE)	H-AL	HIGHWAY/ROAD - ADD LANES	New or Expanded Highway
		H-RCNST	HIGHWAY/ROAD - RECONST WITH CHANGE IN USE OR WIDTH OF LANE	New or Expanded Highway
		H-WRS	HIGHWAY/ROAD - WIDEN LANES AND RESURFACE	New or Expanded Highway
09-94-0037	IL 31 FROM KANE CO LINE (KENDALL/OSWEGO) TO US 34 WASHINGTON ST (KENDALL/OSWEGO)	H-AL	HIGHWAY/ROAD - ADD LANES	New or Expanded Highway
		H-INTIMP	HIGHWAY/ROAD - INTERSECTION IMPROVEMENT	Intersection LOS D E or F
		H-RCNST	HIGHWAY/ROAD - RECONST WITH CHANGE IN USE OR WIDTH OF LANE	New or Expanded Highway
09-96-0011	US 34 FROM IL 47 (KENDALL/BRISTOL TWP) TO IL 31 (KENDALL/OSWEGO)	H-AL	HIGHWAY/ROAD - ADD LANES	New or Expanded Highway
		H-CLTL	HIGHWAY/ROAD - CONTINUOUS BI-DIRECTIONAL TURN LANES	New or Expanded Highway
12-04-0015	BRISBIN RD AT I- 80 (GRUNDY/MORRIS) APPROX 3 MILES EAST OF MORRIS	I-NEW	INTERCHANGE - NEW	New or Expanded Highway

CMAP has also developed a process to estimate PM2.5 emissions generated by a project (not for hot spot analysis purposes). Emissions are estimated by multiplying a project's expected VMT (truck and total) by emission rates CMAP developed for conformity analyses. Use of the project's expected volume of truck traffic yields an emissions estimate that is specific to the project. Emissions are calculated for the year the project opens for service and for subsequent conformity analysis years through 2030. If the calculation shows the emissions fall over time and data from adjacent monitors identified by Illinois EPA indicate no violations in the base year, it can then be concluded that no violations should occur in the future. Table 3 illustrates evaluation results. CMAP documents the procedure and analysis results in a memo to the project implementer.

There are several issues associated with the evaluation procedure worth mentioning. This method could theoretically miss the peak year for emissions, although there is no evidence that this has occurred for the projects evaluated to date. However, in the case of new highway facilities, VMT may increase enough over time that emissions could increase in future years. Therefore, a comparative approach between facilities is used for new highway facilities projects. Lastly, methods must be worked out to incorporate transit facilities into the current evaluation procedure.

Table 3. Sample Evaluation Analysis Results

Hot Spot Analysis Summary Results

I- 90 94 DAN RYAN EWY FROM 15TH ST (COOK/CHICAGO) TO I- 57 (COOK/CHICAGO) - TIP ID 01-00-0024

Total Emissions

	Annual Fine Particulate Matter		
Year	**VMT**	**Global Rate (gm/mi)**	**Tons**
2002	732,666,452	0.0474608	**38.330**
2010	738,982,485	0.0360964	**29.403**
2020	748,875,566	0.0175055	**14.451**
2030	754,772,826	0.0154200	**12.829**

Notes

2002 Annual VMT is Daily VMT times 350.838, the ratio of annual to daily VMT for 2010 and 2030

2002 Global emissions rate is from PM2.5 conformity analysis

2002 emissions are Global Rate times applicable VMT

POTENTIAL NEW NONATTAINMENT AREAS UNDER THE REVISED NAAQS

By Michael Leslie, U.S. Environmental Protection Agency, Region 5

Current USEPA's designation of PM2.5 nonattainment areas, as shown in Figure 1, is based on the 1997 standards. Factors affecting the designations are:

- Emissions in areas potentially included versus excluded from the nonattainment area
- Air quality in potentially included versus excluded areas
- Population density and degree of urbanization including commercial development in
- included versus excluded areas
- Traffic and commuting patterns
- Expected growth (including extent, pattern and rate of growth)
- Meteorology (weather/transport patterns)
- Geography/topography (mountain ranges or other air basin boundaries)
- Jurisdictional boundaries (e.g., counties, air districts, Reservations, etc.)
- Level of control of emission sources

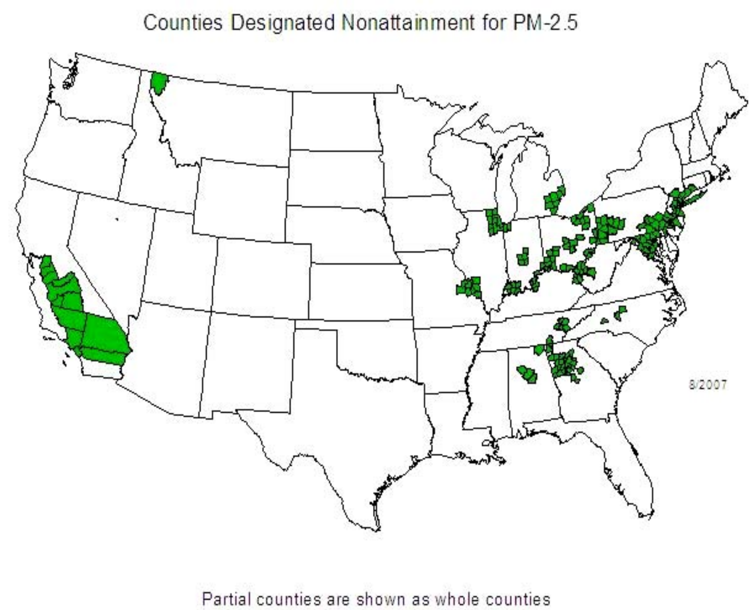

Figure 1. Counties designated nonattainment for $PM_{2.5}$ (annual standards).

USEPA's revised (2006) PM standards, compared to the 1997 ones, have a more stringent 24-hour $PM_{2.5}$ standard (reduced to 35 $\mu g/m^3$ from 65 $\mu g/m^3$) and have revoked the PM_{10} annual standard (see Table 1). Under the revised PM standards, there are an increasing number of counties exceeding the $PM_{2.5}$ standards, for example, based on the 2003-2005 monitoring data, as shown in Figure 2.

Table 1. EPA's PM Standards: Old (1997) and New (2006)

	1997 Standards		2006 Standards	
	Annual	24-hour	Annual	24-hour
$PM_{2.5}$ (Fine)	**15 μg/m^3** Annual arithmetic mean, averaged over 3 years	**65 μg/m^3** 98th percentile, averaged over 3 years	**15 μg/m^3** Annual arithmetic mean, averaged over 3 years	**35 μg/m^3** 98th percentile, averaged over 3 years
PM_{10} (Coarse)	**50 μg/m^3** Annual average	**150 μg/m^3** 24-hr average (one expected exceedance)	**Revoked**	**150 μg/m^3** 24-hr average (one expected exceedance)

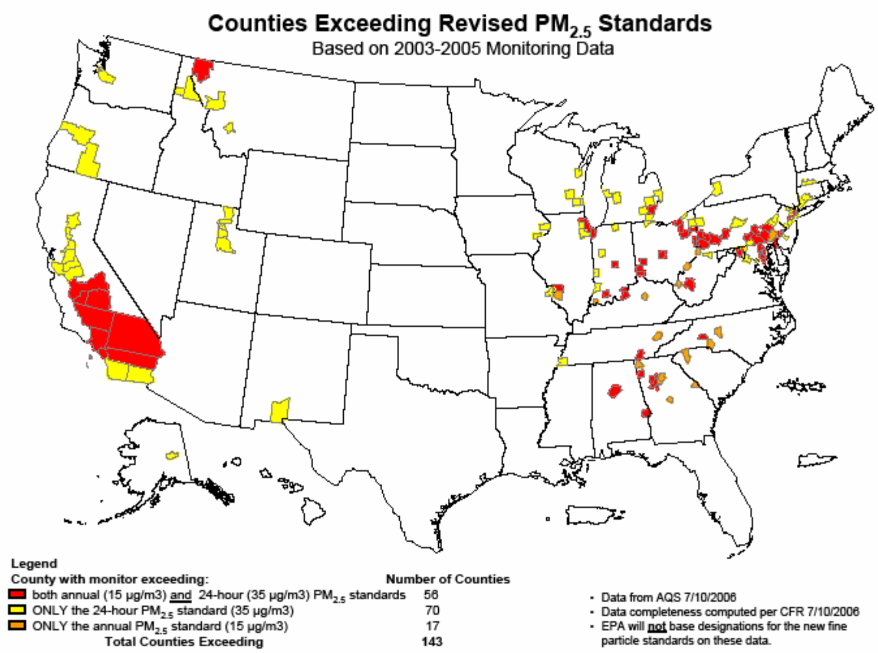

Figure 2. Counties exceeding the 2006 $PM_{2.5}$ standards.

If zoomed into the US EPA's Region 5, air quality models projected areas to violate the revised PM2.5 standard in 2010, 2015, and 2020, as shown in Figure 3 (b-d), in comparison to the violating areas based on the 2003-2005 monitoring data (Figure 3a). The finding that some areas remain in violation of the standard into 2020 suggests that local controls are needed.

Under the current PM2.5 standard schedule, state implementation plans are due in April 2008. Most states have adopted the multi-pollutant approach that considers Ozone, PM, and haze all in one submittal. Those states have until April 2010 to meet annual standards, based on 2007-2009 monitoring data. Some may be extended up to April 2015.

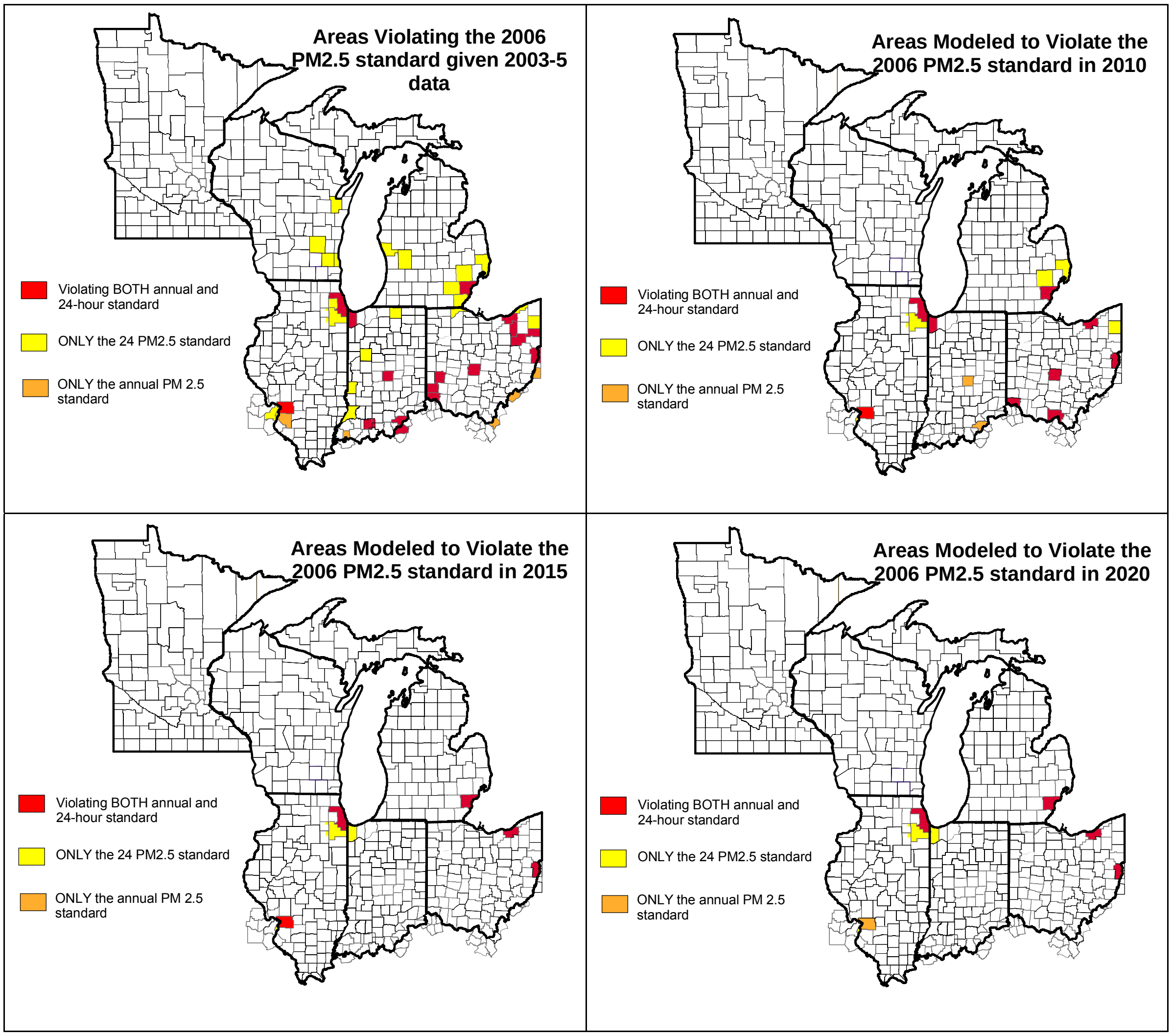

Figure 3. Areas to violated the 2006 PM2.5 standard (Clockwise from top left) (a) based on the 2003-2005 monitoring data, (b) model projection in 2010, (c) model projection in 2015, and (d) model projection in 2020.

Under the new PM2.5 standard, which took effect in December 2006, states have until December 18, 2007 to submit recommendations to USEPA with regard to non-attainment areas based on 2004-2005 monitoring data. The final designations will be signed into effect no later than December 18, 2008. However, in the event the Administrator has insufficient information to promulgate the designations by December 18, 2008, the date of final designations may be extended up to one year, but no later than December 18, 2009. In accordance, the monitoring data used for the designations may be between 2005 and 2007 or 2007 and 2009, depending on the final designations schedule. The effective date of designations takes place typically no later than 90 days after publication in the Federal Register. As usual, SIPs are due three years and the attainment date is no later than five years after the effective date of designations.

PM2.5 HOT-SPOT CONSIDERATION PROCESS IN KENTUCKY

By Jesse Mayes, Kentucky Transportation Cabinet

Background

The Clean Air Act, which was last amended in 1990, requires USEPA to set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. USEPA has set NAAQS for particulate matter with diameter less than 10 microns (PM10) and for particulate matter with diameter less than 2.5 microns (PM2.5). On March 10, 2006, USEPA amended the conformity rule to address project level, or "hot-spot", analysis requirements in PM nonattainment and maintenance areas. Subsequently, on March 29, 2006, USEPA and FHWA released qualitative PM hot-spot analysis guidance.

The final rule and guidance identified three PM2.5 project types as:

- **Exempt projects and non-federal projects:**
  - No project-level conformity determination required
- **Nonexempt projects of air quality concern:**
  - Project-level conformity determination required, including hot-spot analysis
- **Nonexempt projects not of air quality concern:**
  - Project-level conformity determination required, but no hot-spot analysis

The final rule and guidance state that the PM2.5 project types should be determined through interagency consultation and that:

- **Exempt projects are determined by:**
  - Projects meeting requirements of 40 CFR 93.126 or 93.128
- **Nonexempt projects of air quality concern:**
  - Projects fitting criteria under 40 CFR 93.123(b)(1) and as further clarified by March 29, 2006 guidance
- **Nonexempt projects not of air quality concern:**
  - Projects that are not exempt, but are found through interagency consultation to be a project not of concern

Further, the March 29, 2006 guidance provides the following examples of projects **"of air quality concern"** and subject to hot-spot analysis:

- A project on a new highway that serves a significant volume of diesel truck traffic such as **>125,000 AADT _*and*_ 8% or more diesel truck traffic**
- New exit ramps to connect a highway to a major freight terminal
- A new major bus terminal
- Expansion of an existing highway or other facility that affects a congested intersection (operated at Level-of-Service D, E, or F) that has a significant increase in the number of diesel trucks

Kentucky Situation

In April 2005, three areas (5 counties and one partial county) were designated as nonattainment for PM2.5. Between the effective date (April 2006) and August 2007, Kentucky reviewed about two hundred projects for PM2.5 hot-spot consideration. Approximately 80% were found to be exempt and the remaining (with the one exception of the Ohio River Bridges project) were found to be not exempt, but not of concern.

Kentucky Process

The Kentucky process consists of:

- Checklist
- Interagency Consultation
- Public Involvement
- NEPA Documentation

Kentucky developed a checklist that allowed for systematic documentation of the information necessary to determine the project type. The checklist consists of the following:

- Project Identification
- Step 2: Exempt Status (and skip to Step 6 if exempt)
- Step 3: Traffic Information
    - Determine Worst Case Area – Usually an Intersection
    - For Worst Case, Document Current Traffic and LOS
    - For Worst Case, Document Forecasted Traffic and LOS for Open-To-Traffic Date for:
    - Build, and
    - No-Action Scenarios
- Step 4: Air Quality Concern Determination (and skip to Step 6 if not of concern)
- Step 5: Analysis and Documentation (and develop separate hot-spot analysis document utilizing guidance for project of concern)
- Step 6: Meetings, Notices, Dates
- Step 7: Signatures

Making the necessary additions to the interagency consultation network already established for regional conformity, Kentucky established interagency consultation teams for each PM2.5 area. Relying heavily on the checklist, Kentucky utilizes email for interagency review. For projects for which the NEPA process had been completed, Kentucky utilized a newspaper notification to fulfill the public notification requirement. For projects still in the NEPA process, the PM2.5 documentation is included as part of the NEPA document and thus, subjected to the NEPA public involvement. Specific language was developed for the NEPA document.

Ohio River Bridges Project

To date, Kentucky has had one project that required a PM2.5 hot-spot analysis --- The Ohio River Bridges (ORB) project. Current (2007) traffic levels in the downtown area are 290,000 AADT and 32,000 trucks. Traffic forecasts for 2020 for no-action predict downtown traffic of 330,000 AADT and 52,000 trucks. The planned project consists of a new (additional) downtown bridge, rebuilt downtown interchange, improvements on the Indiana side, and an "east end" bridge and roadway about eight miles from downtown. More project details, including the hot-spot document, can be found at the ORB website http://www.kyinbridges.com/ .

Since this project is a bi-state project, the interagency team included representatives from Kentucky and Indiana FHWA, state transportation agencies, local planning agencies, and project team members, as well as from multiple USEPA and FTA regions. The hot-spot document documented the regulations background, project detail and schedule, as well as the regional monitor data and emissions trends. The open to traffic date was assumed to be the worst-case year since regional emission trends were downward. The interagency team agreed to use a multi-prong approach of a surrogate site comparison and a build vs. no-build comparison. The surrogate site comparison consisted of finding a site with current traffic similar to the project build scenario worst-case year traffic and also having a non-violating monitor in the vicinity. While surrogate sites were found with associated monitor readings below the standard, the distance of the monitors from the traffic made the interpretation questionable. The document demonstrated that the build scenario would result in less traffic, and, hence, fewer emissions, in the downtown area than the no-build scenario. Additionally, it was demonstrated that the construction impact would not last more than 5 years at any individual site and, per the guidance, could be construed as not significant. The build vs. no-build comparison was used to infer that project would not create or add to a hot-spot. Finally, regional monitor data and emissions trends were used to infer that this was true for both the annual and daily standard. Interagency consultation was relied on heavily throughout the development of the hot-spot document.

APPENDICES

A1. US EPA and FHWA's Memorandum of Interim Guidance for Qualitative Project-Level: Hot-spot Analysis in PM10 Nonattainment and Maintenance Areas

A2. Transportation Conformity Guidance for Qualitative Hot-spot Analyses in PM2.5 and PM10 Nonattainment and Maintenance Areas (EPA420-B-06-902, March 2006)

- **Table of Contents**
- **Chapter 1**

A3. Meeting agenda

A4. List of participants

A5. Selected presentation slides

A.1 US EPA AND FHWA'S MEMORANDUM OF INTERIM GUIDANCE FOR QUALITATIVE PROJECT-LEVEL: HOT-SPOT ANALYSIS IN PM10 NONATTAINMENT AND MAINTENANCE AREAS

U.S. Department of Transportation
Federal Highway Administration

FHWA Home | Feedback

Environment FHWA > HEP > Environment > Air Quality > Conformity

U.S. Department of Transportation
and
U.S. Environmental Protection Agency

MEMORANDUM

Subject: Transportation Conformity Guidance for Qualitative Hot-spot Analysis in PM2.5 and PM10 Nonattainment and Maintenance Areas

Date: March 29, 2006

From: /original signed by/
Merrylin Zaw-Mon, Director
Transportation and Regional Programs Division
Office of Transportation of Air Quality
Environmental Protection Agency

/original signed by/
April Marchese, Director
Office of Natural and Human Environment
Federal Highway Administration

To: EPA Regional Air Directors
FHWA Division Administrators

The Environmental Protection Agency (EPA) and the Federal Highway Administration (FHWA) are issuing the attached joint guidance on how to perform qualitative hot-spot analyses in PM2.5 and PM10 nonattainment and maintenance areas. This guidance provides information for State and local agencies to meet the PM2.5 and PM10 hot-spot analysis requirements established in the March 10, 2006, final transportation conformity rule (71 FR 12468).

From this date forward, future qualitative PM2.5 and PM10 hot-spot analyses should be based on today's new guidance, which supersedes FHWA's existing September 12, 2001, "Guidance for Qualitative Project-Level: Hot-spot Analysis in PM10 Nonattainment and Maintenance Areas." However, any PM10 hot-spot analysis that was started prior to the release of this guidance may be completed with the previous 2001 guidance.

PM2.5 hot-spot analysis that was started prior to the release of EPA and FHWA's new guidance must meet the March 2006's final rule requirements, and should meet the new guidance whenever possible.

PLEASE FORWARD THE GUIDANCE TO YOUR STATE AND LOCAL AIR QUALITY AND TRANSPORTATION AGENCIES. THE GUIDANCE DIRECTS THAT PEOPLE WITH SPECIFIC QUESTIONS CONCERNING A PARTICULAR NONATTAINMENT OR MAINTENANCE AREA

CONTACT THE EPA, FHWA, AND FEDERAL TRANSIT ADMINISTRATION (FTA) REGIONAL AND DIVISION OFFICES. GENERAL QUESTIONS ABOUT THE GUIDANCE MAY BE DIRECTED TO: MEG PATULSKI OF EPA AT (734) 214-4842; CECILIA HO OF FHWA AT (202) 366-9862; OR ABBE MARNER OF FTA AT (202) 366-4317.

A.2 TRANSPORTATION CONFORMITY GUIDANCE FOR QUALITATIVE HOT-SPOT ANALYSES IN $PM_{2.5}$ AND PM_{10} NONATTAINMENT AND MAINTENANCE AREAS (EPA420-B-06-902, MARCH 2006)

EPA420-B-06-902 March 2006

Transportation Conformity Guidance for Qualitative Hot-spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas

United States
Environmental Protection Agency

Federal Highway Administration

Table of Contents

Chapter 1: Introduction

1.1. What is the purpose of this guidance?

On March 10, 2006, the Environmental Protection Agency (EPA) published a final rule that establishes the transportation conformity criteria and procedures for determining which transportation projects must be analyzed for local air quality impacts in $PM_{2.5}$ and PM_{10} nonattainment and maintenance areas ("areas") (71 FR 12468). The final rule also provides flexibility so that state and local resources are used efficiently. The EPA and the Federal Highway Administration (FHWA) have developed this guidance to help state and local agencies meet the final rule's hot-spot analysis requirements.

Transportation conformity is required under Clean Air Act section 176(c) (42 U.S.C. 7506(c)) to ensure that federally supported highway and transit project activities are consistent with ("conform to") the purpose of the state air quality implementation plan (SIP). Conformity to the purpose of the SIP means that transportation activities will not cause new air quality violations, worsen existing violations, or delay timely attainment of the relevant national ambient air quality standards (NAAQS or "standards"). EPA's transportation conformity rule (40 CFR 51.390 and Part 93) establishes the criteria and procedures for determining whether transportation activities conform to the SIP.

From this date forward, future qualitative $PM_{2.5}$ and PM_{10} hot-spot analyses should be based on today's new guidance, which supersedes FHWA's existing September 12, 2001, "Guidance for Qualitative Project-Level 'Hot Spot' Analysis in PM_{10} Nonattainment and Maintenance Areas." However, any PM_{10} hot-spot analysis that was started prior to the release of EPA and FHWA's new guidance may be completed with the previous 2001 guidance. Any $PM_{2.5}$ hot-spot analysis that was started prior to the release of EPA and FHWA's new guidance must meet the March 2006 final rule's requirements, and should meet the new guidance whenever possible.

1.2. What is a hot-spot analysis?

A hot-spot analysis is defined in 40 CFR 93.101 as an estimation of likely future localized $PM_{2.5}$ or PM_{10} pollutant concentrations and a comparison of those concentrations to the relevant air quality standards. A hot-spot analysis assesses the air quality impacts on a scale smaller than an entire nonattainment or maintenance area, including for example, congested roadway intersections and highways or transit terminals. Such an analysis is a means of demonstrating that a transportation project meets Clean Air Act conformity requirements to support state and local air quality goals with respect to potential localized air quality impacts. When a hot-spot analysis is required, it is included within the project-level conformity determination that is made by FHWA or the Federal Transit Administration (FTA).

EPA and FHWA are issuing guidance at this time for qualitative hot-spot analyses. Quantitative

$PM_{2.5}$ or PM_{10} hot-spot analyses will be required when appropriate methods and modeling guidance are available. Qualitative hot-spot analyses involve more streamlined reviews of local factors such as local monitoring data near a proposed project location.

1.3. What projects in $PM_{2.5}$ and PM_{10} areas are addressed by this guidance?

This guidance provides information to meet hot-spot analysis requirements for projects in $PM_{2.5}$ and PM_{10} areas. See Chapter 2 and Appendix B for more specific information.

For $PM_{2.5}$ areas

For all $PM_{2.5}$ areas, this guidance would be used to complete qualitative $PM_{2.5}$ hot-spot analyses only for "projects of air quality concern" as defined in the final rule by 40 CFR 93.123(b)(1). The final rule specifies that projects of air quality concern are certain highway and transit projects that involve significant levels of diesel traffic, or any other project that is identified by the $PM_{2.5}$ SIP as a localized air quality concern.

A qualitative $PM_{2.5}$ hot-spot analysis is not required for projects that are not an air quality concern. For these types of projects, state and local project sponsors should briefly document in their project-level conformity determinations that Clean Air Act and 40 CFR 93.116 requirements were met without a hot-spot analysis, since such projects have been found to not be of air quality concern under 40 CFR 93.123(b)(1).

For PM_{10} areas without approved conformity SIPs

For these PM_{10} areas, this guidance would also be used to complete qualitative PM_{10} hot-spot analyses only for "projects of air quality concern" as defined by 40 CFR 93.123(b)(1).

A qualitative PM_{10} hot-spot analysis is not required for projects that are not an air quality concern. For these types of projects, state and local project sponsors should briefly document in their project-level conformity determination that Clean Air Act and 40 CFR 93.116 requirements were met without a hot-spot analysis, since such projects have been found to not be of air quality concern under 40 CFR 93.123(b)(1).

For PM_{10} areas with approved conformity SIPs

In areas where EPA has already approved conformity SIPs that include PM_{10} hot-spot provisions from previous conformity rulemakings, the revised PM_{10} hot-spot requirements in the March 10, 2006 final rule will only be effective when a state either:

- withdraws the existing provisions from its approved conformity SIP and EPA approves the withdrawal, or
- includes the revised PM_{10} hot-spot requirements in a SIP revision and EPA approves that SIP revision.

For more information on revising approved conformity SIPs, please see the February 14, 2006 EPA and DOT guidance entitled, "Interim Guidance for Implementing the Transportation Conformity Provisions in the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU)."[1]

Therefore, for all non-exempt federally funded or approved projects, PM_{10} areas with approved conformity SIPs must continue to follow the PM_{10} hot-spot procedures in their existing conformity SIPs until the SIP is updated and subsequently approved by EPA. PM_{10} areas with approved conformity SIPs most likely are required to complete a qualitative PM_{10} hot-spot analysis for every project-level conformity determination, since these were the federal conformity requirements prior to the March 10, 2006 final rule.

1.4. How is this guidance structured?

This guidance is in the form of questions and answers for basic components of $PM_{2.5}$ and PM_{10} hot-spot analyses. The guidance addresses many issues such as:

- What requirements must be met under the March 10, 2006 final rule?
- When must the analysis be performed?
- What are the different agencies involved in $PM_{2.5}$ and PM_{10} hot-spot analyses and project-level conformity determinations?
- What information should be included in a qualitative hot-spot analysis?

Following the question and answer section are three appendices that provide examples of:

- Projects that are or are not an air quality concern,
- Approaches for qualitative $PM_{2.5}$ and PM_{10} hot-spot analyses, and
- Potential project-level mitigation measures.

These examples demonstrate different levels of inquiry that may be used to qualitatively consider the local air quality impacts of projects in a given $PM_{2.5}$ or PM_{10} nonattainment or maintenance area. This guidance is not definitive for any specific project but rather is general guidance for all relevant projects.

Additional assistance is available from:

- EPA regional and headquarters offices,
- FHWA division and headquarters offices, and
- FTA regional and headquarters offices.

See Question 1.6 for specific contact information.

[1] SAFETEA-LU is Public Law 109-59. EPA and DOT's interim conformity guidance is available at either http://www.epa.gov/otaq/transp/conform/policy.htm#legacy, or http://www.fhwa.dot.gov/environment/conformity/sec6011guidmemo.htm.

1.5. Which parts of this guidance apply to $PM_{2.5}$ hot-spot analyses and which parts of this guidance apply to PM_{10} hot-spot analyses?

The criteria and procedures for hot-spot analyses will be generally the same for both $PM_{2.5}$ and PM_{10} areas, except for PM_{10} areas with approved conformity SIPs as noted elsewhere in this guidance. Questions and answers in this guidance address $PM_{2.5}$ and PM_{10} together where the requirements or analytical methods and data are the same. Separate answers are provided where the answers differ.

1.6. Who can I contact for more information?

For specific questions concerning a particular nonattainment or maintenance area, please contact the transportation conformity staff person responsible for your state at the appropriate EPA regional office, FHWA division office, or FTA regional office.

- Contact information for EPA regional offices can be found at: http://www.epa.gov/otaq/transp/conform/contacts.htm.
- Contact information for FHWA division offices can be found at: http://www.fhwa.dot.gov/field.html.
- Contact information for FTA regional offices can be found at: http://www.fta.dot.gov/about/offices/4978_ENG_HTML.htm.

General questions about this guidance can be directed to:

- Meg Patulski at EPA's Office of Transportation and Air Quality, patulski.meg@epa.gov, (734) 214-4842;
- Joe Pedelty at EPA's Office of Transportation and Air Quality, pedelty.joe@epa.gov, (734) 214-4410;
- Cecilia Ho at FHWA's Office of Natural and Human Environment, cecilia.ho@fhwa.dot.gov, (202) 366-9862; or
- Abbe Marner at FTA's Office of Planning and Environment, abbe.marner@fta.dot.gov, (202) 366-4317.

1.7. Does this guidance create new requirements?

No, this guidance explains how to implement the hot-spot analysis requirements of the March 10, 2006 final rule, and does not create any new requirements.

The regulations described in this document contain legally binding requirements. This document is not a substitute for those provisions or regulations, nor is it a regulation itself. Thus, it does not impose legally binding requirements on EPA, FHWA, FTA, states, or the regulated community, and may not apply to a particular situation based upon the circumstances. EPA, FHWA, and FTA retain the discretion to adopt approaches on a case-by-case basis that may differ from this guidance, but still comply with the Clean Air Act and the transportation conformity regulations. Any decisions regarding a particular conformity determination or hot-spot analysis will be made based on the statute and regulations, after appropriate public input. This guidance may be revised periodically without public notice.

A3. MEETING AGENDA

PM Hot-Spot Peer Exchange—FINAL AGENDA

October 23-24, 2007
Allerton Park, Monticello, Illinois

Time	Topic	Speaker
Oct. 23, 2007		
Morning Session		
8:30AM	Welcome	Walt Zyznieuski, IDOT Jane Lin, University of Illinois at Chicago David Lippert, IDOT
8:45AM	Introduction	Walt Zyznieuski, IDOT
9:00AM	Overview of PM hotspot requirements	Kevin Black, FHWA
10:00AM	BREAK	
10:15AM	Recent health studies	Kevin Black, FHWA
10:45AM	Roundtable discussion-PART I	Roundtable discussion
11:45AM	LUNCH	
Afternoon Session		
12:45PM	State of the modeling science (studies, model performance, PM improvements in MOVES model)	Mike Claggett, FHWA
2:00PM	BREAK	
2:15PM	Diesel retrofit	Frank Acevedo, US EPA Region 5
2:35PM	Roundtable discussion-PART II	Roundtable discussion
3:30PM	Latest PM research	Jay Turner (Washington University)
4:30PM	CMAP's experience on PM Hot-Spot Requirements	Ross Patronsky, Chicago Metropolitan Agency for Planning (CMAP)
5:30-6:30PM	RECEPTION	
Oct. 24, 2007		
Morning Session		
8:30AM	Potential new nonattainment areas under revised NAAQS	Michael Leslie, USEPA Region 5
9:15AM	Innovations in PM analyses	Jesse Mayes, Kentucky Transportation Cabinet Jay Turner, Washington University
10:45AM	BREAK	
11:00AM	Roundtable discussion-PART III	Roundtable discussion
11:30AM	Concluding remarks	Walt Zyznieuski, IDOT
11:45AM	LUNCH	

A4. LIST OF PARTICIPANTS

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Wenjing Pu	University of Illinois at Chicago	wpu2@uic.edu

A5. SELECTED PRESENTATION SLIDES

1. Qualitative Project-level Hotspot Analysis in PM10 and PM2.5 Nonattainment and Maintenance Areas
    - Kevin Black, Federal Highway Administration
2. Improving Public Health - Revision of the PM10 and PM2.5 Standards (selected slides)
    - Kevin Black, Federal Highway Administration
3. State of the Modeling Science
    - Michael Claggett, Federal Highway Administration Resource Center
4. Overview of Clean Diesel Requirements and Voluntary Programs
    - Frank Acevedo, U.S . Environmental Protection Agency, Region 5
5. Ambient Particulate Matter Research - Selected Topics (selected slides)
    - Jay Turner, University of Washington, St. Louis
6. Particulate Matter Research - Selected Data Analyses (selected slides)
    - Jay Turner, University of Washington, St. Louis
7. Hot Spot Analyses in Northeastern Illinois
    - Ross Patronsky, Chicago Metropolitan Agency for Planning
8. Potential New Nonattainment Areas under the Revised NAAQS
    - Michael Leslie, U.S . Environmental Protection Agency, Region 5
9. PM2.5 Hot-Spot Consideration Process in Kentucky (selected slides)
    - Jesse Mayes, Kentucky Transportation Cabinet

Qualitative Project-level Hotspot Analysis in PM10 and PM2.5 Nonattainment and Maintenance Areas

This training covers:

- Background information on particulate matter (PM)
- Project-level conformity requirements under applicable laws and regulation
- Projects subject to a PM hotspot analysis
- Roles and responsibilities for the different agencies involved in PM project-level conformity determinations
- When PM hotspot analyses must be preformed
- Types of information that may be included in a qualitative hotspot finding
- Analysis examples

Structure of Training

This training generally follows the Qualitative PM Hotspot Guidance released by EPA and FHWA:

1) Introduction
2) Conformity Requirements
3) Analytical Requirements
4) Developing a Hotspot Analysis

Project Analysis Summary Table

Criteria For Considering Analysis	Pollutants			Comments
	CO	PM	MSATs	
Regulatory Basis	NEPA, Conformity Rule	NEPA, PM Hotspot Conformity Rule	NEPA, FHWA MSAT Guidance	NEPA, conformity rule and guidance documents are basis of analysis requirements
Criteria Used in Defining Analysis Requirement	Not defined	AADT, % diesel, receptors	AADT, % diesel, receptors	These criteria generally define type of analysis required (qualitative; quantitative – mass or concentration)
AADT Volume	Not defined	125, 000	140, 000 – 150, 000	AADT volumes are guidelines; decision made by project sponsor
Percent Diesel Traffic	Not defined	8%	High Volumes	Percent of diesel vehicles based on national defaults used in MOBILE model; high volumes not defined
Receptor Sensitivity or Population Proximity	Not defined	100 m, 300 feet from roadway	100 m, 300 feet from roadway	Dependent on project sponsor; 100m from roadway may define "area of influence"; consult with interested parties
Analysis Methods	Qualitative, Quantitative (concentration)	Qualitative	Qualitative, Quantitative (total mass)	Qualitative methods generally refer to text and graphical references; quantitative methods refer to calculations

Section I: Introduction

What is particulate matter?

- Particulate matter is generic term for broad class of chemically and physically diverse substances that exist as discrete particles (liquid droplets or solids) over a wide range of sizes.
- Chemical and physical properties vary greatly with
  - Time
  - Region
  - Meteorology
  - Source category

What is PM?

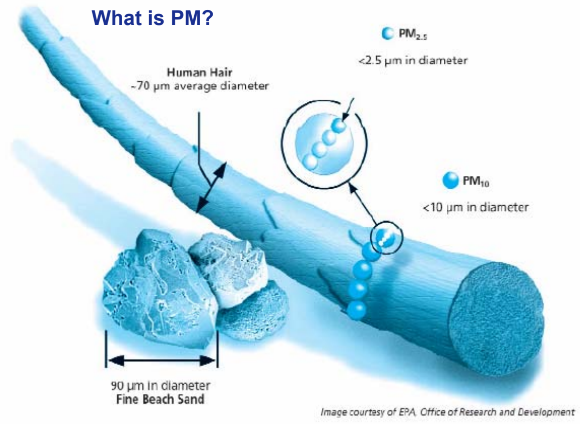
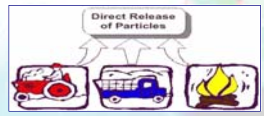


Image courtesy of EPA, Office of Research and Development

How is PM2.5 formed?

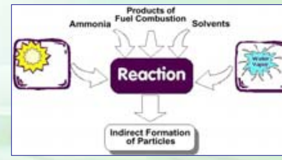
Directly Emitted into the Air

- Cars, trucks, buses
- Power plants, factories
- Construction sites
- Tilled fields, paved and unpaved roads
- Wood burning



Indirectly Formed

- Gases react to form particles



When Are Project-Level Conformity Determinations Required?

- Prior to the first time a Federal project is adopted, accepted, approved, or funded
  - Examples include:
    - NEPA Decision Document (CE, FONSI, ROD)
    - Right-of-Way Acquisition
    - Construction Authorization
- Typically, project-level conformity is completed as part of the NEPA process (prior to adoption of CE, FONSI, ROD)

Is Project-level Conformity Ever Redetermined?

Yes.

Project-level conformity must be redetermined if any of the following occur:

- There is a significant change in design concept/scope
- More that 3 years have passed since the most recent major step to advance project
  - *e.g.*, NEPA process completion, start of final design, acquisition of significant portion of right-of-way, and construction (including Federal approval of PS&E)
- Initiation of supplemental environmental document for air quality purposes

40 CFR 93.104(d)

General Requirements for Project-level Conformity Determinations

- Use latest planning assumptions
- Use latest emissions model
- Include consultation
- Be part of a currently conforming long-range plan and TIP
- Include a hotspot analysis for any applicable pollutants (CO, PM)
- Comply with PM control measures in the applicable state implementation plan

For isolated rural areas, also:

- Project does not interfere with timely implementation of any transportation control measures in the applicable implementation plan
- Part of regional emissions analysis

What is a hot-spot analysis?

- Definition: An estimation of likely future localized pollutant concentrations and a comparison of those concentrations to the relevant air quality standard (40 CFR 93.101).
- Assesses impacts on a smaller scale than the entire nonattainment or maintenance area
- Demonstrates that a transportation project meets Clean Air Act conformity requirements:
  - **to not create a new air quality violation, or**
  - **worsen an existing violation, or**
  - **delay timely attainment of an air quality standard.**

Final Rule & Guidance

- On March 10, 2006, EPA amended the Conformity Rule to address hotspot analysis requirements in PM nonattainment and maintenance areas.
- On March 29, 2006, EPA and FHWA released Qualitative PM Hotspot Analysis Guidance.
- This training presents information found in the guidance on how to implement the final rule.
- It does not in itself present new requirements. Please refer to the final rule as necessary.

EPA & FHWA Qualitative PM Hotspot Guidance

Issued March 2006; available at

http://www.fhwa.dot.gov/environment/conformity/pmhotspotguidmemo.htm

Contents of Guidance:

Qualitative Project-level Hotspot Analysis in PM10 and PM2.5 Nonattainment and Maintenance Areas

Section II: Transportation Conformity Requirements

Section II Overview

- What projects require a PM hotspot analysis?
  - What is a project of air quality concern?
  - Q&As; Examples
- When is project level conformity required?
- What are the conformity requirements?
- What are the roles and responsibilities of stakeholders?

What projects are subject to a PM hotspot analysis?

Federal Projects…

- ✓ Within a PM nonattainment or maintenance area
- ✓ Not exempt under either 40 CFR 93.126 or 93.128
- ✓ Fit criteria under 40 CFR 93.123(b)(1) – projects of local air quality concern…

What projects are subject to PM hotspot analysis? (con't)

Projects of Air Quality Concern are…

(i) New or expanded highway projects that have a significant number of or significant increase in diesel vehicles;

(ii) Projects affecting LOS D, E, or F with a significant number of diesel vehicles, or those that will change to LOS D, E, or F because of increased traffic volume from a significant number of diesel vehicles related to the project;

(iii) New bus and rail terminals and transfer points that have a significant number of diesel vehicles congregating at a single location;

(iv) Expanded bus and rail terminals and transfer points that significantly increase the number of diesel vehicles congregating at a single location; and

(v) Projects in or affecting locations, areas, or categories of sites which are identified in the PM10 or PM2.5 applicable implementation plan or implementation plan submission as appropriate, as sites of violation or possible violation

40 CFR 93.123(b)(1)

What projects are subject to PM hotspot analysis? (con't)

- The final rule and the March 2006 guidance provide examples of projects of air quality concern…
  - A project on a new highway that serves a significant volume of diesel truck traffic such as >125,000 AADT and 8% or more diesel truck traffic
  - New exit ramps to connect a highway to a major freight terminal
  - A new major bus terminal
  - And more
- And, projects that are **not** an air quality concern…
  - A new highway project that primarily serves gasoline vehicles
  - Intersection channelization or interchange reconfiguration project involving turn lanes or other operational improvements
  - A new compressed natural gas bus terminal
  - And more

What projects are subject to PM hotspot analysis? (con't)

- **Projects not listed under 40 CFR 93.123(b)(1) as projects of concern are NOT required to have a hotspot analysis.**
  - These projects are presumed to meet Clean Air Act requirements without explicit hotspot analysis.

Projects of Air Quality Concern Q&As

? Are the examples of projects of air quality concern in the hotspot rule the only examples? Or can other cases apply?

√ Those examples are not exclusive. Interagency consultation can be use to determine if the project is of air quality concern according to the rule's definition.

? What percentage of total trucks should be considered diesel trucks?

√ In areas where truck volume data is not easily disaggregated, total truck volume could be used. Interagency consultation should be used to discuss data and the appropriate ways to categorize diesel vehicles.

Projects of Air Quality Concern Q&As

? For the example of 125,000 AADT and 8% diesel trucks, is this the existing levels, the open-to-traffic levels, or the design year levels?

√ **The example could apply to any of these years. The hotspot analysis should examine the year(s) during the timeframe of the plan in which the project's emissions, in addition to background levels, are expected to be the highest and a new violation or worsening of an existing violation would most likely occur.**

? For this same example, what if the project's AADT is high enough that a truck percent less than 8 still yields the equivalent total trucks as the example? Is this still a project of air quality concern?

√ **Yes. The same would also hold true for a project with lower AADT but higher truck percent. However, remember that this example is to illustrate a typical project of air quality concern and should not be treated as a threshold.**

Projects of Air Quality Concern Q&As

? Would any nonexempt project on a facility with 125,000 AADT and 8% diesel trucks be a "project of air quality concern"? Or only a project that significantly increased the number of diesel vehicles on such a facility?

√ 40 CFR 93.123(b)(1) should be interpreted as applying only to projects that would involve a significant increase in the number of diesel transit buses and diesel trucks on an existing highway facility. The 125,000 AADT and 8% diesel trucks example is intended for new facilities, not as an example of a "significant increase."

<u>Summary</u>: Three Types of Projects

- Exempt projects and non-federal projects:
  - ➢ no project-level conformity determination required
- Projects of air quality concern:
  - ➢ project-level conformity determination required, including hotspot analysis
- Nonexempt projects not of air quality concern:
  - ➢ project-level conformity determination still required, but no hotspot analysis needed
    - Should document that project is not of type in 40 CFR 93.123(b)(1) in project-level conformity determination

When is a PM hotspot analysis required?

PM2.5 Areas:

- **For a project level conformity determination that is made on or after April 5, 2006**

PM10 Areas*:

- **Prior to April 5, 2006, project-level conformity determinations must meet the previous rule's requirements**
- **On or after April 5, 2006, project-level conformity determinations would follow the amended rule (in areas without approved conformity SIPs)**

***PM10 areas with approved conformity SIPs must continue to follow the procedures in the SIP until it is amended.**

When is PM2.5 project-level conformity required for projects already under development or construction?

- **If a project or a portion of a project still requires FHWA approval or authorization, then PM2.5 conformity would be required before the first action that occurs on or after April 5, 2006.**

- **For any phase of a multi-phase project, the hotspot analysis should focus on the portions of the project area not already under construction or not completed and require a new FHWA approval or authorization.**

How does the release of the guidance affect projects in PM10 areas with hotspot analyses already underway?

- A PM10 hotspot analysis started prior to the release of the new guidance may be completed according to the 2001 guidance.

What are the requirements for assessing impacts?

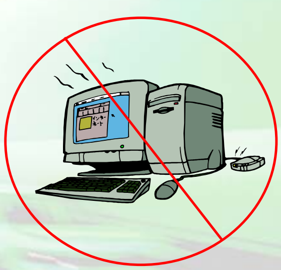
✓ Hotspot analyses must demonstrate that:
  - No new local PM violations will be created
  - The frequency or severity of existing violations will not be increased as a result of the project

✓ Project-level conformity determinations must address both the annual and 24-hour PM2.5 and/or PM10 standards, regardless of which form of the standard the area has violated.

(40 CFR 93.116)

What are the requirements for assessing impacts? (con't)

Until EPA releases modeling guidance for a quantitative analysis, the demonstration to meet 40 CFR 93.116 must be based on qualitative consideration of local factors.



[40 CFR 93.123(b)(2) and (b)(4)]

What are the requirements for interagency consultation?

The interagency consultation process is an important tool in completing project-level conformity determinations and hotspot analyses, as required by 40 CFR 93.105, such as

- evaluate and choose method(s) and assumptions used in the qualitative analysis.

The consultation process may be used to:

- determine if a project meets requirements for a project of air quality concern (40 CFR 93.123(b)(1))
- determine whether new violations or increases in frequency or severity of existing violations is anticipated.

What are the roles and responsibilities of different agencies in project-level conformity determinations?

EPA
- Promulgating conformity regulations and guidance
- Member of interagency consultation
- Provides policy and technical support

FHWA/FTA
- Make conformity determinations
- Review and approve NEPA documents
- Member of interagency consultation
- Provide policy and technical support

What are the roles and responsibilities of different agencies in project-level conformity determinations?

Project Sponsor
- Providing hotspot analysis
- Meeting consultation requirements
- Conducting environmental analyses to comply with NEPA

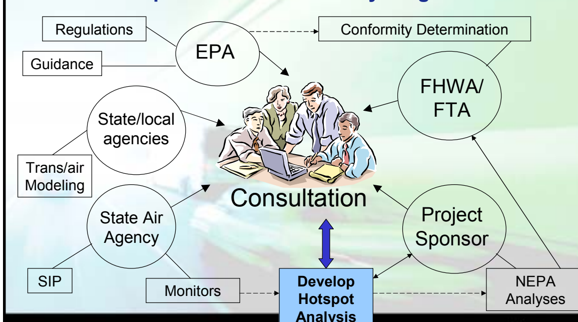
State and Local Agencies
- Part of interagency consultation
- Aid in air quality/transportation modeling
- State air agency develops SIPs and operates monitors

What are the roles and responsibilities of different agencies in project-level conformity determinations?

MPO

- Involvement for specific project-level conformity determinations is not defined by conformity regulations
- Interagency consultation should be used to discuss the role of MPOs in project-level determinations
- MPO data may be valuable in hotspot analyses, particularly regarding regional transportation and traffic conditions and emissions

Roles & Responsibilities: Summary Diagram



What are the requirements for public participation?

Affected agencies making project level conformity determinations need to establish a proactive public involvement process.

✓ Public review & comment

Since hotspot analyses are often conducted as part of NEPA, the NEPA public involvement process can often be used to satisfy this requirement.

Public Involvement Q&As

? How should the public involvement criteria be met for a project-level conformity determination not being made as part of the initial NEPA process?

√ Project sponsors must provide an opportunity for public review and comment of project-level conformity analyses for projects of air quality concern. Interagency consultation should be used to determine the extent of public involvement necessary to satisfy 40 CFR 93.105(e). Consideration should be given to the scale and scope of the analysis supporting the determination.

√ For projects not of air quality concern, a comment period is only required for project-level conformity determinations if such a comment period would have been required under NEPA.

Lists of Projects

√ For ongoing projects, a list of specific projects that are not of air quality concern can made available to the public to satisfy public involvement requirements

√ The list must be discussed through interagency consultation, and include description and explanation

√ Not applicable for projects that still need to undergo NEPA

Qualitative Project-level Hot Spot Analysis in PM10 and PM2.5 Nonattainment and Maintenance Areas

Section III: Analytical Requirements

What are the requirements for assessing impacts?

- **The analysis must:**
  - Analyze total emissions burden of direct PM emissions which may result from implementing the project, together with background concentrations
  - Include the entire project; be performed only after the major design features have been identified

(40 CFR 93.123(c))

What are the requirements for assessing impacts? (con't)

- **The analysis must:**
  - Use assumptions consistent with the regional emissions analysis
  - Assume mitigation only with written commitments
  - Consider emissions increases from construction-related activities as temporary if only during construction phase and last 5 years or less at any individual site

(40 CFR 93.123(c))

What emissions are considered in the PM hotspot analysis?

PM2.5 and PM10 : Directly emitted PM emissions must be considered in all analyses

- ✓ Tailpipe
- ✓ Brake wear
- ✓ Tire wear

What are the requirements for considering reentrained road dust?

PM2.5: Only considered in any PM2.5 analysis (including hotspot) if it has been found to be a significant contributor (40 CFR 93.102(b)(3).

PM10: Must be considered in all analyses

What are the requirements for considering construction dust?

(40 CFR 93.123(c)(5))

PM2.5 and PM10: Not required to be assessed if considered temporary (only during construction, and lasts five years or less at any individual site)

Photo courtesy of Massachusetts Turnpike Authority

What are the requirements for including PM precursors?

Not included.

What time frame and analysis years should be used?

- **Consider the full time frame of an area's transportation plan (or regional emissions analysis for isolated rural areas)***
- **Examine the year(s) which peak emissions are expected**
  - This is the year(s) a new violation or worsening of an existing violation would most likely occur.
  - Both the project's emissions as well as the background emission are considered when selected which year(s) to examine.
  - If no hotspot impacts are expected for the year of highest total emissions, then no adverse impacts would be expected in any other years within the timeframe of the plan/regional emissions analysis

* Not affected by SAFETEA-LU allowance to elect a change in time horizons for plan/TIP conformity determinations

RESOURCE CENTER

Qualitative Project-level Hotspot Analysis in PM10 and PM2.5 Nonattainment and Maintenance Areas

Section IV: Developing a Hotspot Analysis

This Section Covers:

- **What should be included in a PM hotspot analysis?**
- **What are the factors to be considered for existing conditions?**
- **How would changes in factors be evaluated for the future?**
- **Possible mitigation strategies**
- **Qualitative estimation examples**

Qualitative Estimation Techniques

- ✓ **Comparison to another location with similar characteristics**
- ✓ **Air quality study approach**

Qualitative Estimation Techniques

Comparison to another location with similar characteristics

- Review existing highway/transit facilities built in location similar to proposed project
  - If possible, near an air quality monitor
- Should discuss similarities and differences between "surrogate" and proposed project location
- Document reasons for selecting "surrogate"
- Use interagency consultation to determine appropriate "surrogate" and air quality monitor(s)

Qualitative Estimation Techniques

Air quality study approach

- Use available air quality information/studies (state/local air agencies, universities, etc.)
- Use information in SIP (PM10) or preliminary data (PM2.5) for the area that may be relevant
- Document air quality information used, and its appropriateness
- Use interagency consultation to determine appropriate air quality information for assessing air quality impacts of proposed project

Analytical Considerations

- The EPA/FHWA guidance describes a number of factors that should be considered in a qualitative analysis
- Not every factor will apply to every project
- Size or scope of project will dictate required documentation

What should be included in a PM hotspot analysis?

- Project description, including location, scope, and opening date
- Applicable part of 40 CFR 93.123(b)(1)
- Description of hotspot analysis method chosen
- Description of emissions considered
- Factors that would influence emissions and concentrations from the project, including current conditions and how they would change in the future
- Analysis year(s) considered
- Mitigation strategies, if any, and expected effects
- Conclusion (how project meets 40 CFR 93.116 and 93.123)

Documentation Q&A

? How should a project-level conformity determination be documented that is not being made as part of the initial NEPA process?

√ The project-level conformity documentation prepared by the project sponsor and the determination made by the FHWA Division office can be documented in a format consistent with other documents in the project files or Administrative Record. When appropriate, it is recommended that this project-level conformity determination is made in conjunction with the re-evaluation required under 23 CFR 771.129.

Factors that may be considered in qualitative analysis for existing and future scenarios

- ✓ **Air quality**
- ✓ **Transportation and traffic conditions**
- ✓ **Built and natural environment**
- ✓ **Meteorological, climate, and seasonal data**
- ✓ **Retrofit, anti-idling or other adopted emission control measures**

Air Quality

- ✓ PM10 and PM2.5 design values from nearby monitors in the nonattainment/maintenance area
- ✓ PM10 and PM2.5 monitoring data from monitors in other nonattainment/maintenance areas with similar traffic or environmental conditions to proposed project
- ✓ Future projected air quality including attainment year, years beyond attainment, changes at project location
- ✓ PM source apportionment studies, where available
- ✓ Future emissions trends that could affect concentrations at the project location, such as stationary, port, or other sources
- ✓ Scientific studies or other regional/local trend data where available and applicable

Transportation and Traffic Conditions

- ✓ **Current and projected volumes**
  - Types, percentages of diesel and other vehicles on affected roadways
  - Consider planned/expected development that may affect traffic volume growth rates
- ✓ **Changes in vehicle fleet characteristics (trends in VMT, mix of vehicles, etc.)**
- ✓ **Other: transportation modes, volumes, congestion, trends, etc.**

Built and Natural Environment

- ✓ **Classification of project area (urban, suburban, rural)**
  - Relevant infrastructure/topography (i.e, barriers to PM dispersal)
- ✓ **Relevant development trends and land use patterns**
  - i.e., new area/stationary source, increased truck traffic due to port terminal or agricultural reasons

Meteorological, Climate and Seasonal Data

- ✓ **Atmospheric inversions, prevailing wind speed, wind direction**
- ✓ **Describe the effect these variables have on PM concentrations**

Retrofit, Anti-idling or Other Adopted Emission Control Measures

- ✓ **Retrofit or anti-idling programs**
- ✓ **Impact of phase-in of national rules and regulations (e.g., heavy-duty diesel rules)**
- ✓ **Other emissions control measures, as relevant**

Data Source Examples

- ❖ **Air quality**: State/local air quality agencies, public health departments, universities
- ❖ **Transportation and traffic conditions:** Project sponsor, state department of transportation (DOT), local planning agency, MPO
- ❖ **Built and natural environment**: State DOT, project sponsor, local planning agency, MPO
- ❖ **Meteorological, climate, and seasonal data:** State/local air quality agencies, applicable SIP, National Weather Service
- ❖ **Retrofit, anti-idling, or other adopted emission control measures:** state/local air agencies, EPA, applicable SIP

Mitigation Strategies

- Consider where the proposed project may lead to potential new PM violation or increase in frequency or severity of an existing violation
- Written commitments must be obtained for project-level mitigation before the project-level conformity determination. (40 CFR 93.125(a))
- Appendix C of the EPA/DOT guidance gives examples.

Possible Mitigation Strategies: Diesel Emissions

- **Retrofit for older, higher emitting vehicles**
- **Anti-idling requirements or policies**
  - Restrictions on idling
  - Truck stop electrification
- **Truck routing (e.g., truck restricted zone)**
- **Replace older buses with cleaner buses (i.e., new diesel engine standards, hybrid-electrics)**

Possible Mitigation Strategies: Fugitive Dust (PM10)

- Truck cover laws
- Street cleaning programs
- Site watering programs
- Street/shoulder paving
- Runoff and erosion control
- Changes in truck weight and length restrictions
- Use of alternative deicers in place of sand for snow/ice control

Examples

- **Appendix B**
  - New major bus terminal
  - Major modification to highway interchange
  - New highway interchange
- **Real-life**
  - Legacy Parkway in Utah
  - I-25/E470 Interchange in Colorado

Comparison of a New Bus Terminal to Another Site Based on Monitoring Data

- **Proposed Project:**
  - New major bus terminal along public transit route in PM2.5 nonattainment area
  - Rapidly growing suburban area
- **Air Quality Concern:**
  - Significant increase diesel bus traffic (40 CFR 93.123(b)(1)(iii)
- **Data Considerations:**
  - Road dust not considered; no significance finding by EPA/state
  - Nearby monitor: Significantly below 24-hr standard (50 ug/m3); close to annual standard (14.5 ug/m3)
  - Monitor near existing bus terminal with similar traffic characteristics to proposed project: Near 24-hr standard (60 ug/m3); violation of annual standard (15.1 ug/m3)
  - Project includes anti-idling policy and older bus retrofit program

Comparison of a New Bus Terminal to Another Site Based on Monitoring Data (con't)

✓ **Conclusion:**
- Interagency consultation process concludes that mitigation measures should allow PM concentrations to be lower than standards.
- Mitigation measures allow the project to meet conformity hotspot requirements in 40 CFR 93.116 and 40 CFR 93.123.

Consideration of a Highway Project and Nearby Monitoring Data

- **Proposed Project:**
  - Major modification to highway interchange connecting primary route to interstate
  - Significant number of diesel vehicles are expected to use the interchange
  - Located in suburban portion of large metropolitan city in PM10 and PM2.5 nonattainment areas
- **Air Quality Concern:**
  - New or expanded highway project that has a significant number or significant increase in diesel vehicles (40 CFR 93.123(b)(1)(i))

Consideration of a Highway Project and Nearby Monitoring Data (con't)

- **Data Considerations:**
  - Project's location does not have any current violations: Significantly below the annual and 24-hour PM2.5 and PM10 standards
  - PM2.5 and PM10 emissions from existing sources is decreasing in project area in the future
  - Road dust: not considered for PM2.5 (no significance finding); yes for PM10
  - VMT changes estimated for the project are consistent with regional trends which show no expected increase in PM concentrations
  - Meteorology at the project location is variable; some wind dispersion of PM emissions; no effect by temperature, humidity, rainfall

Consideration of a Highway Project and Nearby Monitoring Data (con't)

✓ **Conclusion**
  - Any increases in emissions due to traffic changes would be offset by decreases from the transportation facility due to decreasing on-road emissions trends and decreasing background concentrations
  - A scientific journal article about the air quality impact of similar projects supports this conclusion. It was discussed in consultation and cited in the analysis documentation.
  - The project meets the requirements in 40 CFR 93.116 and 40 CFR 93.123 for both PM2.5 and PM10.

Comparison of New Highway Project to Similar Project Location in the SIP

- **Proposed Project:**
  - New interchange on 6-lane freeway; at border of urban area
  - Located in PM10 maintenance area
  - Significant increase in diesel traffic from new connecting road and commercial/industrial development planning for vicinity
- **Air Quality Concern:**
  - New or expanded highway project that has a significant number or significant increase in diesel vehicles (40 CFR 93.123(b)(1)(i))

Comparison of New Highway Project to Similar Project Location in the SIP (con't)

- **Data Considerations:**
  - PM10 SIP shows annual PM10 standard met as long as 24-hour PM10 standard is met
  - New interchange is compared to existing interchange within SIP's modeling domain. Existing interchange…
    - Is located near urban edge
    - Has similar meteorological conditions
    - Has higher diesel traffic volumes
    - Has more intensive surrounding development
  - Modeling grid for existing interchange is predicted to experience concentrations of about 110 ug/m3 (current standard is 150 ug/m3).

Comparison of New Highway Project to Similar Project Location in the SIP (con't)

✓ **Conclusion**
  - New interchange would see lower traffic volumes and less development than existing, modeled interchange which is not predicted to experience any new or worsened violations of the 24-hour and annual PM10 standards.
  - The project meets the requirements in 40 CFR 93.116 and 40 CFR 93.123.

Real-life Example: Legacy Parkway in Utah

- Volumes on proposed Legacy Parkway compared to volumes on I-15 at a point ~ 100 yards from a PM10 monitor
- Volumes on I-15 ranged from 99,700 to 121,600 vehicles per day, with no violations at the nearby monitor (this is documented with data in the EIS)
- Volumes on Legacy Parkway are expected to be around 20,000 vehicles per day; since the higher volumes on I-15 don't cause a violation, Legacy wouldn't be expected to cause a violation either.

Real-life Example: I-25/E470 Interchange (Denver area)

- New interchange connecting I-25 and a new beltway; major retail/residential development planned
- Proposed project compared to Denver PM10 SIP modeling for a location with similar traffic patterns and development
- Since the comparison location was safely below the PM10 NAAQS in the SIP modeling, it was concluded that the proposed project would also be below the NAAQS

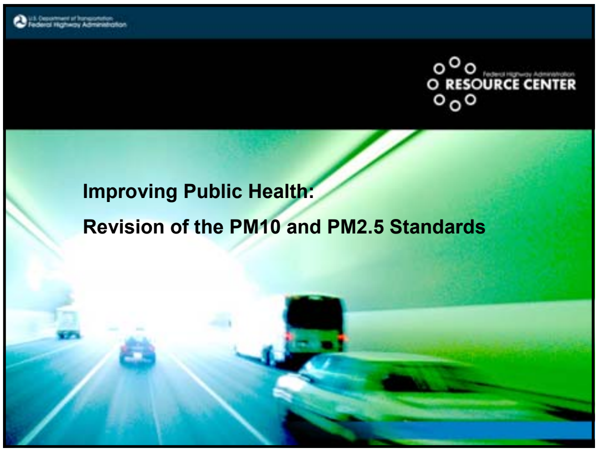
More Information

A listing of contacts for EPA, FHWA, and FTA is available in the qualitative guidance, found at:
http://www.fhwa.dot.gov/environment/conformity/pmhotspotguidmemo.htm

FHWA's Transportation Conformity website:
http://www.fhwa.dot.gov/environment/conform.htm

EPA's Transportation Conformity website:
http://www.epa.gov/otaq/stateresources/transconf/index.htm

FHWA Resource Center Air Quality Technical Services Team
http://www.fhwa.dot.gov/resourcecenter/teams/airquality/index.cfm



Revision of the National Ambient Air Quality Standards (NAAQS) for Particle Pollution EPA, September 21, 2006

- The final rule addresses two categories of particle pollution:
  - *fine particles* ($PM_{2.5}$), which are 2.5 micrometers in diameter and smaller; and
  - *inhalable coarse particles*, which are larger than 2.5 micrometers and smaller than 10 micrometers in diameter.
- In the final rule EPA :
  - revised the fine particle standards to better protect public health and visibility, and
  - retained the 24-hour PM_{10} standard to protect against exposure to inhalable coarse particles.

http://www.epa.gov/air/particles/

Particular Matter Pollution: Where does it come from?

Fine Particles
Combustion, gases to particles
Sulfates/acids
Nitrate
Ammonium
Organics
Carbon
Metals
Water

Sources:
Coal, oil, gasoline, diesel, wood combustion
Transformation of SOx, NOx, organic gases including biogenics
High temperature industrial processes (smelters, steel mills)
Forest fires

Exposure/Lifetime:
Lifetime days to weeks, regional distribution over urban scale to 1000s of km

Inhalable Coarse Particles
Crushing, grinding, dust
Resuspended dusts (soil, street dust)
Coal/oil fly ash
Aluminum, silica, iron-oxides
Tire and brake wear
Inhalable Biological Materials (e.g., from soils, plant fragments)

Sources:
Resuspension of dust tracked onto roads
Suspension from disturbed soil (farms, mines, unpaved roads)
Construction/demolition
Industrial fugitives
Biological sources
Exposure/Lifetime:
Coarse fraction (2.5-10 µm) lifetime of hours to days, distribution up to 100s km

Particular Matter: How does it affect us?

- Larger particles (> PM_{10}) deposit in the upper respiratory tract
- Smaller, inhalable particles (≤ PM_{10}) penetrate deep into the lungs

- Both coarse particulate matter and fine particulate matter can penetrate to lower regions of the lung
- Deposited particles may accumulate, react, be cleared or absorbed

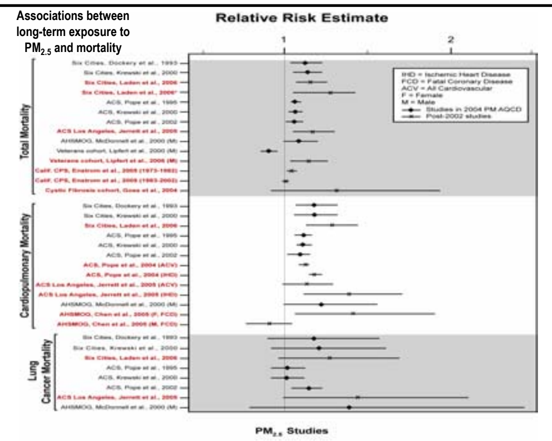
5

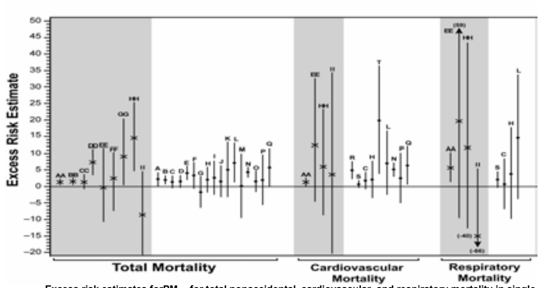
Particular Matter: How does it affect our health?

- Many scientific studies have linked breathing particle pollution to a series of significant health problems, including:
  - Aggravated asthma
  - Increases in respiratory symptoms like coughing and difficult or painful breathing
  - Chronic bronchitis
  - Decreased lung function
  - Premature death in people with heart and lung disease

Health Effect of long-term exposure to $PM_{2.5}$, Major Studies

- Key mortality studies
  - American Cancer Society (ACS) and 6 Cities Reanalyses: replication and validation study and sensitivity analysis; confirmed association between mortality and fine PM and sulfate exposures (Krewski et al., 2000)
  - ACS Study - Extended analyses: reported significant association with premature mortality from all causes, cardiopulmonary diseases, and lung cancer (Pope et al., 2002)
  - California Seventh Day Adventist Study (AHSMOG): extended analyses (more recent air quality data for PM_{10} and estimated $PM_{2.5}$ from visibility data) reported positive but not generally statistically significant association with mortality in males (Abbey et al., 1999; McDonnell et al., 2000)
  - Veterans Administration (VA) Study: inconsistent and largely nonsignificant associations between PM (TSP, PM_{10}, $PM_{2.5}$, PM_{15}, $PM_{15-2.5}$) exposure and mortality in hypertensive males (Lipfert et al., 2000)
- Key morbidity studies of respiratory effects
  - Southern California Children's Study: reported decreases in some measures of lung function growth seen in 1 cohort of children (Gauderman et al., 2000/2002) supporting previous findings of Harvard 24-city study (Dockery et al. 1996; Raizenne et al., 1996)

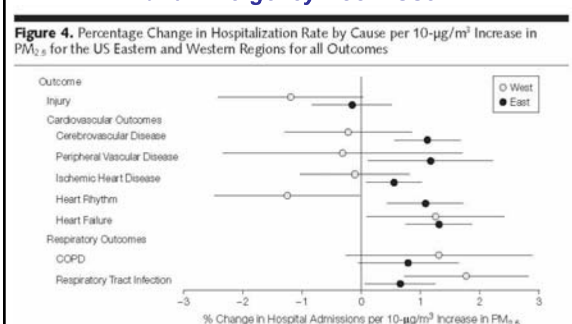




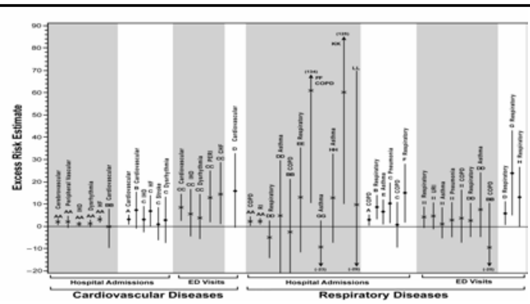
Excess risk estimates for$PM_{2.5}$ for total nonaccidental, cardiovascular, and respiratory mortality in single-pollutant models for U.S. and Canadian studies

A. Burnett and Goldberg (2003), 8 Canadian cities
B. Klemm and Mason (2003), 6 U.S. cities
C. Moolgavkar (2003), Los Angeles
D. Klemm and Mason (2003), St. Louis
E. Klemm and Mason (2003), Boston
D. Klemm and Mason (2003), Kingston-Harriman
G. Klemm and Mason (2003), Portage
H. Ito (2003), Detroit
I. Chock et al. (2000), Pittsburgh (age <75 yr)
J. Chock et al. (2000), Pittsburgh (age 75+ yr)
K. Klemm and Mason (2000), Atlanta
L. Fairley (2003), Santa Clara County
M. Klemm and Mason (2003), Topeka
N. Tsai et al. (2000), Newark
O. Klemm and Mason (2003), Steubenville
P. Tsai et al. (2000), Elizabeth
Q. Tsai et al (2000), Camden
R. Lipfert et al. (2000), Philadelphia
S. Ostro et al. (1995), Southern California
T. Mar et al. (2003), Phoenix
U. Ostro et al. (2003), Coachella Valley
AA. Ostro et al. (2006), 9 counties in CA
BB. Ostro et al. (2006), 9 counties in CA (age >65 yr)
CC. Burnett et al. (2004), 12 Canadian cities
DD. Ito et al. (in press), Washington, DC
EE. Villeneuve et al. (2003), Vancouver, Canada
FF. Slaughter et al. (2005), Spokane
GG. Goldberg et al. (2006), Montreal, Canada (age 65+yr)
HH. Klemm et al. (2004), Atlanta (age 65+ yr)
II. Klemm et al. (2004), Atlanta (age <65 yr)

Excess in Hospitalizations and Emergency Room Use



Source: Dominici et al., 2006



Excess risk estimates for $PM_{2.5}$ (per 25 ug/m3) for hospital admissions and emergency department visits for cardiovascular and respiratory diseases in single-pollutant models for U.S. and Canadian studies

A. Moolgavkar (2003), Los Angeles
B. Burnett et al. (1997), Toronto
C. Ito (2003), Detroit
D. Stieb et al. (2000), St. John
E. Sheppard (2003), Seattle
F. Thurston et al. (1994), Toronto
G. Delfino et al. (1997), Montreal
H. Delfino et al. (1998), Montreal
AA. Dominici et al. (2006), 204 U.S. counties (age >65 yr)
BB. Slaughter et al. (2005), Spokane (age 15+ yr)
CC. Metzger et al. (2004), Atlanta
DD. Slaughter et al. (2005), Spokane
EE. Chen et al. (2005), Vancouver, Canada (age 65+ yr)
FF. Chen et al. (2004), Vancouver, Canada (age 65+ yr)
GG. Yang et al. (2004), Vancouver, Canada (age >3 yr)
HH. Lin et al. (2002), Toronto, Canada (age 6-12 yr, boys)
II. Lin et al. (2002), Toronto, Canada (age 6-12 yr, girls)
JJ. Peel et al. (2005, Atlanta
KK. Lin et al. (2005), Toronto, Canada (age <16 yr, boys)
LL. Lin et al., (2005), Toronto, Canada (age <16 yr, girls)

Revisions History of the National Ambient Air Quality Standards (NAAQS) for Particle Pollution

1971 – EPA promulgates NAAQS for "total suspended particulate" (particles smaller than ~25-45 µm in diameter)

1987 – EPA revises PM NAAQS, changing the indicator from TSP to PM10 to focus on "inhalable" particles (< 10 µm)

1997 – EPA revises PM NAAQS to focus separately on the "fine" and "coarse" fractions of PM10

- •New standards established for "fine" particles < 2.5 µm in diameter (PM2.5)
- •PM10 standards retained to focus on "coarse fraction" (particles between 2.5 and 10 µm in diameter)
- •A number of events delayed the implementation of PM2.5.
- •Industry organizations and state governments challenged EPA in the U.S. District Court.

2001 - the U.S. Supreme Court upheld EPA's authority under the Clean Air Act to set standards. Several unresolved issues were sent back to the District Court.

2002 - the District Court rejected all remaining legal challenges to EPA's 1997 standards for PM2.5.

2004- EPA designated 224 counties, as well as DC, as not meeting the standards for PM2.5.

Why size and mass do matter?

- Particle size
  - Epidemiological evidence largely based on $PM_{2.5}$
  - Fine particles captured more completely under all conditions
  - Larger accumulation-mode particles included that may act as carriers of other toxic agents into respiratory system
- Total mass
  - Epidemiological evidence
    - Effects observed in a large number of areas with differing components or sources (e.g., sulfates, wood smoke, nitrates, carbon, organic compounds, and metals)
    - Studies incorporating $PM_{2.5}$ speciation data limited
  - Toxicological evidence *(in vivo, in vitro)*
    - Effects observed for a variety of components (e.g., sulfates, notably primary metal sulfate emissions from residual oil burning; metals; organic constituents; bioaerosols; diesel particles)
  - No sufficient evidence to identify any component(s) as being primarily responsible
  - No sufficient evidence available to identify any component(s) as <u>not</u> contributing

EPA's PM Standards: Old and New

	Previous Standards		2006 Standards	
	Annual	24-hour	Annual	24-hour
$PM_{2.5}$ (Fine Particles)	15 µg/m³ Annual arithmetic mean, averaged over 3 years (established in 1997)	65 µg/m³ 24- hour average, 98th percentile, averaged over 3 years (established in 1997)	15 µg/m³ Annual arithmetic mean, averaged over 3 years	35 µg/m³ 24- hour average, 98th percentile, averaged over 3 years
PM_{10} (Coarse Particles)	50 µg/m³ Annual average (established in 1987)	150 µg/m³ 24-hr average, not to be exceeded more than once per year on average over a three year period (established in 1987)	Revoked	150 µg/m³ 24-hr average, not to be exceeded more than once per year on average over a three year period

The 15 µg/m³ seems like a good long-term exposure standard

Annual standard of 15 µg/m³ retained, spatial averaging criteria revised

- Level: "stronger and more robust" evidence from long-term exposure studies was principal basis; risk assessment provided "supporting evidence" of need to revise current suite of $PM_{2.5}$ standards
  - Across-city long-term average concentrations in key mortality studies provide basis for a level no higher than 15 µg/m³, but do not provide clear basis for a lower level
    - Greatest weight to 6 Cities and ACS reanalyses (18 and 21 µg/m³) and extended ACS (17.7 µg/m³)
  - Key morbidity studies provide uncertain basis for establishing a level
    - Harvard 24-City (~14.5 µg/m³) provided uncertain evidence of association below ~15 µg/m³
    - Important findings from S. California Children's Study (~15 µg/m³), but only study of decreased lung function growth in just one area of the country; one cohort statistically significant
- Form: spatial averaging constraints tightened to avoid substantially greater exposures in some areas and disproportionate impacts on vulnerable populations
  - Revised NAAQS allow spatial averaging under more restrictive criteria for correlations between monitors

Is 15 µg/m³ a good standard for the long-term exposure?

Annual standard: enhanced evidence for adverse health effects associated with <u>long-term</u> exposures to $PM_{2.5}$

- Additional epidemiological evidence of mortality and morbidity associations observed in 10 new studies (5 follow up/extensions)
  - Overall pattern of results consistent with earlier studies (see figure)
  - Higher risk estimates from 6-city prospective study (lower $PM_{2.5}$ over decades) and within city analysis of ACS data in Los Angeles
  - Follow-up to S. CA Children's Health study (lung function) and new Cystic Fibrosis cohort have lower mean levels (15 ug/m³ original, 13.7 µg/m³ follow up; 13.8 µg/m³)
  - Disparate mortality results from Veterans cohort (traffic and components) and California cancer cohort; contrasts with national, LA findings

Short-term exposure standard: Why it was changed

24-hour standard: focus on short-term exposure $PM_{2.5}$ studies

- Much expanded body of evidence provides more robust data for effects previously observed and provides evidence of additional effects
  - Additional evidence of mortality, hospitalization/ED visits for respiratory disease, respiratory symptoms
  - New effects include cardiovascular (CV) hospitalization/ED visits and effects on the cardiovascular system (e.g., myocardial infarction, cardiac function and biomarkers, blood biomarkers)
- Key <u>mortality</u> studies, including multi-city $PM_{2.5}$ studies, as well as multi-city PM_{10} studies that provide important new information to help address uncertainties
  - 6 Cities Study (Schwartz et al., 2003); reanalysis (Klemm and Mason, 2003)
  - 8 Canadian Cities (Burnett and Goldberg, 2003)
  - Many single-city $PM_{2.5}$ studies [e.g., Phoenix (Mar et al., 2003); Santa Clara (Fairley, 2003)]
  - PM_{10} multi-city studies: 90 US Cities NMMAPS (Samet et al, 2000; Dominici et al, 2003);10 US Cities (Schwartz, 2003)
- Key <u>morbidity</u> studies
  - 6 US Cities – lower respiratory symptoms in children (Schwartz and Neas, 2000)
  - Philadelphia – reduced lung function in children (Neas et al., 1999)
  - Toronto – CV and respiratory hospital admissions (Burnett et al., 1997)
  - Detroit – CV and respiratory hospital admissions (Ito, 2003)
  - Los Angeles - CV and respiratory hospital admissions (Moolgavkar, 2003)
  - Boston - myocardial infarction (Peters et al., 2001)

New short-term exposure standard: 24-hour, 35 µg/m^3

24-hour standard: level revised down to 35 µg/m^3 and 98th percentile form retained

- Emphasis placed on using 24-hour standard rather than annual standard to protect against effects associated with short-term exposures
  - Evidence of short-term exposure effects is greater than for long-term exposure effects
  - Toxicological findings largely related to the effects of short-term, rather than long-term exposures
- Level: "much expanded" body of evidence from short-term exposure studies used as principal basis, with risk assessment providing "supporting evidence" of need to revise current suite of $PM_{2.5}$ standards
  - Vast majority of studies indicating adverse effects had 98th percentile levels generally <*65 µg/m^3*
  - Strong predominance of studies with 98th percentile levels down to ~ 39 µg/m^3 (Burnett and Goldberg, 2003)reported statistically significant associations with mortality, hospital admissions/ED visits, and respiratory symptoms
  - Mixed results observed in studies with 98th percentile levels of 30 to 35 µg/m^3
  - Very limited number of studies below this range provide no basis for going below 30 µg/m^3
  - Confidence in associations down close to this range provides basis for selecting level within range
  - Uncertainties (e.g., threshold, models, causality at lower levels) weighed in selecting 35 µg/m^3

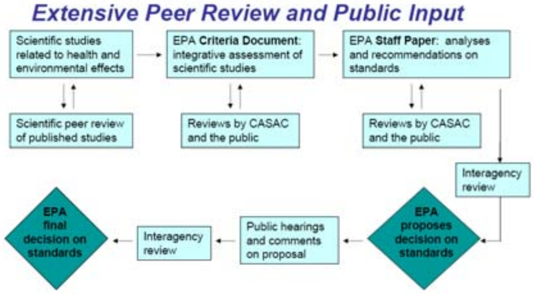
More supporting evidence

- Evidence of cardiovascular and respiratory morbidity is strengthened
  - Largest multi-city study to date (Dominici et al., 2006); 11.5 million medicare patients in 204 counties
    - Multiple cardiovascular and respiratory endpoints significant, annual $PM_{2.5}$ across counties 13.5 ug/m^3
    - Evidence of regional variation in nature and significance of effects (east > west)
- Additional evidence on mortality
  - Focus on new multi-city Canadian study on NO_2 (Burnett et al., 2004), relation to key earlier 8-city study (98th percentile at 39 ug/m^3)
    - Overall study stresses NO_2, limited $PM_{2.5}$ sampling, marginal significance, not robust
    - Subset analyses with daily $PM_{2.5}$, $PM_{2.5}$ reduces NO_2 effect, robust against NO_2

Regulating Particle Pollution

- The Clean Air Act requires EPA to set two types of national ambient air quality standards (NAAQS) for 'criteria' air pollutants
  - ***Primary standards*** to protect public health with an adequate margin of safety
  - ***Secondary standards*** to protect public welfare and the environment (visibility, wildlife, crops, vegetation, national monuments and buildings)
- EPA has set NAAQS for six common air pollutants:
  - Particulate matter - Ground level ozone (smog)
  - Carbon monoxide - Lead
  - Nitrogen dioxide - Sulfur dioxide
- The law requires EPA to review the scientific information and the standards for each pollutant ***every five years***
- The law also requires EPA to obtain advice from the Clean Air Scientific Advisory Committee (CASAC) on each review

PM NAAQS Review Process – Extensive Peer Review and Public Input



Process for revising New $PM_{2.5}$ NAAQS Standards

- Rulemaking on PM NAAQS:
  - ***Proposal*** signed on December 20, 2005 (as required by consent agreement)
  - ***Public comment*** period: ended April 17, 2006. EPA received more than 120,000 comments.
  - ***Public Hearings*** held March 2006 in Philadelphia, Chicago and San Francisco
  - ***Final Rule*** signed on September 21, 2006 (consent agreement required signature by September 27, 2006)
  - September 21, 2006 rulemaking includes:
    - PM NAAQS, Federal Reference Method, & Data Handling (Part 50)
  - Upcoming and related rulemakings:
    - Air Monitoring Regulations: Requirements for Reference and Equivalent Methods, Network Design Requirements (Parts 53 & 58) (September 27, 2006)
    - Final Rule to Implement the 1997 PM Standards (October 2006)
    - Final Rule on Exceptional & Natural Events (March 2007)

Reviewing the PM Standards

- EPA final decisions reflect the review of thousands of peer-reviewed scientific studies about the effects of particle pollution on public health and welfare.
- External scientific advisors and the public provided extensive review of the Agency's science and policy documents.
- The Agency also carefully considered public comments on our proposal. EPA held three public hearings and received over 120,000 written comments.

Reviewing the PM Standards

- The Agency provisionally assessed new, peer-reviewed studies about particle pollution and health (including some studies received during the comment period) to ensure that the Administrator was aware of new science before setting the final standards. That assessment did not materially change EPA's understanding of PM health effects.
- EPA did not base its decision on these new studies, however, because they have not been through as rigorous a level of review as the science on which the Agency based its December 2005 proposal.
- EPA will consider these new studies and other relevant information during the next review of the PM standards.
- The rigorous review has resulted in a suite of standards that will protect the health and welfare of all Americans.

Timeline for Implementing New $PM_{2.5}$ NAAQS Standards

Milestone	1997 $PM_{2.5}$ Primary NAAQS	2006 $PM_{2.5}$ Primary NAAQS
Promulgation of Standard	July 1997	Sept. 2006
State Recommendations to EPA	Feb. 2004 (based on 2001-2003 monitoring data)	Dec. 2007 (based on 2004-2006 monitoring data)
Final Designations Signature	Dec. 2004	Dec. 2009
Effective Date of Designations	April 2005	April 2010
SIPs Due	April 2008	April 2013
Attainment Date	April 2010 (based on 2007-2009 monitoring data)	April 2015 (based on 2012-2014 monitoring data)
Attainment Date with Extension	Up to April 2015	April 2020

EPA's PM Standards: Old and New

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	Annual	24-hour	Annual	24-hour
$PM_{2.5}$ (Fine Particles)	15 µg/m³ Annual arithmetic mean, averaged over 3 years (established in 1997)	65 µg/m³ 24- hour average, 98th percentile, averaged over 3 years (established in 1997)	15 µg/m³ Annual arithmetic mean, averaged over 3 years	35 µg/m³ 24- hour average, 98th percentile, averaged over 3 years
PM_{10} (Coarse Particles)	50 µg/m³ Annual average (established in 1987)	150 µg/m³ 24-hr average, not to be exceeded more than once per year on average over a three year period (established in 1987)	Revoked	150 µg/m³ 24-hr average, not to be exceeded more than once per year on average over a three year period

$PM_{2.5}$ – Primary 24-hour Standard

- EPA has strengthened the level of the **24-hour $PM_{2.5}$ standard** from the 1997 level of **65 µg/m³** to **35 µg/m³**.
  - EPA made this change based on its assessment of a significantly expanded body of scientific information.
  - Epidemiologic studies show health effects at and below the levels allowed by the 1997 24-hour standard including premature death, increased emergency room visits and increased hospitalizations.
  - There was consensus among CASAC panelists to place more emphasis on lowering the 24-hour $PM_{2.5}$ standard.
  - EPA's assessment concluded that the standard should be strengthened to better protect the public from short-term fine particle exposures.
- An area will meet the 24-hour standard if the average of the 98th percentile of 24-hour $PM_{2.5}$ concentrations averaged over three years, is less than or equal to the level of the standard of 35 µg/m³. This is the same averaging convention as the 1997 24-hour $PM_{2.5}$ standard.

$PM_{2.5}$ – Primary Annual Standard

- EPA has retained the level of the **annual $PM_{2.5}$** standard at **15 µg/m³**.
  - EPA retained this level, set in 1997, based on its assessment of several expanded, re-analyzed and new epidemiologic studies.
  - The study results have increased the Agency's confidence in associations between long-term $PM_{2.5}$ exposure and serious health effects, including heart and lung-related death.
  - While the Administrator carefully considered the advice received from CASAC to lower the annual standard to 13 – 14 µg/m³, he has a different view than CASAC on whether the evidence warrants a further tightening of the annual standard. In the Administrator's judgment, an annual standard of 15 µg/m³ provides the appropriate level of protection with an adequate margin of safety.
- An area will meet the annual $PM_{2.5}$ standard when the three-year average of the annual average $PM_{2.5}$ concentration is less than or equal to 15 µg/m³.
- EPA made a small revision to the form of this standard, tightening the conditions under which more than one monitor could be used to determine the annual average $PM_{2.5}$ levels in an area. This is known as spatial averaging.

Inhalable Coarse PM – Primary 24-hour Standard

- The Agency has retained the existing 24-hour PM_{10} standard of 150 µg/m³ in order to protect the health of Americans in all areas of the country.
  - EPA based its final decision on a number of factors, including the review of the scientific information and public comments.
  - While the available science indicates that coarse particles in urban areas generally are linked to adverse health effects, the evidence is inconclusive about whether coarse particles in rural areas harm health.
  - Based on the lack of evidence about coarse particles in rural areas, and after considering public comments, EPA decided to take a cautious approach and retain the existing 24-hour PM_{10} standard to protect people in all areas of the country.
- An area will meet the 24-hour PM_{10} standard when the 150 µg/m³ level is not exceeded more than once per year on average over a three year period.

Inhalable Coarse PM – Revoking the Annual Standard

- The Agency is revoking the annual PM_{10} standard.
- Available evidence does not suggest a link between long-term exposure to PM_{10} at current ambient levels and health problems.
- Analysis of air quality data shows that the 24-hour PM_{10} standard generally results in annual average PM_{10} levels at or below the level of the former annual standard of 50 µg/m³.

Secondary Standards–

- EPA set the secondary standards to be identical in all respects to the revised primary standards.

  $PM_{2.5}$
  - EPA revised the 24-hour $PM_{2.5}$ standard to be 35 µg/m³ and retained the annual $PM_{2.5}$ standard at 15 µg/m³ .

  PM_{10}
  - EPA retained the 24-hour PM_{10} standard at 150 µg/m³ and revoked the annual PM_{10} secondary standard
- These standards were established to protect against visibility impairment and other PM welfare effects including effects on vegetation and ecosystems and materials damage and soiling.

Benefits and Costs

- The Clean Air Act prevents EPA from considering costs in setting or revising NAAQS.
- However, the Agency does analyze the benefits and costs of implementing standards as required by Executive Order 12866 and as a good government practice, to inform Congress and the public of benefits and costs.
- When fully met, the revised 24-hour $PM_{2.5}$ standards are estimated to yield between $9 billion and $75 billion a year in health and visibility benefits in 2020. This estimate is based on the opinions of outside experts on PM and the risk of premature death, along with other benefits information.
- The results of one key study alone suggest that a central estimate of the benefits of meeting the revised 24-hour $PM_{2.5}$ standards is $17 billion per year in 2020, though other recent studies suggest the benefits may be higher.
- These benefits are in addition to the benefits of meeting the 1997 standards.
- EPA estimates the cost of meeting these revised standards at $5.4 billion per year in 2020.

Benefits and Costs

- The benefits of meeting the revised 24-hour $PM_{2.5}$ standards include the value of estimated annual reductions of:
  - 1,200 to 13,000 premature deaths in people with heart or lung disease;
  - 2,600 cases of chronic bronchitis;
  - 5,000 nonfatal heart attacks;
  - 1,630 hospital admissions for cardiovascular or respiratory symptoms;
  - 1,200 emergency room visits for asthma;
  - 7,300 cases of acute bronchitis;
  - 97,000 cases of upper and lower respiratory symptoms;
  - 51,000 cases of aggravated asthma;
  - 350,000 days when people miss work or school; and
  - 2 million days when people must restrict their activities because of particle pollution-related symptoms.

Implementation Issues

<u>24-hour $PM_{2.5}$ Standard</u>

- EPA intends to designate areas in late 2009–3 years plus 60 days after the PM standards are published in the *Federal Register*.
- These designations would likely become effective in early 2010.

<u>Annual $PM_{2.5}$ Standard and 24-hour PM_{10} Standard</u>

- In the near future, EPA intends to address, as necessary, issues such as designations, conformity, and new source review, related to implementation of today's final rule.

State of the Modeling Science

Illinois Department of Transportation Peer Exchange Series
Particulate Matter Peer Exchange Meeting

Michael Claggett
FHWA Resource Center

October 23, 2007

Challenge

Need to reliably forecast potential adverse air quality impacts from proposed highway projects for particulate matter (PM)

Existing tools
- Vehicle speed forecasting
- Emission factor models
- Highway air dispersion models

Future tools
- EPA's MOVES model

What's the outlook for quantitative PM hot-spot analyses?

Vehicle Speed Forecasting

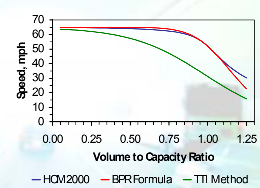
Emissions from motor vehicles vary with operating speed

Computations at the planning level
- Highway Capacity Manual 2000 (HCM2000), Chapter 30
- Bureau of Public Roads (BPR) formula
- Texas Transportation Institute (TTI) method

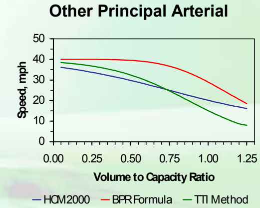
Assembling data by highway groupings
- Demand data
- Free-flow speed
- Capacity

Congested Vehicle Speed Forecasting

Interstate



Other Principal Arterial



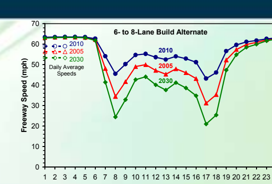
(Small Urbanized Area)

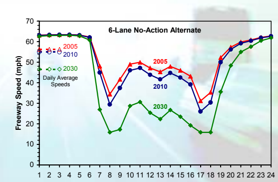
Representativeness Check

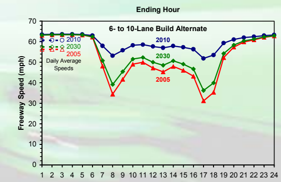
Interstate				
Speed Methodology	Small Urbanized V/C = 1.0	Small Urbanized V/C = 1.25	Large Urbanized V/C = 1.0	Large Urbanized V/C = 1.25
HCM 2000	52	30	51	29
BPR Formula	52	23	51	27
TTI Method	31	16	30	16
EPA – LOS F	19			
EPA – LOS G	13			

Other Principal Arterial				
Speed Methodology	Small Urbanized V/C = 1.0	Small Urbanized V/C = 1.25	Large Urbanized V/C = 1.0	Large Urbanized V/C = 1.25
HCM 2000	20	16	13	11
BPR Formula	29	19	18	9
TTI Method	15	8	14	8
EPA – LOS E-F	12			

Freeway Hourly Traffic Speeds







Current Emission Factor Models

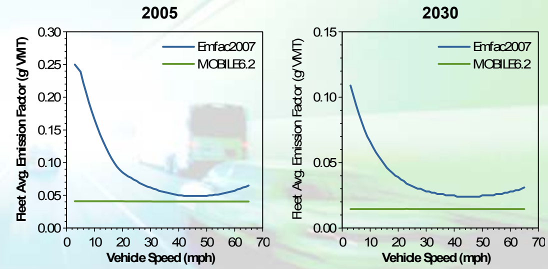
MOBILE6.2

Emfac2007

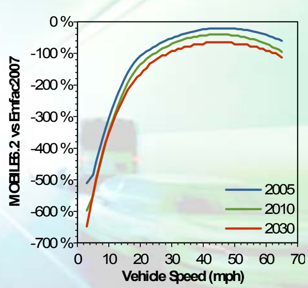
Similar design, except for PM

- Emissions based on motor vehicle testing
- Correction factors applied in Emfac2007 to account for on-road use, including changes in vehicle operating speeds
- Key correction factors missing from MOBILE6.2
  - As a result, EPA deems it unsatisfactory for use in quantitative hot-spot analyses for PM-2.5 and PM-10

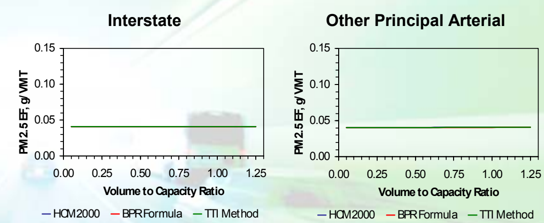
PM2.5



PM2.5

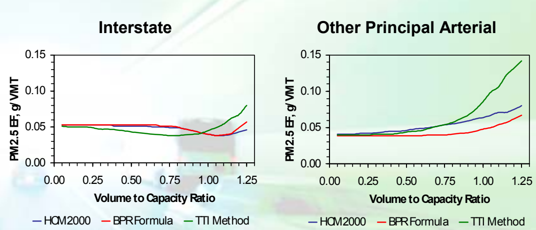


Implications for Congestion Relief Projects



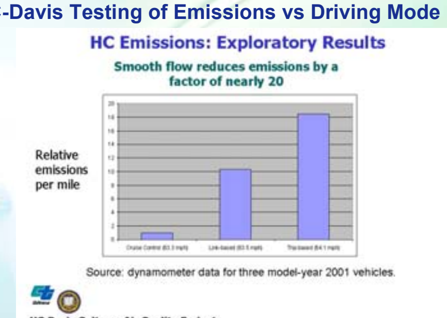
MOBILE6.2 – Small Urbanized Area – 2010

Implications for Congestion Relief Projects



Emfac2007 – Small Urbanized Area – 2010

UC-Davis Testing of Emissions vs Driving Mode



MOVES

MOtor Vehicle Emissions Simulator

Replacement for MOBILE6.2 (and eventually NONROAD)

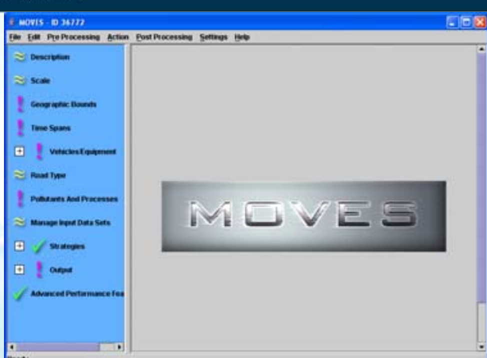
New software framework

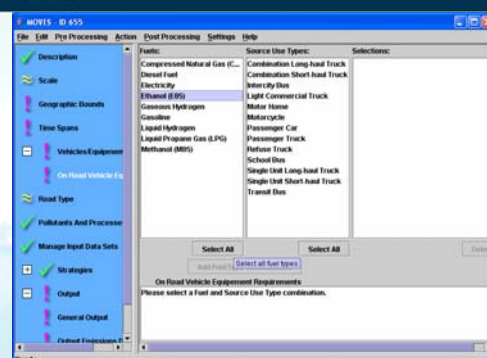
- Relational database structure to store fleet, activity, and emission rate data
- Graphical user interface

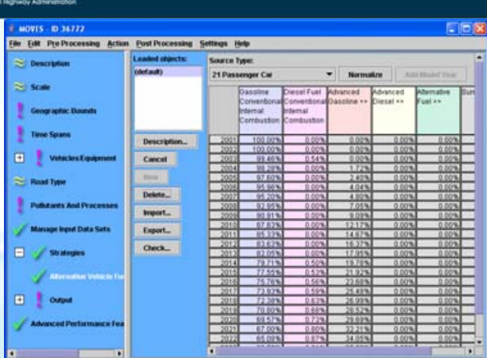
MOVES

New framework accommodates

- Large amounts of in-use data to be incorporated from a variety of sources
- Easier to update with new data
- Multiple computer processing







MOVES

MOVES vs. MOBILE6.2

- Inventory estimation in g/time vs. emission factors in g/mi
- Analysis at multiple scales vs. regional level only
  - Macroscale
  - Mesoscale (regional level)
  - Microscale (project level)
- Modal emission rates vs. emission rates based on aggregate driving cycles
- New data and methodologies

MOVES

New data collected since the release of MOBILE6.2

- Activity
  - In-use vehicle trip patterns
- Light-duty vehicles
  - Thousands of in-use vehicles from I/M programs
  - Kansas City gasoline program
  - Remote sensing data
- Heavy-duty vehicles
  - 100 in-use vehicles

RESOURCE CENTER

MOVES

On-road emission processes

- Running
- Start
- Extended idle
- Evaporative
- Crankcase
- Tire wear
- Break wear
- Life cycle
  - Well-to-pump

RESOURCE CENTER

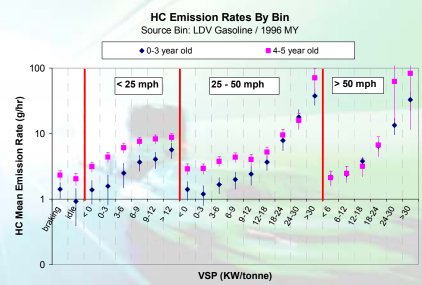
MOVES

Modal binning approach for running emission process

- Group activity and emissions segregated into bins
  - Vehicle specific power (VSP) and speed
    Accounts for speed, acceleration, road grade, load
- Any driving pattern can be modeled
- Allows direct use of data from many sources
  - Laboratory, I/M programs, research
- Common emission rates across all scales

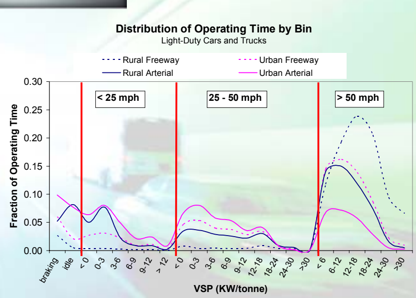
RESOURCE CENTER

MOVES



RESOURCE CENTER

MOVES



RESOURCE CENTER

MOVES

Versions

- MOVES2004 released
  - On-road energy consumption, CH4, N2O, well-to-pump
- Highway Vehicle Implementation (HVI)
  - Adds HC, CO, CO2, NOx, PM
  - Later version for MSATs, NH3, SO2
  - Replaces MOBILE6.2
  - MOVES-HVI demonstration available
- Off-Road Implementation
  - Equipment covered in NONROAD model
  - Plus aircraft, commercial marine, locomotive

RESOURCE CENTER

Schedule

- Spring 2007
  - Demonstration model posted for comment
- Late 2007 to mid-2008
  - Complete emission rate analysis
- Fall 2008
  - Draft MOVES for highway vehicles released for comment
- Fall 2009
  - Final MOVES for highway vehicles released
- 2010 and beyond
  - Other sources added

MOVES Demo

- Demonstration version of MOVES-HVI
- Tool to learn MOVES input and output structure
- Placeholder values for emission rates
  - Actual emission rates are not represented
  - Not for regulatory applications (State Implementation Plans, conformity determinations, National Environmental Policy Act)

MOVES Demo posted May 2007

- MOVES website
  http://www.epa.gov/otaq/ngm.htm
- MOBILENEWS e-mail list
  http://www.epa.gov/otaq/models/mobilelist.htm
- User guide
- Software development reference manual

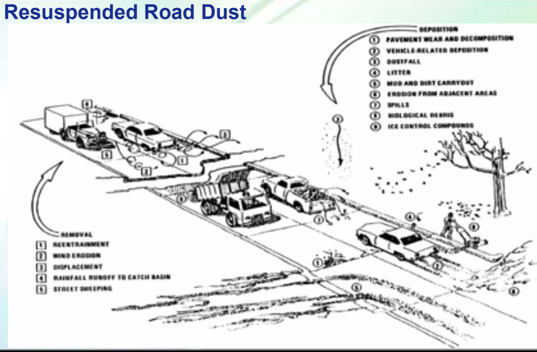
More to come from EPA

- Training
  - When draft model is ready
- Tools development
  - Convert MOBILE6 inputs to MOVES inputs
  - Interface for project-level analysis inputs
  - Ways to integrate travel model output with MOVES inputs
- Guidance
  - Use of locale-specific inputs versus default values

EPA wants to hear from you

- How you currently use MOBILE6 and how you would like to use MOVES
- If you've tried MOVES Demo
  - What works well?
  - What doesn't?
- Contact EPA at
  mobile@epa.gov

Resuspended Road Dust



Predictive Equation for Paved Roads

$$E = k\left(\frac{sL}{2}\right)^{0.65} \times \left(\frac{W}{3}\right)^{1.5} - C$$

E = annual average PM emission factor in units matching the units of k;
k = particle size multiplier;
sL = road surface silt loading (g/m^2) – mass of silt size material (≤ 75 µm diameter) as determined by measuring the amount that passes a 200-mesh screen using the ASTM-C-136 method;
W = average weight (tons) of the vehicles traveling the road; and
C = emission factor for 1980's vehicle fleet exhaust, brake wear, and tire wear.

Size Range	k g/VMT	C g/VMT
PM-2.5	1.1	0.1617
PM-10	7.3	0.2119
PM-15	9.0	0.2119
PM-30	38.0	0.2119

Predictive Equation for Paved Roads (continued)

EPA has assigned the equation a quality rating of A (B for PM-2.5) if applied within the range of source conditions tested:

- sL = 0.3 – 400 g/m^2
- W = 2.0 – 42 tons
- S = 10 – 55 mph

Applicable for:

- Freely flowing vehicles
- Constant speed
- No stop and go traffic
- Relatively level roads

Predictive Equation for Paved Roads (continued)

Example Baseline Annual Average PM-2.5 Emission Factors for Resuspended Road Dust from Paved Roads (g/VMT)

Year	Annual Average Daily Traffic (vpd)				
	< 500	500 - 5,000	5,000 - 10,000	> 10,000	> 10,000 Limited Access
2005	1.0	0.42	0.11	0.0092	0.0000
2010	1.1	0.44	0.11	0.013	0.0000
2030	1.1	0.46	0.12	0.019	0.0000

Highway Air Dispersion Models

Current EPA guideline highway air quality models

- CALINE3 / CAL3QHC
  - Developed more than a decade ago for episodic analysis of CO
  - Traffic, emission factor, and dispersion models have been updated considerably

Highway Air Dispersion Models

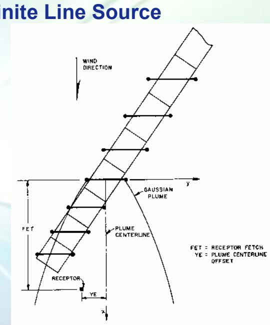
Alternative models are being used to predict short-term and long-term concentrations of MSATs

- CALINE4
- HYROAD
- ISCST3
- AERMOD

Similar design

- Based on the Gaussian plume equation

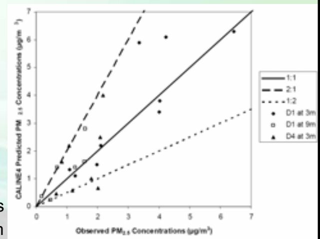
Equivalent Finite Line Source



Modeled Versus Measured PM 2.5 Comparisons

UC Davis-Caltrans Air Quality Project – PM2.5 Modeling Capabilities of CALINE4

- ~ 80% of predicted values are within a factor of two of the observed value
- Very low observed concentrations
- Traffic volume range: 1064 to 4517 vph
- Sampling times of 3 to 5 hours
- D1 = 26.5 m; D4 = 106 m from NW corner of intersection



Modeled Versus Measured CO Comparisons (NCHRP Report on HYROAD Model Formulation, July 2002)

Precision (correlation, r) –

- Better for top concentrations unpaired in space and time (a conformity-type application)
- Much worse for concentrations paired at specific locations and times (an exposure-type application)

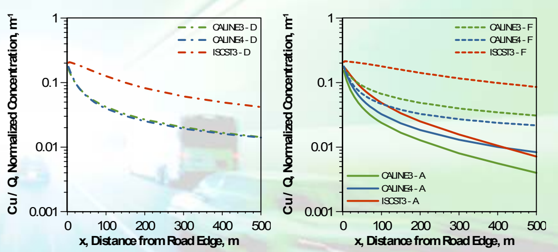
Accuracy (bias, k) –

- Ranges from a factor of 3 under-prediction to a factor of 5 over-prediction

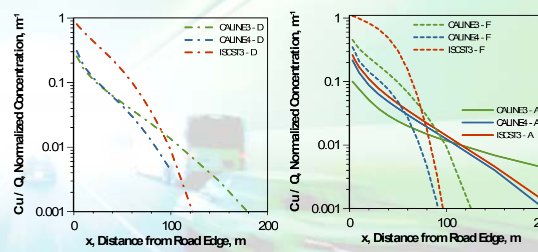
CAL3QHC / MOBILE5a / 1985 Highway Capacity Manual

	Tucson	Denver	Virginia
All Data Paired in Space and Time	n = 2016 k = 0.34 r = 0.60	n = 1848 k = 3.13 r = 0.34	n = 1848 k = 4.76 r = 0.19
Top Concentrations Paired in Space and Time	n = 25 k = 0.22 r = 0.38	n = 25 k = 1.75 r = -0.31	n = 25 k = 3.13 r = -0.07
Top Concentrations (Ranked) Unpaired in Space & Time	n = 25 k = 0.39 r = 0.95	n = 25 k = 7.50 r = 0.97	n = 25 k = 9.68 r = 0.98

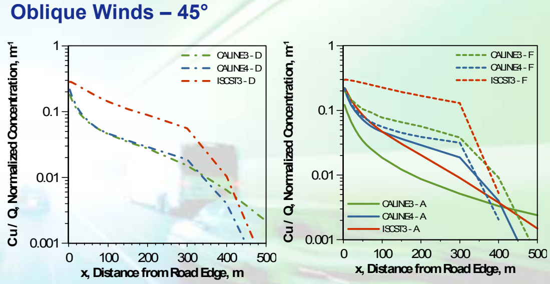
Perpendicular Winds – 90°



Parallel Winds – 10°



Oblique Winds – 45°



What If ?

The U.S. EPA has not recommended a quantitative hot-spot analysis methodology for PM2.5

- Primarily due to the short comings of the MOBILE6.2 model

What if Emfac2007 emission factors for PM2.5 were employed in the CALINE3/CAL3QHC models

- Predict worst case pre-screen concentrations
- Similar to that routinely done for CO

FHWA is not recommending this approach – this is an academic exercise

What If ?

6-lane by 6-lane Intersection operating at capacity

- 2010
  - Maximum predicted 24 hour average PM2.5 concentration = 14.4 μg/m^3 (without background)
  - Maximum predicted annual average PM2.5 concentration = 2.9 μg/m^3 (without background)
- 2030
  - Maximum predicted 24 hour average PM2.5 concentration = 8.8 μg/m^3 (without background)
  - Maximum predicted annual average PM2.5 concentration = 1.8 μg/m^3 (without background)

What If ?

14-lane Interstate by 6-lane Arterial Crossover operating at capacity

- 2010
  - Maximum predicted 24 hour average PM2.5 concentration = 29.1 μg/m^3 (without background)
  - Maximum predicted annual average PM2.5 concentration = 5.8 μg/m^3 (without background)
- 2030
  - Maximum predicted 24 hour average PM2.5 concentration = 17.0 μg/m^3 (without background)
  - Maximum predicted annual average PM2.5 concentration = 3.4 μg/m^3 (without background)

Concluding Thoughts

There is little consensus among the available analytical tools for predicting:

- Vehicle speeds;
- Emissions; and
- Concentrations

Mitigating persistent congestion on highways may reduce PM2.5 emissions from motor vehicles on a unit vehicle-mile of travel basis

Concluding Thoughts

The degree of mitigation depends on the:

- Speed forecasting approach used;
- Manner in which the speed forecasting approach is applied; and
- Emission correction factors used to account for on-road vehicle use

Different results are obtained with different assumptions

Concluding Thoughts

Emfac2007 predicts substantially higher PM2.5 emission factors compared to MOBILE6.2

PM2.5 emission factors from Emfac2007 vary with speed – with MOBILE6.2 they do not

Concluding Thoughts

CAL3QHC paired with MOBILE5a

- Substantially over-predicts concentrations at signalized intersections with considerable vehicle queuing and
- Substantially under-predicts concentrations at signalized intersections with minimal vehicle queuing

MOBILE6.2 predicts substantially higher relevant CO emission factors than either MOBILE4 (used in the development of CAL3QHC) or MOBILE5a (used in the NCHRP study)

Idle emission factors, a critical input parameter for air quality modeling near signalized intersections, are not calculated by the MOBILE6.2 or Emfac2007 models

Overview of Clean Diesel Requirements and Voluntary Programs

Francisco J. Acevedo

Particulate Matter Peer Exchange Meeting
October 23-24, 2007
Allerton Park, Monticello, IL

A New Approach to Clean Air Programs for Mobile Sources

- In the past, EPA created separate programs for vehicle emission standards and cleaner fuels
- The new 2007 diesel program and the nonroad diesel program take a systems approach (vehicle & fuel) to optimize costs and benefits
- Also considers the inter-relationship with other programs (like gasoline desulfurization)

Regulatory Strategy

New Standards for NEW diesels

Diesel engines in all mobile source applications--

- *Regulations adopted; now focused on implementation:*

Light-duty vehicles

- **Tier 2 Standards (1999 rulemaking)** – 77-95% lower light-duty vehicle standards (beginning in 2004)– Same standards for light trucks and cars; gasoline and diesel

Heavy-duty trucks & buses

- **Heavy-Duty 2007 Standards (2000 rulemaking)** – Diesel sulfur control (15 ppm maximum, beginning in 2006)– 90% lower heavy-duty gasoline & diesel vehicle standards

Nonroad machines

- **Nonroad Tier 4 Standards (2004 rulemaking)** – Diesel sulfur control (2 steps -500 ppm in 2007, 15 ppm in 2010)– 90-95% lower emission standards -based on highway technology

Regulatory Strategy

New Standards for NEW diesels

Diesel engines in all mobile source applications--

- *Rulemakings underway for:*

Locomotives

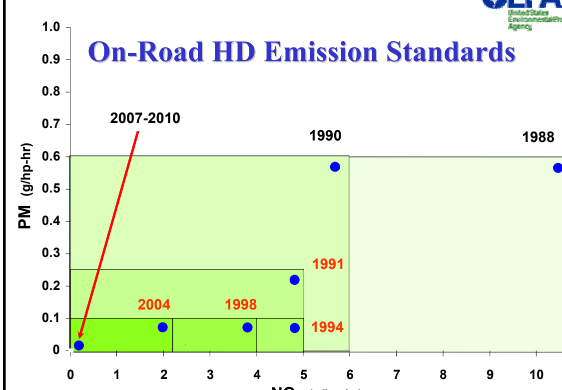
Marine vessels

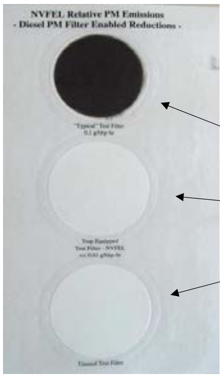
- **Locomotive and Marine Diesel Standards (proposal -April 3, 2006)** – Marine diesel sulfur control (15 ppm maximum) in 2012– Proposes requiring same technologies as on-road (Tier 3 &4)
- **Diesel Retrofit (ongoing)** – Ultra-low sulfur diesel fuel enables advanced technologies– Realize substantial air quality and health benefits earlier

Heavy-Duty 2007 Standard Requirements

	2006	2007	2008	2009	2010	2011	2012
PM		**100%** at **0.01** g/hp-hr					
NOx		**50%** at **0.20** g/hp-hr			**100%** at **0.20** g/hp-hr		
Fuel		**80%** at **15** ppm maximum sulfur (under temporary compliance option)			**100%** at **15 ppm**		

On-Road HD Emission Standards





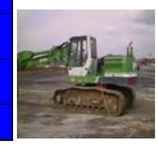
PM Emissions with Trap

- Typical test filter – current standards
- Test filter – 2007 standards
- Unused test filter

Nonroad Program Requirements

- **Exhaust emission standards apply to diesel engines used in most kinds of construction, agricultural, and industrial equipment**
  - **Excludes diesel engines used in locomotives or marine vessels**

Rated Power	First Year that Standards Apply	PM (g/hp-hr)	NOx (g/hp-hr)
hp < 25	2008	0.30	-
25 ≥ hp < 75	2013	0.02	3.5*
75 ≥ hp < 175	2012-2014	0.02	0.30
175 ≥ hp < 750	2011 - 2013	0.01	0.30
hp > 750	2011 - 2014	0.01	0.30



Nonroad Diesel Rule Fuel Provisions

- 500 ppm cap on sulfur in 2007
  - for all nonroad diesel fuel including locomotive and marine applications
- 15 ppm cap on sulfur in 2010
- 99% reduction from pre-2007 levels (~3,400 ppm)

MVNRLM Diesel Fuel Standards

Who	Covered Fuel	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Highway Diesel Fuel	80% 15 ppm / 20% 500 ppm				100% 15 ppm (including small refiner fuel)				
Large Refiner & Importer	Nonroad		500	500	500	15	15	15	15	15
Large Refiner & Importer	Loco and Marine		500	500	500	500	500	15	15	15
	NRLM with Credits (Not in NE or AK)		HS	HS	HS	500	500	500	500	15
Small Refiner	NRLM (Not in NE, w/ approval in AK)		HS	HS	HS	500	500	500	500	15
Transmix Processor & In-use	Nonroad (Not in NE or AK)		HS	HS	HS	500	500	500	500	15
Transmix Processor & In-use	Loco and Marine (Not in NE or AK)		HS	HS	HS	500	500	500	500	500

MV diesel fuel dates for 2006: *June 1 for refiners/importers, September 1 for downstream parties except retailers & WPCs, October 15 for retailers & WPCs*

MV diesel fuel dates for 2010: *June 1 for refiners/importers, October 1 for downstream parties except retailers & WPCs, December 1 for retailers & WPCs*

NRLM diesel fuel dates: *June 1 for refiners/importers, August 1 for all downstream parties other than retailers & WPCs, October 1, 2010 for retailers & WPCs, December 1 for all locations/in-use*

National Clean Diesel Campaign
Midwest Clean Diesel Initiative

- **Regulations for new engines**
  - Heavy-Duty Highway, Nonroad, Light-duty Tier 2
  - Upcoming standards for Marine/Locomotives
- **Voluntary Programs to address existing diesel fleet**
  - Voluntary Diesel Retrofit Program – Midwest Clean Diesel Initiative
    - Projects involving: diesel exhaust catalysts, particulate filters, engine modifications, cleaner fuels, idle reduction
    - Project evaluation, Communications & Outreach
  - SmartWay Transport
    - Projects involving: idle reduction, tires, logistics, lubricants, aerodynamics, speed management, ECM reflash
    - Communications & Outreach

Goal: By 2014 reduce emissions from the over 11 million engines in the existing fleet

The 5 Rs + Operational Strategies

- Refuel- Use of advanced diesel fuels, i.e. ULSD can lower emissions
- Retrofit- Installation of exhaust aftertreatment devices such as Diesel Oxidation Catalyst (DOC), Diesel particulate filters (DPF), etc
- Repair/Rebuild- regular engine maintenance plays a critical role in maintaining emissions performance while engine rebuilding can upgrade emissions performance of older engines.
- Repower – replacing older engines with newer cleaner engines
- Replace- replacing the entire equipment to ensure that your new purchase utilizes the most cost effective emission reduction technology
- Operational Strategies- utilizing various strategies to reduce idling

SmartWay Transport Partnership

- **Voluntary partnership between EPA and the freight industry:**
  - Developed jointly by EPA and 15 Charter Partners. Trucking companies represented included: Schneider, Swift, Yellow Roadway, UPS, Fedex. Freight shippers included: Coca Cola, Home Depot, and IKEA. CSX represented the railroad industry.
  - Freight industry interests: reduce fuel consumption, public recognition, improved public image.
  - EPA interests: reduced emissions (CO_2, NO_x, PM) and improved energy security.

How Does the Partnership Work?

- **Carriers (Rail and Truck):**
  - Join the Partnership and agree to work toward improved fuel efficiency and reduced emissions over a 3 year period.
- **Shippers:**
  - Join the Partnership and agree to work toward shipping more of their product with SmartWay Carrier Partners, as well as improving their operations over a 3 year period.
- **Logistics:**
  - Join the Partnership and agree to work toward shipping more freight with SmartWay Carrier Partners, as well as bringing more of their contracted carriers into the Partnership.

Technologies to Affect Diesel Engines

Technology	Description	Cost	Benefits[1]
Idle Reduction Device- **Bunk Heater**	 Small, lightweight, diesel fuel-fired device mounted in the cab that provides heat for cab comfort. Does not include any air conditioning capabilities.	Approx. $1,000	Approx. 6% fuel savings assuming 1,200 hours idling per year. Additional reduction in engine wear and tear.
Idle Reduction Device- **Auxiliary Power Unit**	 Small diesel powered generator mounted outside the cab that provides heat, air conditioning, and electrical power to run appliances.	Approx. $6,000 to $8,000	Approx. 10% fuel savings assuming 2,400 hours idling per year. Additional reduction in engine wear and tear
Fuel Saving Device- **Single-wide Tires**	 Traditional tires are replaced with one single-wide tire and aluminum wheel. Can be applied to all tractor and trailer tire positions except for the steer tires	Approx. $3,000 to $4,000	Approx. 4-10% fuel savings.
Fuel Saving Device- **Trailer Aerodynamics**	 Fairings added to the front, underside, and rear of the trailer to reduce drag.	Approx. $3,200	Approx. 5-7% fuel savings.
Fuel Saving Device- **Advanced Truck Stop Electrification (ATSE)**	 HVAC is provided by equipment in the truck stop, eliminating the need for idling. ATSE systems also provide phone, internet, and TV services in addition to heating and air.	Approx. $16,000 per space	1 gallon of diesel fuel is saved for every 75 minutes spent at an ATSE-equipped truck stop.

[1]All savings assume a Class 8B tractor trailer traveling approximately 100,000 miles per year

Further Information

U.S. EPA:
-http://www.epa.gov/otaq/retrofit
Midwest Clean Diesel Initiative
-http://www.epa.gov/midwestcleandiesel

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EPA United States Environmental Protection Agency

Ambient Particulate Matter Research: Selected Topics

Jay R. Turner
Department of Energy, Environmental and Chemical Engineering
Washington University in St. Louis

Particulate Matter Peer Exchange Meeting
Allerton Park, Monticello, Illinois
October 23-24, 2007

Today's Presentation

- Near roadway particle dynamics and spatial gradients
  - Behavior on the micro- and middle-scales
  - Direct relationship to hot spot issues
- Mobile source contributions to ambient $PM_{2.5}$ burdens
  - Broader context than hot spot analysis
  - Background perhaps useful in the interagency consultation process

Spatial Scales of Emissions Source Influence

micro	~ 10 m
middle	~ 0.1 – 1 km
neighborhood	~ 1 – 5 km
urban	~ 5 – 50 km
regional	~ 50 – 1000 km
continental	~ 1000 – 5000 km
global	> 5000 km

Watson and Chow (2001)

Evolution of Particle Number Distributions near Roadways

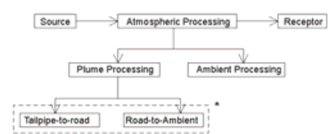


Fig. 1. A source-to-receptor relationship *for mobile sources.

Table 1
Comparison between the 'tailpipe-to-road' and 'road-to-ambient' processes

	Stage 1 'tailpipe-to-road'	Stage 2 'road-to-ambient'
Mixing force	Moving traffic	Atmospheric shear and stability
Characteristic speed ($m\,s^{-1}$)	20–30	1–10
Characteristic length scale (m)	2–3	50–100
Dissipation rate ($m^2\,s^{-3}$)	2500–14000	0.01–20
Spatial range	Tailpipe to roadside	Roadside to ambient
Dilution ratio	~1000 in 1 s	< 10 in 10 min
Temperature gradient	Steep	Flat

Zhang and Wexler (2004)

Evolution of Particle Number Distributions near Roadways

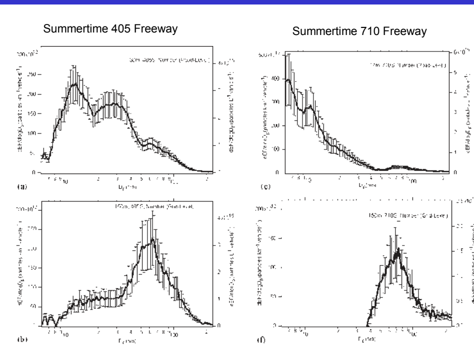
Table 1
Three major types of emission factors and their descriptions

EF	Description
Tailpipe-level	The emission profiles near the exit of the tailpipe
Road-level	The emission profiles on or near the roadway curb
Grid-level	The emission profiles near the end of plume processing (particle dynamics slows down significantly at this point)

Relevant Aside - fundamental differences in tailpipe emissions versus fugitive road dust; grid-level models must include a "fugitive dust transport factor", typically about 0.25, to account for near-roadway losses of the particles

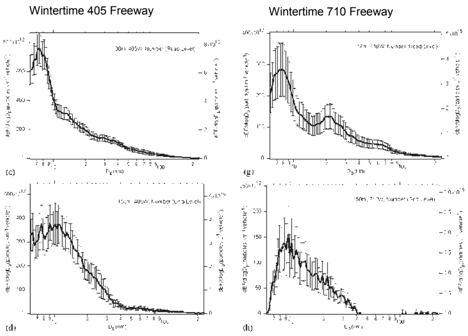
table from Zhang and Wexler (2005)

Evolution of Particle Number Distributions near Roadways... Emission Factors



Zhang and Wexler (2005)

Evolution of Particle Number Distributions near Roadways... Emission Factors



Zhang and Wexler (2005)

Evolution of Particle Number Distributions near Roadways

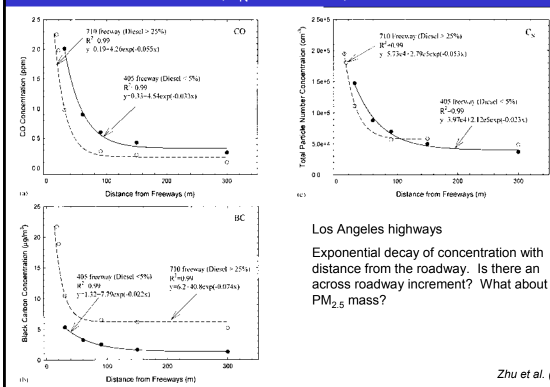
Zhang, Wexler and coworkers describe a comprehensive effort to model the key dynamical processes that influence particle number distributions from the tailpipe to spatial scales commonly used for chemical transport modeling (e.g. 4 × 4 km grids).

Relatively complex, dynamical processes can alter PM physical and chemical properties, especially within the first 90 meters from the roadway.

High concentrations of particles smaller than 6 nm are emitted from the roadways and subsequently grow to about 10 nm within 30 – 90 meters downwind. Subsequently, some of these particles shrink or completely evaporate while other particles continue to grow into the accumulation mode. A seasonal effect was observed with winters exhibiting more dynamic processing of the exhaust aerosol than summers.

Turner and Allen (submitted)

Carbon Monoxide (CO), Black Carbon (BC) and Total Particle Number Concentration (C_N, 6-220 nm) Gradients near Roadways

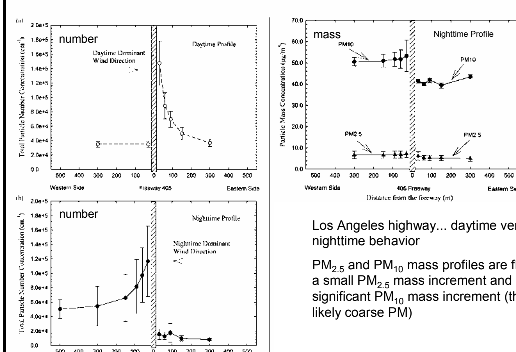


Los Angeles highways

Exponential decay of concentration with distance from the roadway. Is there an across roadway increment? What about $PM_{2.5}$ mass?

Zhu et al. (2002)

Particle Number Concentration, $PM_{2.5}$ Mass, and PM_{10} Mass Gradients near Roadways

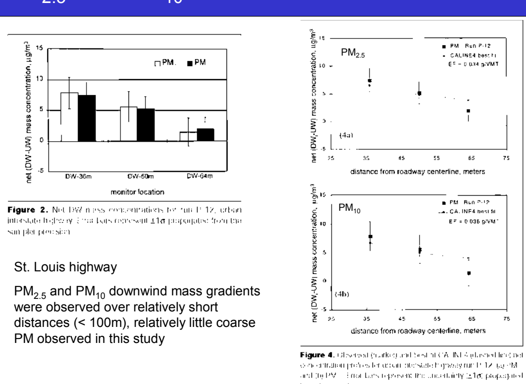


Los Angeles highway... daytime versus nighttime behavior

$PM_{2.5}$ and PM_{10} mass profiles are flat with a small $PM_{2.5}$ mass increment and significant PM_{10} mass increment (thus, likely coarse PM)

Zhu et al. (2006)

$PM_{2.5}$ and PM_{10} Mass Gradients near Roadways



St. Louis highway

$PM_{2.5}$ and PM_{10} downwind mass gradients were observed over relatively short distances (< 100m), relatively little coarse PM observed in this study

Lamoree and Turner (1999)

Near Roadway Gradients

- Steep gradients within first 100 m for CO and ultrafine number, also steep for elemental carbon (EC) with high HDD fraction
- Sometimes the $PM_{2.5}$ and PM_{10} mass increments (roadway contributions) decay to upwind values within 100 m, other times they persist over larger distances
  - Coarse PM contributions likely quite variable, local silt loading data (spatially and temporally resolved) would be helpful
  - Studies of near roadway gradients would greatly benefit from more detailed traffic and silt loading characterization!

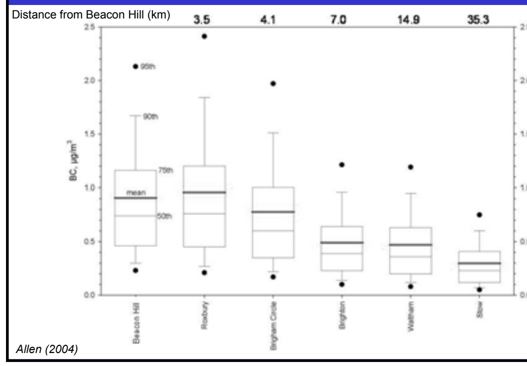
Urban Scale Gradients in Black Carbon

Boston, MA – Aethalometer Black Carbon Measurement Sites

Location	Distance from Beacon Hill (km)	Land Use
Beacon Hill (Boston)	0	Urban residential (near State House)
Roxbury (Boston)	3.5	Urban residential/commercial
Brigham Circle (Boston)	4.1	Urban residential/commercial
Brighton (Boston)	7.0	Semi-urban residential
Waltham	14.9	Suburban residential/light commercial
Stow	35.3	Semi rural; open land (regional background site for Metropolitan Boston)

Allen (2004)

Urban Scale Gradients in Black Carbon



Allen (2004)

$PM_{2.5}$ Source Apportionment

- Many $PM_{2.5}$ apportionments performed for Lake Michigan Air Directors Consortium (LADCO)
  - http://www.ladco.org
  - Currently a contract to Sonoma Technology, Inc. (STI), with my group as a subcontractor, to update apportionments for:
    - Chicago, IL
    - Cincinnati, OH
    - Cleveland, OH
    - Detroit, MI
    - St. Louis, IL/MO (our group has already examined St. Louis in detail)

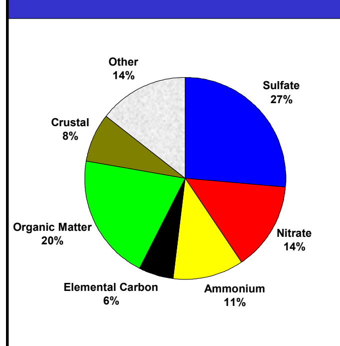
$PM_{2.5}$ Source Apportionment Example – St. Louis Metro Area

- Monitors at East St. Louis and Granite City both exceed the annual-average $PM_{2.5}$ NAAQS
  - Granite City has the highest design value, significantly influenced by local industrial sources
  - Examine the $PM_{2.5}$ mass apportionment for East St. Louis with emphasis on mobile source related contributions.
- First, some background on fine PM burdens in St. Louis...

St. Louis Area $PM_{2.5}$ Levels, $\mu g/m^3$ (2003-2005)

- Annual-average $PM_{2.5}$ air quality standard is 15 $\mu g/m^3$
- Two monitors in St. Louis do not meet this standard
- High baseline concentration throughout the area (85% of standard)

$PM_{2.5}$ Composition in East St. Louis



Identify emissions sources contributing to each of the major chemical classes

Especially interested in local (urban) versus transported (regional) contributions, for this discussion also very interested in mobile source contributions

An aerial view of St. Louis

Tools to Assign Emission Source Contributions to Measured $PM_{2.5}$ Mass

Several approaches and methods

- Basic data analysis... always the first step, and analysis should be ongoing throughout the overall effort
- Chemical Transport Modeling (CTM)
  - Requires detailed emissions and meteorology data
  - CMAQ, CAMx, …
- Receptor modeling
  - Chemical Mass Balance (CMB)
    - Requires emission source profiles
  - APCA, UNMIX and Positive Matrix Factorization (PMF)
    - Requires large ambient monitoring data sets for PM composition

Observational Data Analysis

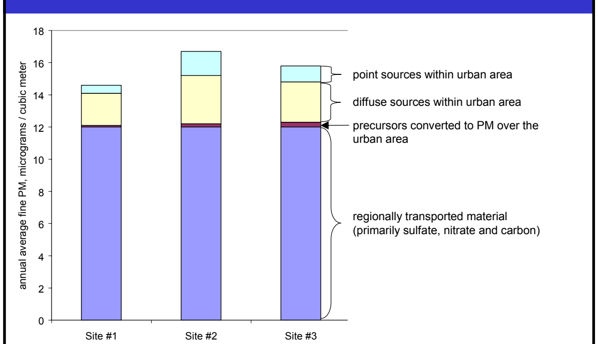
- **OBJECTIVES:** Examine observational data ($PM_{2.5}$ mass and species, allied air quality and weather data) towards building a scientific weight-of-evidence to support the $PM_{2.5}$ SIP
  - Chemical transport model (CTM) performance evaluation and diagnostic testing
  - Additional insights into $PM_{2.5}$ sources and source contributions (complement the CTM effort)
- **METHODS:** Including, but not limited to…
  - Spatiotemporal trends analysis (e.g. day of week trends, urban/rural contrast)
  - Modulation of PM burdens by synoptic weather patterns
  - Source apportionment
- Today's presentation focuses on data sets of 24-hour integrated sampling with subsequent gravimetric mass and chemical analysis (speciation data), available for many areas

Intraurban Variability in Fine PM

- Factors Contributing to Spatial Variability in $PM_{2.5}$ Concentrations within Urban Areas*:
  1. local sources of primary PM (or fast-reacting precursors)
  2. topographic barriers separating sites
  3. transient emissions events
  4. meteorological phenomena
  5. differences in the behavior of semi-volatile components
  6. measurement error
- Data from multiple monitors within the urban area can be used to infer intraurban spatial variability in urban PM burdens

*Pinto, J.P., Lefohn, AS., Shadwick, D.S. *Journal of Air and Waste Management Association*, 54,440-449, 2004

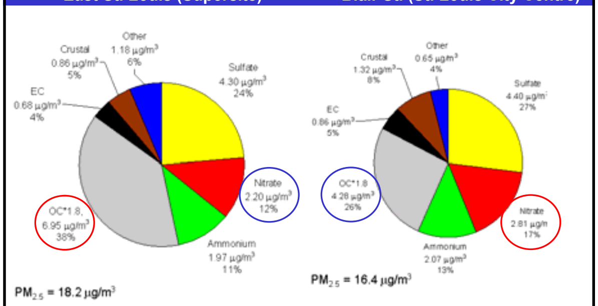
Conceptual Model for Intraurban Variability in Fine PM Mass



Intraurban Variation in $PM_{2.5}$ Mass and Composition

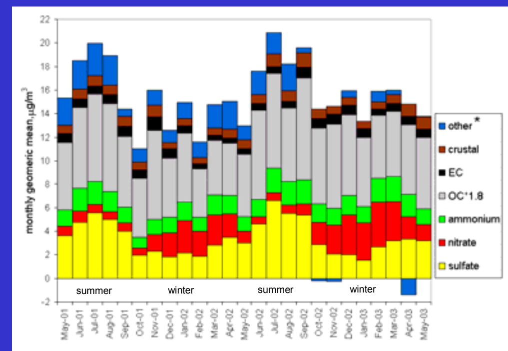
annual-average 2002 speciation at two sites separated by 10 km

East St. Louis (Supersite) **Blair St. (St. Louis City Centre)**



Higher organic matter at Supersite, higher nitrate at Blair (closer to city centre)

Monthly $PM_{2.5}$ Composition at East St. Louis

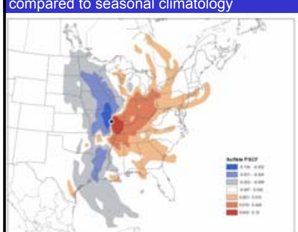


Sulfate (yellow) highest in the summer, nitrate (red) highest in the winter

Secondary Sulfate

- formed from atmospheric chemistry of SO_2 emissions
- sulfate transported from areas with many coal-burning power plants

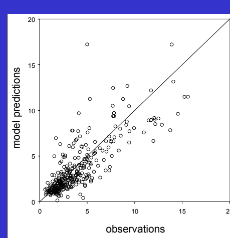
Sulfate Potential Source Contribution Function (PSCF) analysis, incremental probability compared to seasonal climatology



2002 summertime sulfate

Sonoma Technology, Inc.

Chemical Transport Modeling for sulfate

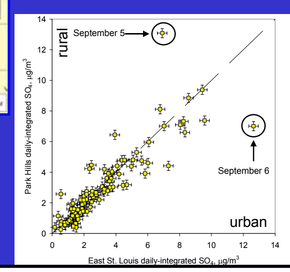


daily averages, CY 2002

ENVIRON, Inc.

Sulfate Urban/Rural Contrast

100 km separation between sites!



Intraurban Variability in Sulfate

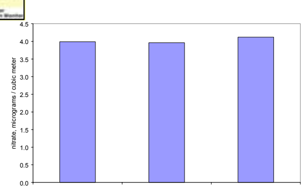
Blair (near City Centre)

East St. Louis (urban residential, near industry)

Arnold (suburban residential)

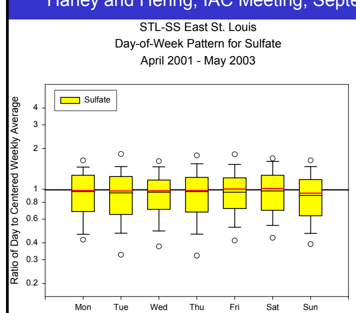
maximum difference is 4% (ESL vs. Blair)

N = 213



East St. Louis Sulfate – Day of Week

- Represent a given day's sulfate by the ratio of its concentration to the weekly average, centered on that day (following Millstein, Harley and Hering, IAC Meeting, September 2006, nitrate analysis)



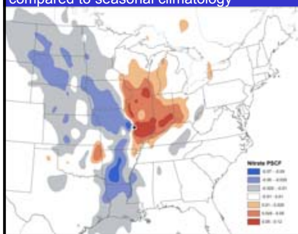
- median = black line
- mean = red line
- circles = 5th / 95th percentiles

No clear day of week trends (as expected)

.: sulfate does not change with weekday/weekend changes in local emissions (industry, traffic), but power plant emissions do not show strong weekend versus weekday differences, either…

Secondary Nitrate
- formed from atmospheric chemistry of NO_x and NH_3 emissions
- nitrate transported for areas with both high NO_x and NH_3

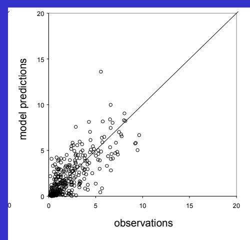
Nitrate Potential Source Contribution Function (PSCF) analysis, incremental probability compared to seasonal climatology



2001-02, 2002-03 wintertime nitrate

Sonoma Technology, Inc.

Chemical Transport Modeling for nitrate



daily averages, CY 2002

ENVIRON, Inc.

Intraurban Variability in Nitrate

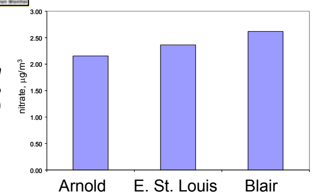
Blair (near City Centre)

East St. Louis (urban residential, near industry)

Arnold (suburban residential)

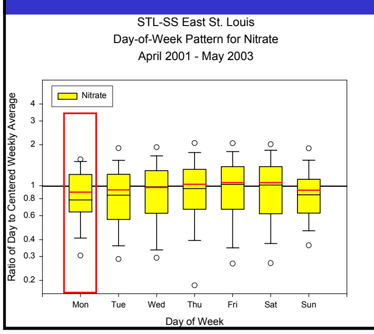
maximum difference is 21% (Arnold vs. Blair)

N = 213



East St. Louis Nitrate – Day of Week

- Same methodology as the sulfate day-of-week analysis

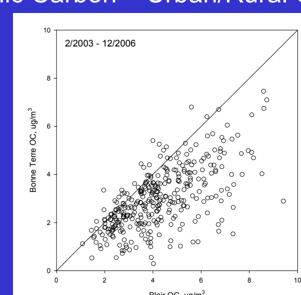


Nitrate lowest on Mondays, followed by Sundays and Tuesdays

Lower NO_x emissions on Saturday and Sunday lead to lower nitrate on Sunday, Monday and Tuesday

Together with other data, estimate 20-30% of nitrate from St. Louis area emissions, 70-80% from regional transport…

Organic Carbon – Urban/Rural Contrast



- On a daily basis, (urban OC) ≥ (rural OC)
- N = 344, rural excess > 1 µg/m³ for only three days
- Urban excess is ~40% of blank-corrected OC
- Urban excess is ~50% of total carbon (EC + blank-corrected OC)

STL Fine PM Mass Apportionment Studies

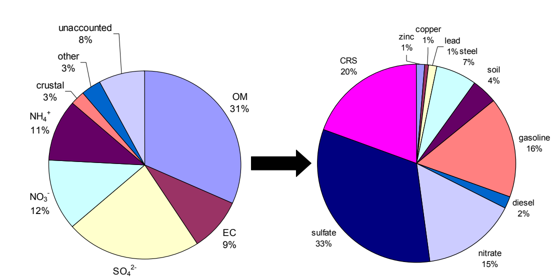
Site	Period	Method	Source
10 sites in STL area (RAPS)	5/75-4/77	PMF2	Kim & Hopke (2005)
10 sites in STL area (RAPS)	7/76-8/76	CMB	Dzubay et al. (1980)
Carondelet (Six-Cities Study)	1979-1988	APCA	Laden et al. (2000)
Blair Street (STN)	4/01-4/02	CMB	Kenski & Koerber (2002)
Blair Street (STN)	4/01-4/02	PMF*	Coutant & Swinton (2002)
Blair Street (STN)	8/00-7/01	PMF*	Battelle (2003)
Blair Street (STN)	[insert]	EPA PMF	MDNR (internal) (2005)
Blair Street (STN)	1/00-1/04	PMF2	Lee & Hopke (2006)
Arnold (STN)	1/01-1/04	PMF2	Lee & Hopke (2006)
East St. Louis (STL-SS)	6/01-5/03	PMF2	Lee et al. (2006)
East St. Louis (STL-SS)**	6/01-5/03	EPA PMF	Garlock (2006)

* Version of PMF to be determined
** Sensitivity studies and refinements to the apportionment of Lee, Hopke and Turner (2006)

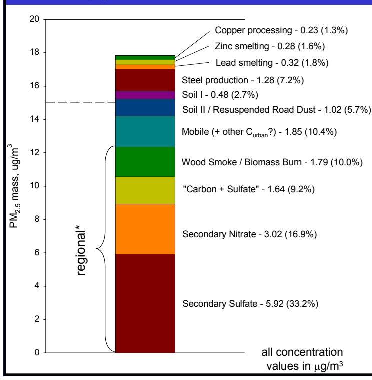
Acknowledgement: Mike Davis (EPA Region VII) for the synthesis of the contemporary STL $PM_{2.5}$ mass apportionment studies

East St. Louis Fine PM Mass Apportionment (Lee et al. 2006)

Measured Species Contributions to $PM_{2.5}$ **Factor Contributions to $PM_{2.5}$**



Current Best-Estimate $PM_{2.5}$ Mass Apportionment for East St. Louis (PMF)



- 11 "factors" represent the time variation of 31 chemical components
- Four factors contain PM that is mostly transported into St. Louis from other areas
- **Mobile = motor vehicles**
- **Soil = resuspended soil, mostly from traffic**
- **Soil II was initially assigned to a "diesel emissions" factor**
- Four factors representing industrial sources

Preliminary apportionment by Lee et al. (2006), refined by Garlock (2006)

Organic Carbon Source Apportionment

source categories	**study-average OC**
– resuspended soil	(0.84 µg/m^3; 21.8 %)
– mobile sources	(0.80 µg/m^3; 20.7 %)
– biomass combustion	(0.53 µg/m^3; 13.8 %)
– secondary organic aerosol	(0.43 µg/m^3; 12.7 %)
– industrial source #1	(0.27 µg/m^3; 7.0 %)
– industrial source #2	(0.09 µg/m^3; 2.4 %)
– winter combustion source #1	(0.25 µg/m^3; 6.5 %)
– winter combustion source #2	(0.18 µg/m^3; 4.7 %)
– residual (unapportioned OC)	(0.46 µg/m^3; 11.9 %)

Assuming the mobile source OC is 30-60% of the mobile source $PM_{2.5}$ (Bae *et al.* 2006), then the mobile source contribution to $PM_{2.5}$ mass is 1.33 - 2.67 µg/m^3. This agrees with the $PM_{2.5}$ mass apportionment of 1.85 µg/m^3 for mobile sources!

Back to the fine PM mass apportionment...

The "Diesel Factor" Conundrum

Lee *et al.* (2006) resolved a diesel/railroad factor at East St. Louis

- Factor rich in carbon and calcium
- Factor loadings do not resemble a "typical" diesel factor
  - OC:EC = 2.6:1, typically see EC>OC
  - however, **recent emission testing data suggests OC>EC for idling and low load operating conditions**
- 10% of factor is Ca and 82% of Ca loads onto this factor rather than the "soil" factor
- Conditional probability function (CPF) plot inconsistent with known diesel/railroad "hot spots"

Summary

Current ambient PM research includes, but is not limited to:

- Ultrafine PM levels and dynamics near roadways
- Near-roadway exposure estimates (e.g., land use regression) [NOT SHOWN]
- Mobile source contributions to ambient PM burdens from receptor modeling
  - Fine PM mass and organic carbon apportionments yielded consistent mobile source contributions for STL
  - Challenges interpreting factors
    - Diesel factor conundrum
    - What fraction of the soil factor is from resuspended road dust?
    - Need larger database of source profiles for motor vehicle emissions and fugitive road dust

Acknowledgements

Collaborators

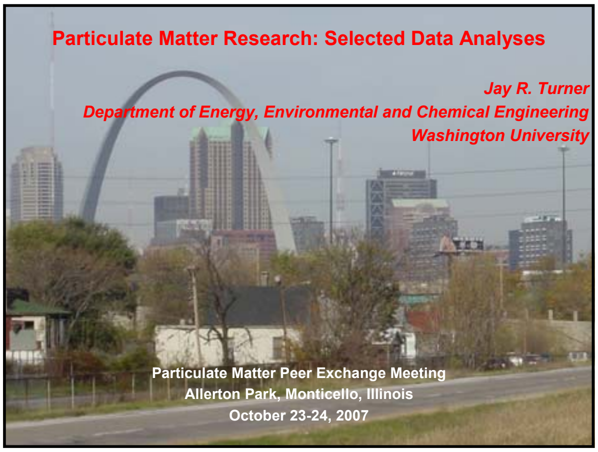
- Jennifer Garlock (M.S. student)
- St. Louis – Midwest Supersite Consortium
  - especially Schauer group, University of Wisconsin
- Sonoma Technology, Inc.
- Hopke group, Clarkson University

Funding

- U.S. Environmental Protection Agency
- Lake Michigan Air Directors Consortium
- Missouri Department of Natural Resources
- Electric Power Research Institute

Particulate Matter Research: Selected Data Analyses

Jay R. Turner
Department of Energy, Environmental and Chemical Engineering
Washington University

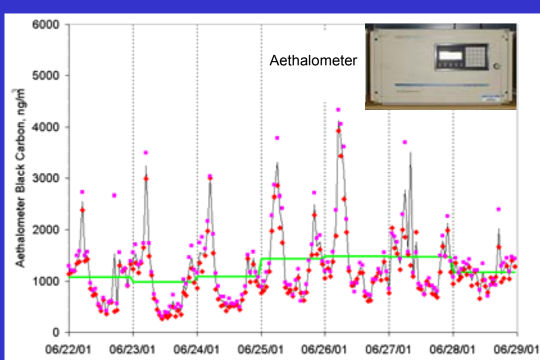


Particulate Matter Peer Exchange Meeting
Allerton Park, Monticello, Illinois
October 23-24, 2007

Today's Presentation

- Using high time resolution measurements to identify contributions to black carbon (BC) from proximate sources
  - Deconvoluting the Aethalometer BC time series
  - Identifying source locations from 2-D nonparametric wind regression (new data analysis methodology)
- Identifying drivers for daily contribution differences observed between proximate monitoring sites
  - Sulfate and elemental carbon (EC) in Cleveland

One Week of Hourly-Average $PM_{2.5}$ Black Carbon



Spatial Scales of Source Emissions Influence*

micro	~ 10 m
middle	~ 0.1 – 1 km
neighborhood	~ 1 – 5 km
urban	~ 5 – 50 km
regional	~ 50 – 1000 km
continental	~ 1000 – 5000 km
global	> 5000 km

Each scale will exhibit different patterns in temporal variation (time scale for fluctuations)

- Middle-scale emissions will vary on a time scale of up to tens of minutes
- Short duration signals from local sources can be separated from a regional baseline and attributed to middle-scale sources

* J. G. Watson & J.C. Chow (2001) *J. Air & Waste Manage. Assoc.*, **51**, 1522-1528

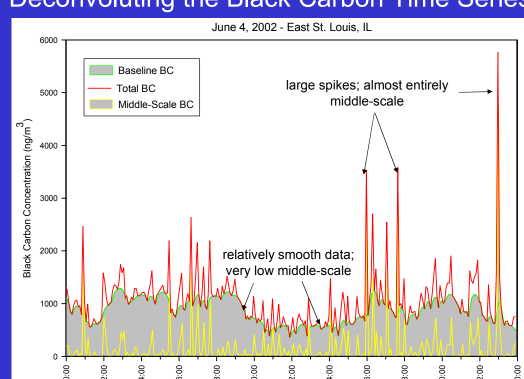
Interpreting Results

Probe the temporal fluctuations in the data by applying a low pass filter to separate the signal (Total BC time series) into two components

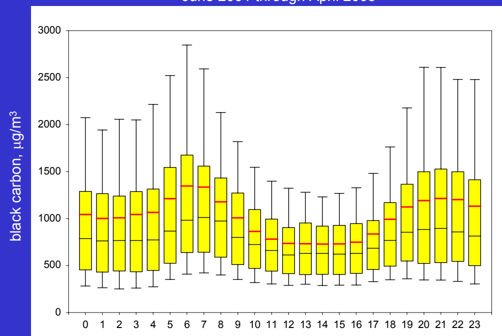
- Attribute the **high frequency** signal to "**local**" sources, which will vary from site-to-site within the at least the neighborhood
  - We'll call this signal the "**middle scale**"
- Attribute the **low frequency** signal to "**urban/regional**" sources which will be the same from site-to-site within at least the neighborhood
  - We'll call this signal the "**baseline**"

* J. G. Watson & J.C. Chow (2001) *J. Air & Waste Manage. Assoc.*, **51**, 1522-1528

Deconvoluting the Black Carbon Time Series

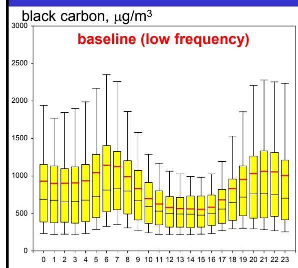


Diurnal Profile for Black Carbon
June 2001 through April 2003



hour of day, local standard time

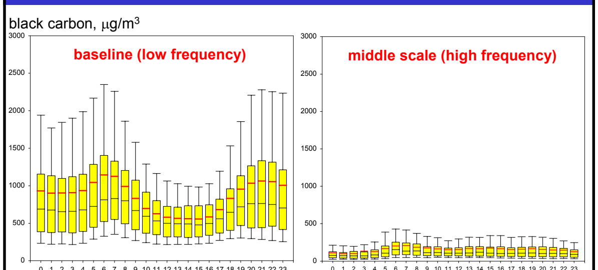
BC Diurnal Profiles – Frequency Components



hour of day, local standard time

Baseline BC concentration has afternoon minimum consistent with atmospheric ventilation (especially growth of the mixing layer depth)

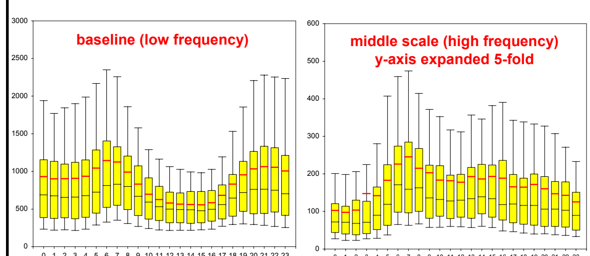
BC Diurnal Profiles – Frequency Components



hour of day, local standard time

Baseline BC concentration has afternoon minimum consistent with atmospheric ventilation (especially growth of the mixing layer depth)
Middle Scale contribution is ~15% of total Black Carbon…

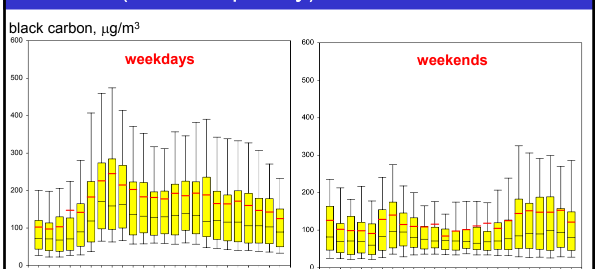
BC Diurnal Profiles – Middle Scale (High Frequency) Component



hour of day, local standard time

Middle-scale BC has a maximum during morning rush hour but decreases very gradually over the day – transport times to short to be strongly affected by changes in mixing height

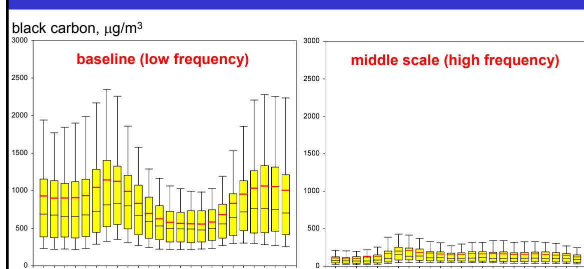
Day of Week BC Middle Scale (Low Frequency) Contributions



hour of day, local standard time

Weekend middle-scale BC contributions lower in the morning and afternoon, but nearly the same in the evening!

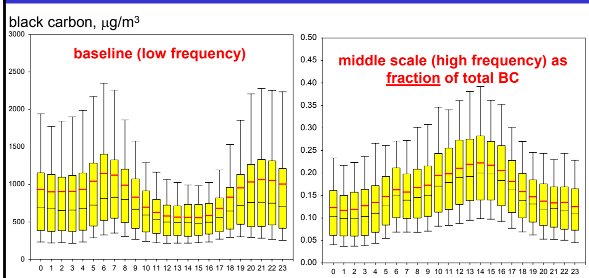
BC Diurnal Profiles – Frequency Components



hour of day, local standard time

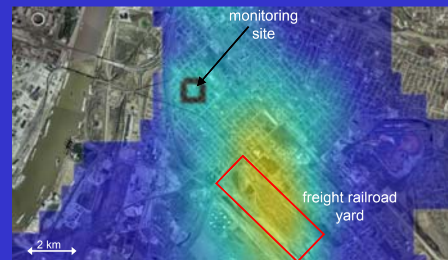
While the middle scale (high frequency) component exhibits interesting features, are the concentration contributions significant? Depends on the analysis questions…

Middle Scale Contributions to Total BC



Baseline (low frequency) BC concentrations low at midday due to atmospheric ventilation; middle scale contributions (high frequency) can be significant!

Spatial Zones Contributing to East St. Louis Black Carbon July – September 2001 Requires Surface Winds Data (Speed and Direction)



Two-dimensional Nonparametric Wind Regression (NWR) analysis, performed by Dr. Ronald Henry (University of Southern California). Paper describing the methodology to be submitted November 2007. Areas with color have an average concentration greater than the quarterly average. Higher concentrations have "hotter" colors. The map of spatial contributions to the observed BC clearly identifies a freight railroad yard as a major contributor to BC at the monitoring site.

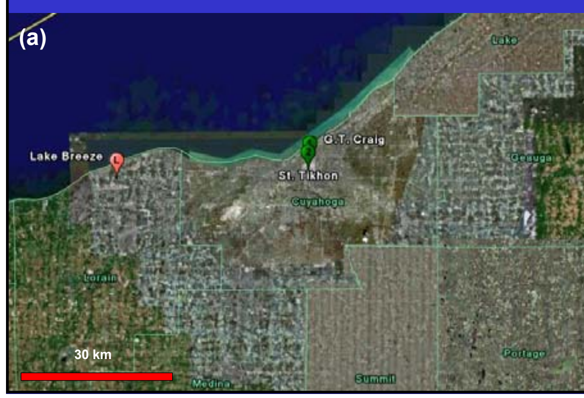
Analyses that Capitalize on Routine Data

Example: Cleveland speciation data for major chemical components of $PM_{2.5}$

Compare speciation data for a far suburban site (35 km from downtown) and urban core sites (1.7 km separation)

Examine three year average excess at urban core and difference between urban core monitors...

Greater Cleveland Region



Intersite Comparisons: $PM_{2.5}$ Major Components

Urban (Tikhon) on Suburban (Lake Breeze)

Species	N	Slope	Intercept(1)	R^2	Mean Diff.(1)	Mean Ratio
Sulfate	139	1.15 ± 0.05	0.16 ± 0.23	0.94	0.70	1.24
Nitrate	139	1.23 ± 0.06	0.21 ± 0.14	0.91	0.59	1.52
Organic Carbon	138	1.34 ± 0.10	-0.23 ± 0.33	0.83	0.85	1.28
Elemental Carbon	137	1.68 ± 0.17	0.03 ± 0.09	0.63	0.34	2.34

(1) Units of $\mu g/m^3$.

Gradient across metro area for all four components

Urban (Tikhon) on Urban (Craig)

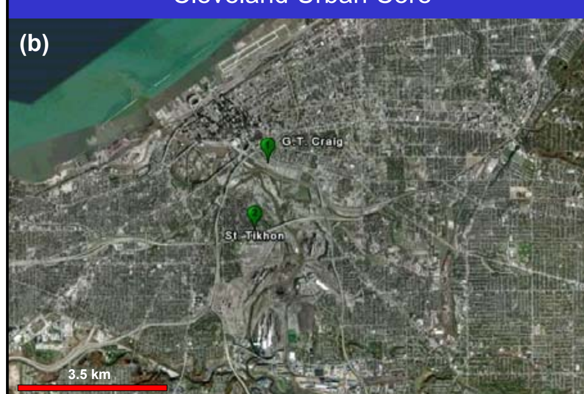
Species	N	Slope	Intercept(1)	R^2	Mean Diff.(1)	Mean Ratio
Sulfate	224	1.02 ± 0.03	-0.14 ± 0.20	0.93	-0.07	0.99
Nitrate	224	0.94 ± 0.03	0.07 ± 0.09	0.96	-0.07	1.01
Organic Carbon	224	1.01 ± 0.06	-0.07 ± 0.30	0.76	-0.04	1.01
Elemental Carbon	224	0.86 ± 0.07	-0.09 ± 0.08	0.62	-0.22	0.82

(1) Units of $\mu g/m^3$.

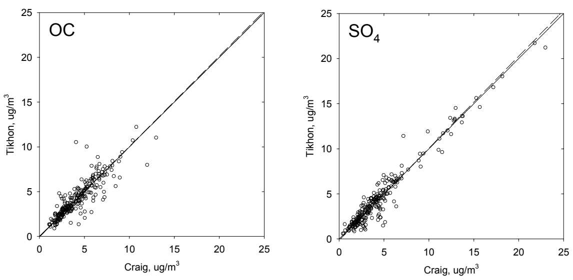
Difference between proximate sites for EC only

Conclusions... Urban scale gradient for all four components, but only elemental carbon exhibits spatial variability between the two urban core sites...

Cleveland Urban Core



Intersite Comparisons: Two Nearby Monitors



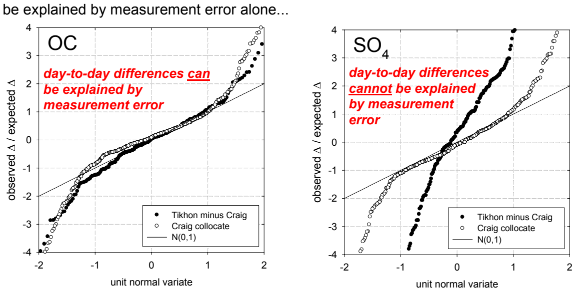
No difference in study-average concentrations at these sites, but can the day-to-day variability be explained by measurement error? Examine in context of extensive collocated measurements conducted at the Craig site..

Methodology

- Determine measurement precision for each component from the collocated sampler data
- Scale the observed daily collocated concentration differences to the expected difference from the precision estimate
  - Should be normally distributed
- Scale the observed daily intersite concentration differences to the expected difference from the precision estimate
  - If the daily intersite concentration differences can be explained by measurement error alone, then they should have the same normal distribution as the collocated data

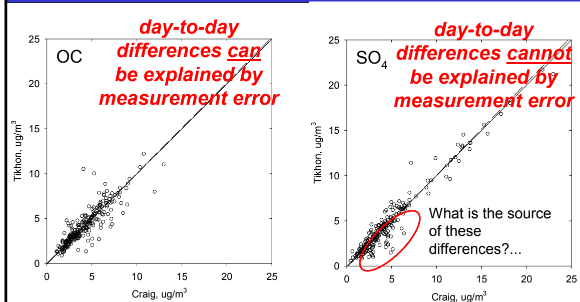
Intersite Comparisons: Two Nearby Monitors

If black circles fall along white circles, then day-to-day differences between sites can be explained by measurement error alone...

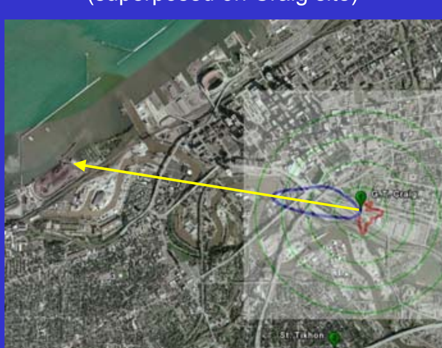


Day-to-day differences in OC, but not sulfate, can be explained by measurement error! Can we identify the emission sources causing the day-to-day differences in sulfate between the two proximate sites?

Intersite Comparisons: Two Nearby Monitors



1-D Nonparametric Wind Regression for Excess Sulfate... shows bearing of potential sources (superposed on Craig site)



1-D Nonparametric Wind Regression for Excess Elemental Carbon... Shows bearing of potential sources (superposed on Craig site)

Summary

- High time resolution particle concentration data can be used to identify contributions from local (micro- and middle-scale sources)
  - Black carbon micro- and middle-scale sources at East St. Louis likely dominated by motor vehicles and trains
  - Together with local surface winds data, potential emission source regions can be identified
    - Neighborhood scale BC from a rail yard
- Opportunities to get more information about emissions sources from the routine monitoring data
  - Examine spatial gradients in PM mass and components
  - Consider concentration differences in light of measurement precision
  - Observed cases, such as sulfate, where there was no average concentration difference between site but daily differences were real, and could identify the likely source location

Acknowledgements

Collaborators

- Jennifer Garlock, Brad Goodwin, Jason Hill (Washington University)
- Ron Henry, University of Southern California
- Warren White, UC - Davis
- Sonoma Technology, Inc.

Funding

- U.S. Environmental Protection Agency
- Lake Michigan Air Directors Consortium
- Missouri Department of Natural Resources
- Electric Power Research Institute

Chicago Metropolitan Agency for Planning

Hot Spot Analyses in Northeastern Illinois

Particulate Matter Peer Exchange Meeting
October 23-24, 2007

Overview

- Have participated in 8 hot spot analyses since requirement went into effect
- 7 other projects were reviewed by the state/FHWA and found not to be of air quality concern
- All highway projects
- Most are state projects
- Most projects are on existing facilities

Identifying Projects

- 2,000 projects in TIP
- Each project has a set of “work types”
- Work types were classified as possibly of air quality concern or not
- Consultation reviewed list
- About 700 projects had work types of possible concern
- Process needs to be refined
  - CMAQ projects show up on list
  - don’t have a clear second or third step for determining which projects should be evaluated

Partial Work Type List

Chicago Area Transportation Study

TIP Work Types - Codes and Definitions

Type Code	Definition	Program Group	Exempt Status	Hot Spot Candidate Type	# in TIP
A-BAR	SAFETY - BARRIERS	SAFETY PROJECTS	EXEMPT	No Concern	0
A-BEA	SAFETY - BEACONS	SAFETY PROJECTS	EXEMPT	No Concern	0
A-FNC	SAFETY - FENCING	SAFETY PROJECTS	EXEMPT	No Concern	1
A-GRD	SAFETY - GUARDRAILS	SAFETY PROJECTS	EXEMPT	No Concern	1
A-LTS	SAFETY - LIGHTING	SAFETY PROJECTS	EXEMPT	No Concern	27
A-MED	SAFETY - MEDIAN PROJECTS	SAFETY PROJECTS	EXEMPT	No Concern	1
A-OPT	SAFETY - OPTICOM EQUIPMENT	SAFETY PROJECTS	EXEMPT	No Concern	1
A-PMRK	SAFETY - PAVEMENT MARKING	SAFETY PROJECTS	EXEMPT	No Concern	1
A-RRXING	SAFETY - RAILROAD CROSSING IMPROVEMENTS	SAFETY PROJECTS	EXEMPT	No Concern	31
A-SHDR	SAFETY - SHOULDER IMPROVEMENTS	SAFETY PROJECTS	EXEMPT	No Concern	1
A-SKIDT	SAFETY - SKID TREATMENTS	SAFETY PROJECTS	EXEMPT	No Concern	0
B-NEW	BRIDGE/STRUCTURE - NEW	No Group - Non-Exempt	NOT EXEMPT	New or Expanded Highway	34
B-PNT	BRIDGE/STRUCTURE - PAINT	BRIDGE PROJECTS (EXCEPT TRANSIT)	EXEMPT	No Concern	11
B-RECNFG	BRIDGE/STRUCTURE - RECONST/REHAB CHNG IN LANE USE/WIDTHS	BRIDGE PROJECTS (EXCEPT TRANSIT)	EXEMPT	New or Expanded Highway	25
B-REPAIR	BRIDGE/STRUCTURE - RECONST/REHAB NO CHNG IN #, WIDTH, OR LANE	BRIDGE PROJECTS (EXCEPT TRANSIT)	EXEMPT	No Concern	124
B-REPLACE	BRIDGE/STRUCTURE - REPLACE	BRIDGE PROJECTS (EXCEPT TRANSIT)	EXEMPT	No Concern	23
C-IMP	STATION - IMPROVE WITH CHANGE IN SERVICE	STATIONS - MAINTAIN/REHAB COMMUTER/RAPID TRANSIT	EXEMPT	Expanded Bus or Rail	1
C-MAINT	RAIL STATIONS - MAINTAIN, REHABILITATE, REPLACE	STATIONS - MAINTAIN/REHAB COMMUTER/RAPID TRANSIT	EXEMPT	No Concern	32
C-NEW	STATION - NEW	No Group - Non-Exempt	NOT EXEMPT	New Bus or Rail Terminal	9
C-RELOC	STATION - RELOCATE	STATIONS - MAINTAIN/REHAB COMMUTER/RAPID TRANSIT	EXEMPT	Expanded Bus or Rail	0

Notifying Sponsors

- Generated report from TIP database; distributed lists to implementers
- Received underwhelming response

Sample Implementer Listing

TIP ID	Description	Work Type Information		Hot Spot Concern
IDOT-DOH DISTRICT 3				
09-00-0043	US 34 AT IL 47 BRIDGE ST (KENDALL/YORKVILLE)	H-INTIMP	HIGHWAY/ROAD - INTERSECTION IMPROVEMENT	Intersection LOS D E or F
09-02-0001	IL 71 FROM ORCHARD RD (CO HWY 9A) (KENDALL/OSWEGO) TO US 34 CHICAGO RD/WOLF'S CROSSING (KENDALL/OSWEGO)	H-AL	HIGHWAY/ROAD - ADD LANES	New or Expanded Highway
09-02-9033	PRAIRIE PARKWAY FROM I-88 (KANE/KANEVILLE TWP) TO I-80 (GRUNDY/AUX SABLE TWP)	H-COR	HIGHWAY/ROAD - CORRIDOR IMPROVEMENT	New or Expanded Highway
		H-NEW	HIGHWAY/ROAD - NEW ROAD	New or Expanded Highway
09-05-0008	IL 71 AT IL 126 (KENDALL/YORKVILLE)	H-INTIMP	HIGHWAY/ROAD - INTERSECTION IMPROVEMENT	Intersection LOS D E or F
09-94-0036	IL 47 BRIDGE STREET FROM US 34 (KENDALL/YORKVILLE) TO IL 71 (KENDALL/YORKVILLE)	H-AL	HIGHWAY/ROAD - ADD LANES	New or Expanded Highway
		H-RCNST	HIGHWAY/ROAD - RECONST WITH CHANGE IN USE OR WIDTH OF LANE	New or Expanded Highway
		H-WRS	HIGHWAY/ROAD - WIDEN LANES AND RESURFACE	New or Expanded Highway
09-94-0037	IL 31 FROM KANE CO LINE (KENDALL/OSWEGO) TO US 34 WASHINGTON ST (KENDALL/OSWEGO)	H-AL	HIGHWAY/ROAD - ADD LANES	New or Expanded Highway
		H-INTIMP	HIGHWAY/ROAD - INTERSECTION IMPROVEMENT	Intersection LOS D E or F
		H-RCNST	HIGHWAY/ROAD - RECONST WITH CHANGE IN USE OR WIDTH OF LANE	New or Expanded Highway
09-96-0011	US 34 FROM IL 47 (KENDALL/BRISTOL TWP) TO IL 31 (KENDALL/OSWEGO)	H-AL	HIGHWAY/ROAD - ADD LANES	New or Expanded Highway
		H-CLTL	HIGHWAY/ROAD - CONTINUOUS BI-DIRECTIONAL TURN LANES	New or Expanded Highway
12-04-0015	BRISBIN RD AT I-80 (GRUNDY/MORRIS) APPROX 3 MILES EAST OF MORRIS	I-NEW	INTERCHANGE - NEW	New or Expanded Highway

Evaluating PM2.5 Impacts

- For most projects, based on estimating emissions generated by project
- Obtain truck and total VMT from implementer
  - Can be overall VMT and percent trucks
  - VMT can be ADT and segment length
- Apply to emission rates used in conformity
- Emissions are calculated at project initiation and analysis years through 2030
- Document results in memo to implementer
- Show that (for most projects) emissions fall from year to year
- Monitor data from vicinity of project are reviewed for violations
- No violations, falling emissions mean no problem

Sample Summary Results

Hot Spot Analysis Summary Results

I- 90 94 DAN RYAN EWY FROM 15TH ST (COOK/CHICAGO) TO I- 57 (COOK/CHICAGO) - TIP ID 01-00-0024

Total Emissions

	Annual Fine Particulate Matter		
Year	VMT	Global Rate (gm/mi)	Tons
2002	732,666,452	0.0474608	**38.330**
2010	738,982,485	0.0360964	29.403
2020	748,875,566	0.0175055	14.451
2030	754,772,826	0.0154200	12.829

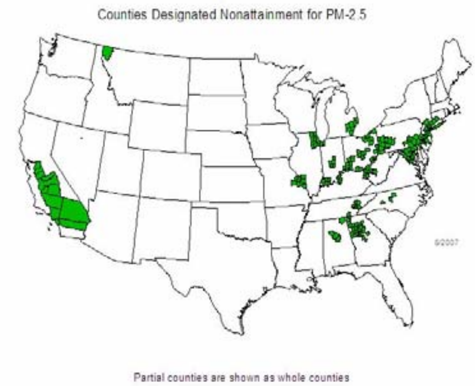
Notes
2002 Annual VMT is Daily VMT times 350.838, the ratio of annual to daily VMT for 2010 and 2030
2002 Global emissions rate is from PM2.5 conformity analysis
2002 emissions are Global Rate times applicable VMT

Outstanding Issues

- Could miss peak year, but so far no indication that this has been an issue
- New highway facilities not well-suited to this approach; use comparison facility approach
- Methods for transit facilities not worked out

Potential New Nonattainment Areas under the Revised NAAQS

Michael Leslie, U.S. EPA - Region 5
Particulate Matter Peer Exchange Meeting
October 24, 2007

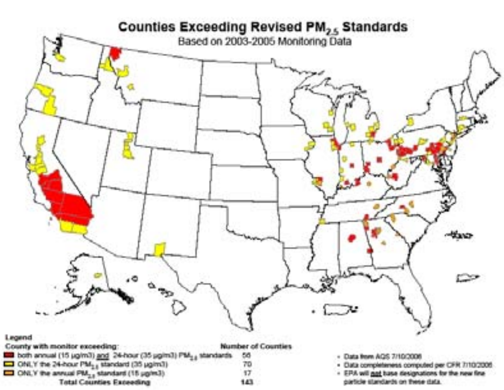


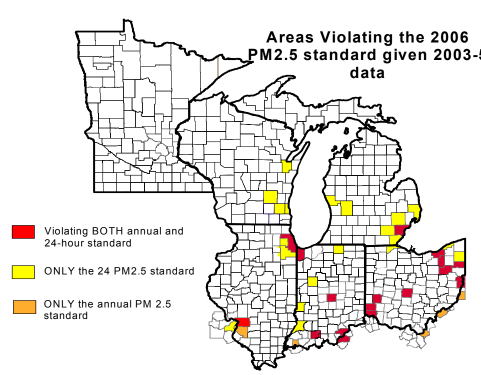
Current PM2.5 Standard Schedule

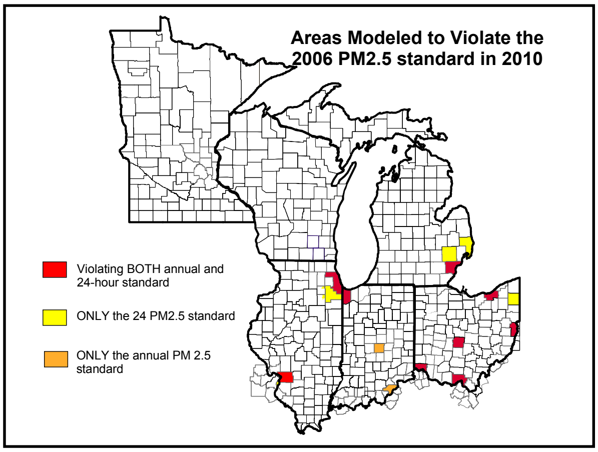
- **State Implementation Plans Due - April 2008**
- Attainment date – April 2010
  - (based on 2007-2009 monitoring data)
- Attainment Date with Extension - Up to April 2015
- **States and local governments are studying emissions reduction opportunities**

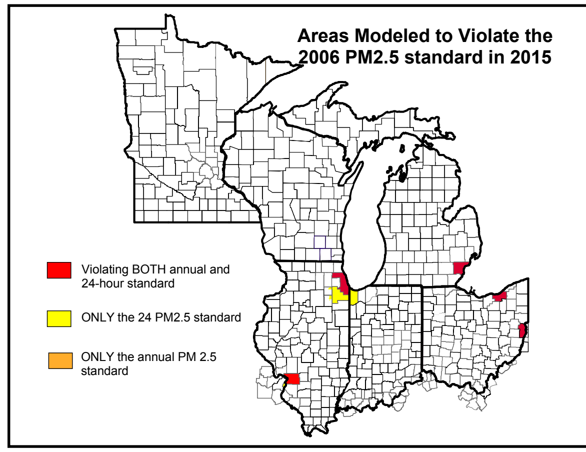
EPA's PM Standards: Old (1997)and New (2006)

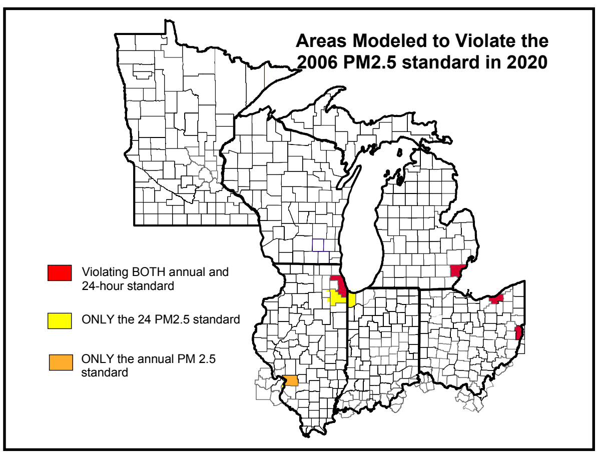
	1997 Standards		2006 Standards	
	Annual	24-hour	Annual	24-hour
PM2.5 (Fine)	$15\ \mu g/m^3$ Annual arithmetic mean, averaged over 3 years	$65\ \mu g/m^3$ 98th percentile, averaged over 3 years	$15 \mu g/m^3$ Annual arithmetic mean, averaged over 3 years	$35 \mu g/m^3$ 98th percentile, averaged over 3 years
PM10 (Coarse)	$50 \mu g/m^3$ Annual average	$150 \mu g/m^3$ 24-hr average (one expected exceedance)	Revoked	$150 \mu g/m^3$ 24-hr average (one expected exceedance)











Factors for Designations

- Emissions in areas potentially included versus excluded from the nonattainment area
- Air quality in potentially included versus excluded areas
- Population density and degree of urbanization including commercial development in
- included versus excluded areas
- Traffic and commuting patterns
- Expected growth (including extent, pattern and rate of growth)
- Meteorology (weather/transport patterns)
- Geography/topography (mountain ranges or other air basin boundaries)
- Jurisdictional boundaries (e.g., counties, air districts, Reservations, etc.)
- Level of control of emission sources

New PM 2.5 Standard

- **Effective Date of Standard** – December 2006
- **State Recommendations to EPA** - December 18, 2007 (based on 2004-2006 monitoring data)
- **Final Designations Signature** No later than Dec. 18, 2008*
  - In the event the Administrator has insufficient information to promulgate the designations by December 18, 2008, the date of final designations may be extended up to one year, but no later than December 18, 2009.
- **Effective Date of Designations** - Typically no later than 90 days after publication in the Federal Register
- **SIPs Due 3 years after effective date of designations**
- **Attainment Date** No later than 5 years after effective date of designations

$PM_{2.5}$ HOT-SPOT CONSIDERATION PROCESS IN KENTUCKY

Jesse Mayes, P.E.
Kentucky Transportation Cabinet
August 2007

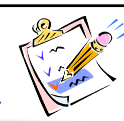
Overview

- $PM_{2.5}$ Background
- Regulations and Guidance
- Kentucky Process
  - Checklist
  - Interagency Consultation
  - Public Involvement
  - NEPA Documentation
- Summary of Kentucky Process
- Example "Of Concern" project – Ohio River Bridges

Kentucky's Process

- Checklist
- Interagency Consultation
- Public Involvement
- NEPA Documentation

Kentucky's Process --- Checklist ---



- Step 1: Project Identification
- Step 2: Exempt Status
- Step 3: Traffic Information
  - Determine Worst Case Area – Usually an Intersection
  - For Worst Case, Document Current Traffic and LOS
  - For Worst Case, Document Forecasted Traffic and LOS for Open-To-Traffic Date for:
    - Build, and
    - No-Action Scenarios
- Step 4: Air Quality Concern Determination
- Step 5: Analysis and Documentation
- Step 6: Meetings, Notices, Dates
- Step 7: Signatures

Kentucky's Process --- Checklist --- Step 1: Project Identification

$PM_{2.5}$ PROJECT LEVEL CHECKLIST

STEP 1: PROJECT IDENTIFICATION

A. KYTC Six Year Plan Item Number:

B. Project Name/Short Description:

C. County

D. $PM_{2.5}$ Nonattainment or Maintenance Area

E. $PM_{2.5}$ Designation

F. $PM_{2.5}$ Standard Associated with Designation

G. Additional Project Information:

H. NEPA Document Type

I. Project Sponsor

J. Included in a "Conforming" MPO TIP or STIP?

K. Location of project in TIP/STIP

L. Is this Project in the Area Travel Demand Model?

Kentucky's Process --- Checklist --- Step 2: Exempt Status

$PM_{2.5}$ PROJECT LEVEL CHECKLIST

STEP 2: EXEMPT STATUS

☐ NOT AN EXEMPT PROJECT

☐ EXEMPT PROJECT

Kentucky's Process --- Checklist --- Step 2A: Types of Exempt Projects

☐ **EXEMPT PROJECT OR TRAFFIC SIGNALIZATION** (40 CFR 93.126 or 93.128).
Select one from the list below. No hotspot analysis required. Go to STEP 4.

Air Quality
☐ Bicycle and pedestrian facilities
☐ Continuation of ride-sharing and van-pooling promotion activities at current levels.

Safety
☐ Adding medians
☐ Emergency relief (23 U.S.C. 125)
☐ Emergency truck pullovers
☐ Fencing
☐ Guardrails, median barriers, crash cushions
☐ Hazard Elimination Program
☐ Increasing Sight Distance
☐ Lighting improvements
☐ Pavement marking demonstration
☐ Pavement resurfacing and/or rehabilitation
☐ Railroad/highway crossing
☐ Railroad/highway crossing warning devices
☐ Reconstructing bridges (no additional travel lanes)
☐ Safer non-Federal-aid system roads
☐ Safety improvement program
☐ Safety roadside rest areas
☐ Shoulder improvements
☐ Skid treatments
☐ Traffic control devices and operating assistance other than signalization projects.
☐ Truck Climbing lanes outside the urbanized area

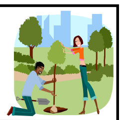
7

Kentucky's Process --- Checklist --- Step 2A: Types of Exempt Projects

Mass Transit
☐ Construction of new bus or rail storage/maintenance facilities categorically excluded in 23 CFR part 771
☐ Construction of small passenger shelters and information kiosks
☐ Construction or renovation of power, signal, and communications systems.
☐ Operating assistance to transit agencies
☐ Purchase of new buses and rail cars to replace existing vehicles or for minor expansion of the fleet. In PM10 and PM2.5 nonattainment or maintenance areas, such projects are exempt only if they are in compliance with control measures in the applicable implementation plan.
☐ Purchase of office, shop, and operating equipment for existing facilities
☐ Purchase of operating equipment for vehicles (e.g., radios, fareboxes, lifts, etc.)
☐ Purchase of support vehicles
☐ Reconstruction or renovation of transit building and structures (e.g., rail or bus building, storage and maintenance facilities, stations, terminals and ancillary structures)
☐ Rehabilitation of transit vehicles – In PM10 and PM2.5 nonattainment or maintenance areas, such projects are exempt only if they are in compliance with control measures in the applicable implementation plan.
☐ Rehabilitation or reconstruction of track structures, track, and trackbed in existing rights-of-way

8

Kentucky's Process --- Checklist --- Step 2A: Types of Exempt Projects

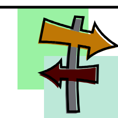


Other
☐ Acquisition of scenic easement
☐ Directional and information signs
☐ Emergency or hardship advance land acquisitions (23 CFR 710.503 (d))
☐ Engineering to assess social, economic, and environmental effects of the proposed action or alternative to that action
☐ Noise attenuation
☐ Planting, landscaping, etc
☐ Repair of damage caused by natural disasters, civil unrest, of terrorist acts, except projects involving substantial functional, locational, or capacity changes
☐ Sign removal
☐ Specific activities which do not involve or lead directly to construction, such as:
- Federal-aid systems revisions
- Grants for training and research programs
- Planning activities conducted pursuant to titles 23 and 49 USC
- Planning and technical studies

☐ Traffic signal synchronization (40 CFR 93.128)
☐ Transportation enhancement activities (except rehabilitation and operation of historic transportation buildings, structures, or facilities)

9

Kentucky's Process --- Checklist --- Step 3: Traffic Information



PM2.5 PROJECT LEVEL CHECKLIST

STEP 3: TRAFFIC INFORMATION

A. Worst Case Scenario
  a. Location
  b. Year
  c. Justification for worst case year chosen
B. Project Data
  a. Project Data for Current Year
    i. Annual Average Daily Traffic (AADT):
    ii. Percentage and/or number of diesel vehicles (trucks and buses):
    iii. Intersections at Level of Service D, E, or F:
  b. Project Data for Worst Case Year for No Action Scenario
    i. Annual Average Daily Traffic (AADT):
    ii. Percentage and number of diesel vehicles (trucks and buses):
    iii. Intersections at Level of Service D, E, or F:
    iv. Impact of No Action:
  c. Project Data for Worst Case Year for Build Scenario
    i. Annual Average Daily Traffic (AADT):
    ii. Percentage and number of diesel vehicles (trucks and buses):
    iii. Intersections at Level of Service D, E, or F:

10

Kentucky's Process --- Checklist --- Step 4: Air Quality Concern Determination

PM2.5 PROJECT LEVEL CHECKLIST

STEP 4: AIR QUALITY CONCERN DETERMINATION

☐ **NOT PROJECT OF AIR QUALITY CONCERN.** *Hot-spot analysis is NOT required. However, InterAgency Consultation (IAC) approval is required. Provide checklist and other relevant documentation to IAC. IAC will determine level of public involvement required. Use space provided to summarize data and rationale for this conclusion.*

Go to STEP 6.

☐ **PROJECT OF AIR QUALITY CONCERN.** *Select one from the list below. Hot-spot analysis IS required. Convene interagency consultation (IAC) meeting and begin to create the hot-spot analysis document.* **Go to STEP 5.**

☐ New or expanded highway projects with a significant number of, or increase in, diesel vehicles (e.g., 125,000 AADT and 10,000 (8%) diesel truck traffic). Note: The example of 125,000 AADT and 10,000 (8%) diesel truck traffic are not exact threshold values and should not be viewed as such.

☐ Project affecting intersections that are at LOS D, E, or F with a significant number of diesel vehicles, or those that will change to LOS D, E, or F because of increased traffic volumes from a significant number of diesel vehicles related to the project.

☐ New bus and rail terminals and transfer points that have significant number of diesel vehicles congregating at a single location.

☐ Expanded bus and rail terminals and transfer points that significantly increase the number of diesel vehicles congregating at a single location.

☐ Projects in or affecting locations, areas, or categories of sites which are identified in the PM10 and PM2.5 applicable implementation plan or implementation plan submissions, as appropriate, as sites of violation or possible violation.

11

Kentucky's Process --- Checklist --- Steps 5, 6, & 7: Analysis, Documentation, Meetings, & Signatures

PM2.5 PROJECT LEVEL CHECKLIST

STEP 5: ANALYSIS AND DOCUMENTATION (for Project of Air Quality Concern)

Documentation to be Included for the PM2.5 Hot-spot Analysis

- Description of type of emissions considered in the analysis
- Contributing Factors
  - Air Quality
  - Transportation and traffic conditions
  - Built and natural environment
  - Meteorology, climate and seasonal data
  - Adopted emissions control measures
- Consider full time frame of area's LRTP
- Description of existing conditions
- Description of changes resulting from project
- Description of method chosen
- Description of analysis years
- Professional judgment of impact
- Discussion of any mitigation measures
- Written commitments for mitigation

STEP 6: MEETING, NOTICES, DATES

A. IAC Approval Date:
B. Public Involvement
  a. Public review & comment period
  b. Public concerns addressed

STEP 7: SIGNATURES

12

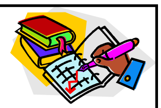
Kentucky's Process
--- Interagency Consultation ---

- Interagency Consultation (IAC) is KEY
- Interagency Consultation through email for "exempt" or "not of concern" projects
  - Send email w/checklist to IAC for review
  - Give 3-5 business days for review deadline
  - Lack of response is implied consent
  - Send final completion email
  - Make pdfs of request email, IAC agreement emails, and completion email
- Interagency Consultation as required for all projects including exempt projects

Kentucky's Process
--- Public Involvement ---

- If NEPA document is unapproved, public involvement follows NEPA process for type of NEPA document involved – nothing special for $PM_{2.5}$
- If project is through NEPA approvals, then:
  - If NEPA document had public involvement, then 15 day comment period must be held with public notice for $PM_{2.5}$
  - NEPA document had no public involvement, then no public notice or public involvement is required for $PM_{2.5}$

Kentucky's Process
--- NEPA Documentation ---



- Verbiage for NEPA document air quality section
  - Air quality status of project area
  - Qualitative discussion of $PM_{2.5}$ consideration
- Interagency Consultation documentation to be included
  - Copy of checklist
  - Pdfs of request, approval, and completion emails
  - Proof of public involvement if required
    - Copy of notice
    - Proof of notice publication

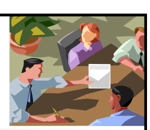
Kentucky's Process --- NEPA Documentation --- Verbiage – Qualitative Discussion

Example of qualitative discussion of $PM_{2.5}$ consideration for "exempt" project

PM2.5 Hot-Spot Consideration

A qualitative PM2.5 hot-spot analysis is not required for this project since it is not a project of air quality concern. This project is not subject to the PM2.5 hot-spot requirements since this project has been found to be exempt under 40 CFR 93.126 (or 93.128). This decision was reached on (date) through interagency consultation which included EPA, FHWA, FTA, the state air agency, the state transportation department, including the state transit agency, the local metropolitan planning organization (MPO), the local transit organization, and the project team. The completed PM2.5 Hot-Spot Checklist containing further details is included with this documentation

Summary….



- Interagency Coordination is KEY.
- Checklist has been very beneficial for quick uniform reviews with few questions.
- Process is easily learned by new staff.

Ohio River Bridges Project

To date, Kentucky has had one project that required a $PM_{2.5}$ hot-spot analysis --- The Ohio River Bridges Project

- Current downtown traffic 290,000 AADT and 32,000 trucks
- No-action 2020 downtown traffic 330,000 and 52,000 trucks

What is the Ohio River Bridges Project?

This Louisville Kentucky/Southern Indiana project is:

- A new downtown bridge and roadway
  - east of the Kennedy Bridge (I-65)
- An east end bridge and roadway about eight miles from downtown
  - connecting the Gene Snyder Freeway (KY 841/I-265)
  - Lee Hamilton Highway (IN 265),
- Rebuild to the south of the Kennedy Interchange
  - I-64, I-65 and I-71 converge

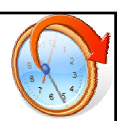
See the ORB website http://www.kyinbridges.com/

Organization

- **Organized interagency consultation team**
  - Multi-state
  - Local, State, and Federal ***Partners***
  - Multi-state
  - Multi- (federal) divisional/regional
  - Mega- project
  - Air quality folks as well as project folks
  - Email & conference calls

Background Informati

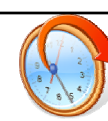
- **Gathered background material**
  - Project detail and construction schedule
  - Regional emissions trends
    - regional conformity analysis
  - Regional monitoring data
- **Searched for "Surrogate" sites**



Requirements for assessing impacts

Project-level conformity determinations must address

- **Construction impact**
- **Long term impact**
- **And, must address**
- **<u>Both annual *and* 24-hour</u> $PM_{2.5}$ regardless of which form of the standard the area has violated**



Requirements for assessing impacts

<u>Construction impact</u>

- Not required to be assessed if considered temporary
  - Only during construction
  - Construction lasts **five** years or less at any individual site

<u>Long term impact</u>

- **Hotspot analyses must demonstrate that:**
  - No new local PM violations will be created
  - The frequency or severity of existing violations will not be increased as a result of the project
- **Based on qualitative consideration of local factors**

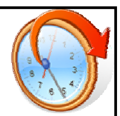
Construction Impact

- Reviewed project schedule for "sub-projects"
- Although the project under construction for 13 years
  - no individual construction element over 5 years
  - therefore, the construction impact is not significant

Long-term Impact
Worse Case

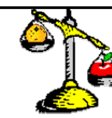
- Determine worst case area – i.e., intersection(s) with highest traffic – current and future
  - Reviewed data for both bridge sites
- Determine worst case year
  - Demonstrated that the area emissions trend was downward
  - Inferred that open-to-traffic date of 2020 was worse case year

Long-term Impact
The Analysis



- Compared Build vs. No-action
- Compared Surrogate sites

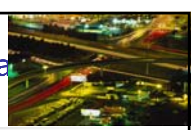
Long-term Impact
The Analysis



Comparison of Build vs. No-action

- Determined that the *build* scenario would produce lower $PM_{2.5}$ emissions more than the *no-action* scenario

Long-term Impact
The Analysis



Comparison With Surrogate Sites

- Found sites with traffic data comparable to the ORB project worse case
- "Adjacent" monitor showing non-violating data

❖ **Therefore, ORB project would not create monitor violations**

The Conclusion

- Construction impact was not significant

The Conclusion

- Long term $PM_{2.5}$ impact
  - Build vs. no-action showed that the build scenario would result in lower area $PM_{2.5}$ emissions in worse case year

The Conclusion

- Surrogate Sites
  - Surrogate sites found with non-violating monitors
  - However, monitors not sufficient close enough to the traffic to demonstrate the hot-spot effect
    - by design, monitors have been placed AWAY from highways
  - the surrogate comparison alone was not sufficient to demonstrate conformity,
    - however, it added creditable to the favorable build vs. no-action scenario

Questions?

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