

# Traffic Data Collection Programs for PM<sub>2.5</sub> Non-Attainment Areas

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*Traffic Data to Address Air Quality  
and Climate Change*

# Outline

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- PM<sub>2.5</sub> background
- Fairbanks PM<sub>2.5</sub> Non-Attainment Area
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# VMT & PM<sub>2.5</sub> References

- [Cooperative Planning and Analysis for Non-Attainment Areas Requirement – 23 CFR 450.314\(b\)](#)
- [Review of Methods for Estimating Vehicle Miles Traveled](#)
- [EPA Technical Note on PM<sub>2.5</sub> National Ambient Air Quality Standards \(NAAQS\)](#)
- [Alaska Recommendations for Designation of Areas](#)
- [EPA Response to Alaska Recommendations](#)
- [Alaska Comments on EPA Non-Attainment Boundary Determination](#)
- [EPA Final Rule - Air Quality Designations for the 2006 24-Hour PM<sub>2.5</sub> NAAQS – 14 Dec, 2009](#)

# VMT & PM<sub>2.5</sub> References

- [EPA MOVES Model](#)
- [MOVES Technical Background](#)
- [Quick Response Freight Manual](#)
- [Simple Freight Growth Factor Methods](#)
- [Alaska State Implementation Plan](#)
- [Alaska 2011 Air Quality Monitoring Network](#)  
State Air Quality Implementation Plan (SIP): Chapter 3 -  
Fairbanks
- [Analysis of Fairbanks Winter Inversions](#)
- [Fairbanks Climatology](#)

# VMT & PM<sub>2.5</sub> References

- Development of the Fairbanks Metropolitan Area Transportation System (FMATS) Travel Demand Model for PM 2.5 Conformity Analysis
- Collecting Local Road Traffic Volumes for FMATS PM 2.5 Conformity Analysis and Regional VMT Estimation

# VMT Estimates – Survey Review\*

## ● VMT estimate methods review:

- Highway Performance Monitoring System (HPMS)
- Indiana Dept of Transportation (INDOT) programs
- Highway and transit network models
- Fuel sales
- Odometer recordings
- Household and driver surveys

## ● Key points

- Principals and assumptions supporting the methods
- Potential sources of error
- INDOT statewide VMT **estimates from traditional traffic count-based method 10 – 20 percent higher** than the cross-classification VMT estimation model estimates

- *Review of Methods for Estimating Vehicle Miles Traveled*
- Robert K. Kumapley and Jon D. Fricker

# PM<sub>2.5</sub> Background

- **Fine particles** – about 1/30 the diameter of a human hair
- **Sources** – generally come from activities that burn fossil fuels, e.g., **mobile sources**, power plants, industrial plants, **wood burning**, heating oil, refineries
  - Filterable fraction
  - Condensable fraction
- **Circumstances:**
  - Can remain suspended for long periods
  - Can create health problems far away from emission sources

# PM<sub>2.5</sub> Background

## ● Public Health Problems

- Aggravated asthma
- Increased respiratory symptoms, e.g., coughing and difficult/painful breathing
- Chronic bronchitis
- Decreased lung function
- Potential for premature death in people with heart and lung disease



# PM<sub>2.5</sub> Background

## ● EPA Non - Attainment Designation Factors (*EPA 2008 Report*)

- 1) **Pollution emissions** - (based on air quality sampling 2006 – 2008)
- 2) Air quality data
- 3) Population density and degree of urbanization
- 4) Traffic and commuting patterns
- 5) **Growth**
- 6) **Meteorology**
- 7) **Geography**
- 8) Jurisdictional boundaries
- 9) Level of control of emissions sources

# Fairbanks North Star Borough Non-Attainment Area

- City of Fairbanks and FNSB designations:
  - CO non-attainment area – 1990
  - CO maintenance area – 2004
  - 24-hour  $PM_{2.5}$  NAAQS non-attainment area – Dec 14, 2009. Extends beyond the MPO boundary
- $PM_{2.5}$  impacts acerbated by:
  - Severity of inversions
  - Limited diurnal variation of mixing heights
  - Lack of wind speed for extended periods

# Fairbanks Non-Attainment Area

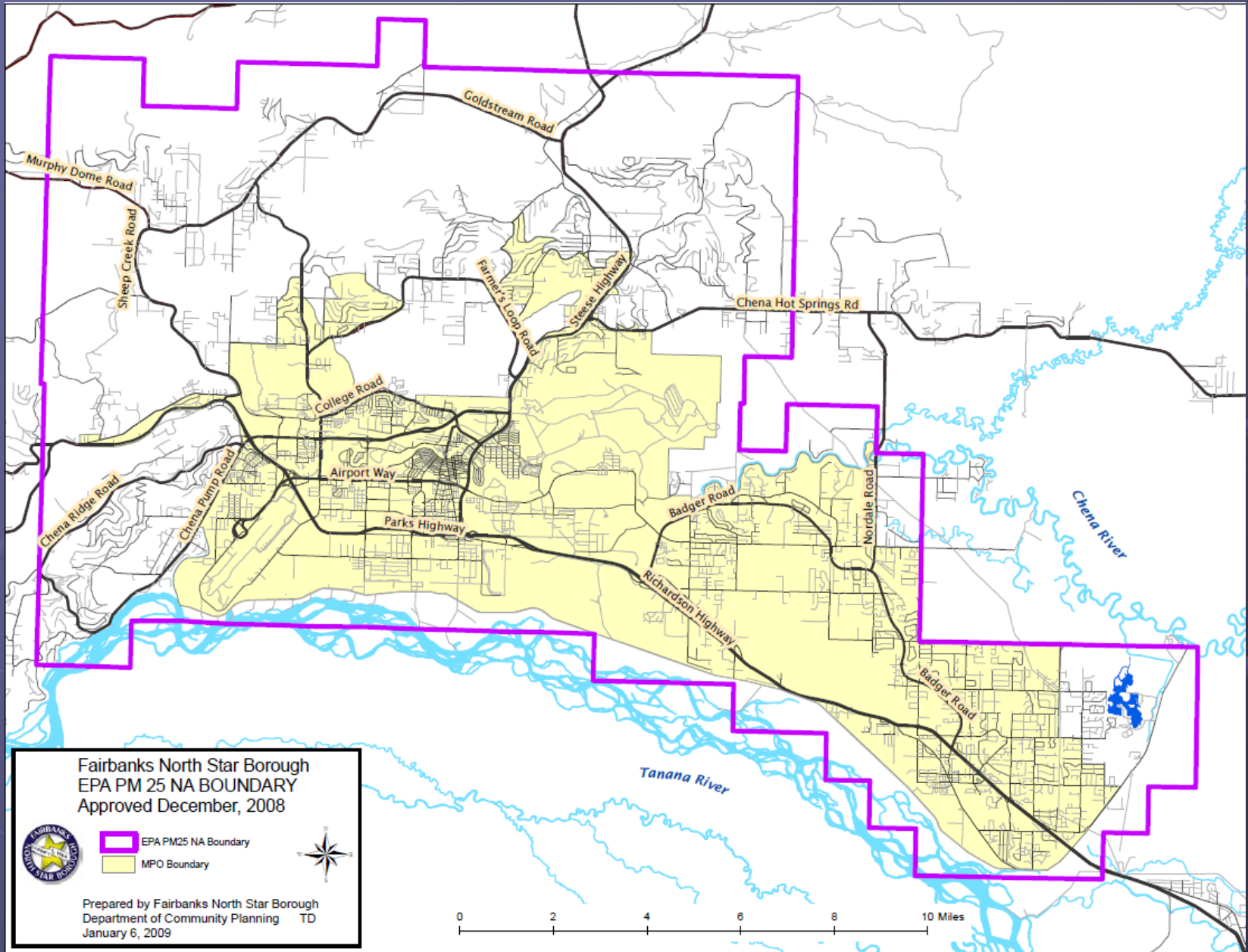
● Average chemical composition highest on winter days:

- Secondary aerosol related (40 – 55% monthly average):
  - SO<sub>2</sub> - sulfur dioxide (space heaters, wood burning)
  - NH<sub>3</sub> - ammonia
  - VOC - volatile organic compounds
  - CO - carbon monoxide (stationary sources)
  - NO<sub>x</sub> - nitrous oxide (power utilities, industrial sources)
- Wood burning related emissions
- Unidentified zinc-related source
- Mobile emissions

# Fairbanks North Star Borough



# Fairbanks PM<sub>2.5</sub> Non-Attainment Area



# Fairbanks Vehicle Miles Traveled (VMT) Growth

- Fairbanks Metropolitan Area Transportation System (FMATS) Long Range Transportation Plan (LRTP) Growth Factors
- Average growth modest
  - 1990 – 2000: 1.1% average
  - 2001 – 2004: 1.2% average
  - 2005 – 2015: estimated 1.4% growth
- Focus on corridor specific VMT growth – VMT estimation becomes important for **nodes/links on transportation network**

# Transportation Conformity Determinations Within the Fairbanks PM<sub>2.5</sub> Non-Attainment Area

● CFR 450.314.4(b) - If the metropolitan planning area (MPA) ***does not include the entire non-attainment or maintenance area***, there shall be an agreement between the **state department of transportation, state air quality agency, local agencies, and MPO** for planning and analysis. The agreement shall:

- Address projects outside the MPO but within the non-attainment area.
- Indicate how total transportation-related emissions will be treated, for areas inside and outside MPA, for EPA conformity regulations.
- Address policy mechanisms for resolving conflicts concerning transportation-related emissions

# PM<sub>2.5</sub> Non-Attainment Area Roles and Responsibilities

## Department of Environmental Conservation

- Participate in the transportation conformity analysis for entire non-attainment area (shared with DOT).
- Provide technical and administrative assistance and assist in dealing with EPA, particularly in developing additional strategies to reduce PM<sub>2.5</sub> levels from mobile sources.
- Implement, along with the FNSB, air pollution control in the FNSB.



# PM<sub>2.5</sub> Non-Attainment Area Roles and Responsibilities

## Department of Transportation & Public Facilities

- Take the lead in developing the **transportation conformity analysis**.
- Lead the regional Long Range Transportation Plan (**L RTP**) that identifies a fiscally constrained transportation project list for the non-attainment area outside the MPA.
- Provide **CMAQ funding** for travel demand modeling and conformity determination.

# PM<sub>2.5</sub> Non-Attainment Area Roles and Responsibilities

## Department of Transportation & Public Facilities

- Maintain a validated **travel demand forecasting model** for future vehicle miles of travel.
- Execute the conformity analysis using the **Motor Vehicle Emission Simulator (MOVES) model** or the latest EPA-approved model meeting the state plan and transportation conformity requirements.
- Develop **future projections of travel** using off-model projections such as the Highway Performance Monitoring System (HPMS).

# PM<sub>2.5</sub> Non-Attainment Area Roles and Responsibilities

## Fairbanks Metropolitan Area Transportation System

- Participate in preparing the **transportation conformity analysis** for the non-attainment area
- Facilitate the **Interagency Consultation Group** to define the specific processes and adhere to the conformity determination schedule
- Coordinate future transportation plans with the **development of transportation control measures**

# PM<sub>2.5</sub> Non-Attainment Area Roles and Responsibilities

## Fairbanks North Star Borough

- Participate in preparing the transportation conformity analysis for non-attainment area.
- Provide DOT a list of transportation projects for the PM<sub>2.5</sub> non-attainment area that are outside the MPA boundary.
- Assume responsibility for air pollution control in the Borough for mobile sources, residential homes, and small scale commercial activities.
- Provide **planning assumptions** to be used in developing the **travel demand model**.

# Travel Demand Forecasting Model

- Need for new Travel Demand Model – existing travel demand model is deficient in 3 areas:
  - Air Quality - developed for CO conformity analysis. Need input to PM<sub>2.5</sub> conformity.
  - Coverage – captures traffic within the MPA. The MPA is substantially smaller than the PM<sub>2.5</sub> non-attainment area. Need increased traffic count coverage in non-attainment area.
  - Technical specifications - fails to meet the model data traffic requirements. Need improved data input to the EPA's new MOVES air quality model.

# Motor Vehicle Emission Simulator (MOVES) Model Attributes

- Estimates air pollution emissions from mobile sources
- Provides estimates for exhaust and evaporative emissions
- Incorporates substantial new emissions test data
- Accounts for changes in vehicle technology & regulations
- Improved understanding of in-use emission levels and factors that influence them
- More flexibility for input and output options

# Motor Vehicle Emission Simulator (MOVES) Model Attributes

- Can use, in most cases, existing MOBILE6 input parameters
- Uses a vehicle classification system based on the HPMS rather than the way they are classified in EPA emissions regulations.

# Motor Vehicle Emission Simulator (MOVES) Model Features

- Execution Mode – Run in County Level execution mode for State Implementation Plan (SIP) and regional transportation conformity use. (EPA recommendation)
- Driving Time Distributions – 16 input speed bins by vehicle type, road type, time of day, and day of week.
- Ramp Fractions – default fraction of ramp driving on selected road types, e.g., 8% of limited access VMT occurs on freeway ramps. Can be changed.
- Zone Road Activity – provides override of the time-of-day distribution **for any geographic subset.**



# Motor Vehicle Emission Simulator (MOVES) Model Attributes

- VMT Road Distribution – VMT input by five road types:
  - Off-network
  - Rural restricted access
  - Rural unrestricted access
  - Urban restricted access
  - Urban unrestricted access
- VMT Vehicle Type Distribution:
  - VMT by vehicle type:
    - Fleet population data compiled from Division of Motor Vehicles (DMV) registrations
    - Sources such as Inspection and Maintenance (I/M) programs.

# Model Challenges

- MOVES does not account for:
  - benefits of motor **block heater** plug-ins
  - **Extended idle time** to warm up vehicle block during cold weather
- Existing FMATS - region is smaller the  $PM_{2.5}$  non-attainment area; **travel is underestimated**.
- Very limited **cold weather test data** incorporated in algorithms. Fairbanks test this past winter at temperatures below 0°F to:
  - Collect  $PM_{2.5}$  at low temperatures
  - Examine the effects of extended idle and block heater use on HC, CO,  $NO_x$ , and  $PM_{2.5}$ .

# Travel Demand Forecast Model Improvements

- Boundary expansion
  - Retain the existing traffic analysis zone (TAZ ) structure within the MPO boundary.
  - Add new TAZs that are outside the MPO boundary
- Network expansion:
  - Add roads outside the MPA but within the  $PM_{2.5}$  non-attainment area; new roads based on actual road network
- Ramp fractions:
  - Use actual MPO ramp fractions in the  $PM_{2.5}$  non-attainment area rather than default values

# Travel Demand Forecast Model Improvements

## ● Demographic and employment data:

- Assemble demographic and employment data for the new TAZs and estimate future changes

## ● Driving Speed Calibration

- Calibrate model with field-measured driving speed data.
- Use GPS-based floating car method to collect speed on major roadways during morning and evening peak hours.
- Speed data not needed during off-peak hours due to lack of congestion.
- Use existing traffic volume data for linking volume to speed.

# Travel Demand Forecast Model Improvements

## ● Calibration of link performance functions:

- Link performance functions for different types of roads using DOT volume and speed data.
- Estimate volume-link running speeds using link performance functions.

## ● Analysis of heavy vehicles:

- Add a heavy vehicle VMT estimate and forecast component. Data source - DOT vehicle classification.
- Perform analysis using Methodologies in the Quick Response Freight Manual.
- Compare locally estimated VMT to VMT data from DMV registrations & I/M program.

# Traffic Demand Forecast Model Improvements

## ● Seasonal traffic patterns:

- Analyze the seasonal variation of VMT by vehicle type using DOT vehicle classification data.
- Identify situations where seasonal VMT estimates are appropriate, e.g., heavy summer tourist traffic increases the seasonal traffic volume variability.

## ● Time of day calibration:

- Re-calibrate model for three different time periods: AM peak, PM peak, and off peak hours that includes a look at heavy vehicle traffic.

# Traffic Demand Forecast Model Improvements

## ● Model re-calibration and validation:

- Re-calibrate expanded model and validate to the most current DOT volume data.
- Re-calibrate trip distribution results with travel time to work data from the US Census 2005 American Community Survey.

## ● Forecasting future traffic:

- Forecast future traffic by modifying the calibrated and validated model based on future demographics and employment.

# Sampling Plan for Traffic Volumes on Local Roads

## ● Four layers of data for identifying local road traffic count locations:

- PM2.5 non-attainment area
- MPO boundary
- Road centerlines
- Borough tax parcels

## ● Forecasting future traffic:

- Forecast future traffic by modifying the calibrated and validated model based on future demographics and employment.



# Sampling Plan for Traffic Volumes on Local Roads

- 1) Create new TAZs for the  $PM_{2.5}$  area outside the MPO boundary following the layout of local road network and distribution of residential parcels
- 2) Create travel demand model links\* for the local roads in the  $PM_{2.5}$  non-attainment area to connect the new  $PM_{2.5}$  TAZs.
- 3) Estimate the number of households for each  $PM_{2.5}$  TAZ.
- 4) Run the extended travel demand model to calculate the number of trips generated for TAZ households in the  $PM_{2.5}$  and estimated traffic flows in the NA.

# Sampling Plan for Traffic Volumes on Local Roads

- 5) Develop sampling plan to select 300 local roads in the entire  $PM_{2.5}$  non-attainment area for traffic counts.
- 6) Enter counted traffic volumes into the travel model network
- 7) Estimate total VMT for the local roads in the  $PM_{2.5}$  NA and the MPO boundaries using counted traffic data in conjunction with the travel model.
- 8) Report the estimates in HPMS.
- 9) Provide the estimates to the air quality conformity analyst.

# Sampling Plan for Traffic Volumes on Local Roads

10) Sample the local roads based on the traffic volume estimates following documented best practices

- Ensures that sufficient numbers of high volume roads are sampled.
- Because closely located links have higher probability of serving the same trip generating zones, oversampling from same area increases the chance of missing critical links in other areas

11) Examine the sampling plan using the Origin-Destination (O-D) estimation procedure in TransCAD.

# Research Needs

- Improved regional and statewide VMT estimates
- Improved algorithms for local VMT estimates
- Impact of extended idle and block heater use on HC, CO, NO<sub>x</sub>, and PM<sub>2.5</sub> emissions
- Larger data set of emissions at low temperatures (< -20° F) for MOVES model
- Exact meteorological conditions required to accurately forecast exceedance conditions
- Better understanding of the exact percent contribution from non-wood contributions, e.g., mobile sources, waste oil, fuel oil, and coal
- Extent of PM<sub>2.5</sub> within isolated areas of the Borough

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