Mobile Monitoring Method Specifications

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MOBILE MONITORING METHOD SPECIFICATIONS

1.0 Scope and Application.

1.1 Analyte. Airborne Particulate Matter (PM), specifically $PM_{2.5}$ and PM_{10}.

1.2 Applicability. This method is applicable to the determination of emission factors for vehicle-entrained dust from paved and unpaved roads.

1.3 Data Quality Objectives. This method is intended to provide an alternative to the traditional AP-42 method of obtaining PM emission factors for traffic-entrained dust from paved and unpaved roadways.

2.0 Summary of Method.

This method utilizes a test vehicle that generates a dust plume and monitors the plume's PM concentration using a continuous particle monitor, a global positioning system (GPS), and a data logger. The method is based on the observation that the dust emission intensity of any given portion of roadway is proportional to the intensity of the dust concentration that is monitored. By traveling over the entire road network (or a representative sample of the road network to be characterized), a map of emission intensity is generated. A calibration factor is used to convert the emission intensity to an equivalent emission factor, based on coincident application of the mobile monitoring technology and the traditional AP-42 roadside plume profiling method at representative test sites.

3.0 Definitions. [Reserved]

4.0 Interferences.

4.1 Background Concentrations. In order to remove the contribution of roadway PM emissions (including engine exhaust) from vehicles other than the test vehicle, the PM concentration in front of the test vehicle is monitored simultaneously with the dust plume concentration generated by the test vehicle. In the case of unpaved roads with infrequent traffic, there may be situations where background concentrations are negligible and do not require separate monitoring.

4.2 Cross-winds. In order to prevent cross-winds from altering the alignment of the test vehicle dust plume with the sampling inlet, mobile monitoring should avoid time periods with strong winds. Guidelines for this requirement are found in Section 9.1.2.

5.0 Safety.

5.1 Disclaimer. This method requires operation of a test vehicle in normal traffic conditions, as well as operation of dust plume sampling devices while the vehicle is traveling. Personnel operating this equipment should use caution to avoid a traffic accident.

6.0 Equipment and Supplies.

6.1 Continuous Particle Monitor. The test vehicle dust plume monitor consists of a portable PM_{10} or $PM_{2.5}$ sampling instrument that collects mass concentration data in real time (typically at 1-sec intervals) and operates reliably with the selected environment (interior or exterior) of the test vehicle. The sampling instrument may be battery operated or connected to an alternate power supply which is either part of the test vehicle electrical system or a separate source. In most reported applications of mobile monitoring, a portable laser photometer (light-scattering device) with an internal battery has been used. Because portable continuous particle mass concentration monitors do not comply with Federal Reference Method (FRM) requirements for the specified particle size range (e.g., PM-10) , a controlled study must be performed to develop a conversion factor that can be used to adjust the monitor reading to the true particle concentration.

6.2 Sampling Line. A sampling line provides for a continuous flow of air from the external probe to the continuous particle monitor. It should be constructed so that the dust sample does not accumulate on the interior surface of the line. The appropriate length and diameter of the sampling line must comply with the continuous particle monitor manufacturer specifications. The sampling line may direct the sample stream to/from a sample conditioning component, such as an inertial separator to remove coarse particles from the sample stream, if it can be demonstrated that the conditioning component does not alter the sample within the specified particle size range. Similarly, a dilution system may be utilized if the particle concentrations would otherwise exceed the reliable operating range of the particle monitor. However, the need for a dilution system is avoided by choosing an inlet position further away from the point of dust generation at the tire/road interface.

6.3 Inertial Seperator (Optional). If the point of dust generation is close to the sampling inlet location, an inertial separator may be used to prevent coarse particles (> 10 microns) from building up in the sampling line or otherwise interfering with the sampling system. The inertial separator should be placed in a location near the sampling inlet so that length of that sampling line that may require periodic cleaning is minimized.

6.4 Dilution System (Optional). If the point of dust generation is close to the inlet location, a dilution system may be used to decrease the concentration in the sample stream with background air (filtered or unfiltered) and thereby prevent the particle monitor from exceeding its detection limit. The dilution system should be positioned so that the sample stream has sufficient time to mix with the dilution air before reaching the particle monitor.

6.5 Sampling Inlet (Probe). The inlet (probe) is the apparatus that guides the air sample stream into the sampling line for delivery to the particle monitor. An inlet should be designed and constructed based on the specific nature of the mobile sampling system. The design and material of construction chosen for the inlet should be such that the dust sample will not accumulate on the interior of the inlet. The shape of the inlet opening and the body of the inlet will vary with custom design specifications.

6.5.1 Inlet Designs. Prototype inlets have included round or elongated openings, and inlets with drop-outs for large particles or water droplets. If the inlet is external to the body profile of the test vehicle, it should be pointed in the direction of vehicle travel, so that the primary condition of isokinetic sampling is satisfied. This will assure that oncoming dust particles are not required to make a turn as they enter the probe, which would allow particles with significant inertia to bypass the probe. It is more difficult to achieve the other requirement of isokinetic sampling, which requires adjustment of the intake air speed at the inlet opening so that it matches the speed of the air approaching the inlet. Although isokinetic sampling is important for large particle sampling, it is less important for particles smaller than 10 microns in aerodynamic diameter and is not an issue for particles smaller than 5 microns in aerodynamic diameter.

6.5.2 Inlet Positioning. Prototype inlets have been placed in the front wheel well (directly behind the wheel), on the passenger side of the vehicle just behind the passenger door, and on a trailer 10 ft behind the test vehicle (See Figure 1 where background sampling inlets are in red circles). In the case of the front wheel well locations, inlets have been placed on both sides of the vehicle to account for differences in the loadings across the road. Multiple inlets normally require blending of the sample streams prior to delivery to the particle monitor. Multiple inlets do not increase the representativeness of measurements unless there is an inconsistent lateral pattern of road surface dust loading so that within a travel lane the loading on one side of the test vehicle is alternatively higher and lower than the loading on the other side of the vehicle. An additional inlet on the front of the vehicle is used for background measurements. Inlets are typically placed at a height at least 10 inches off the ground. The most important characteristic to consider when determining the inlet placement is to ensure that, at the inlet position, the dust plume is stable and well-mixed. It should also be noted that the greater the distance between the probe and the points of dust generation (tire/road interface), the more likely the adverse effect of cross winds as a contributor to measurement uncertainty.

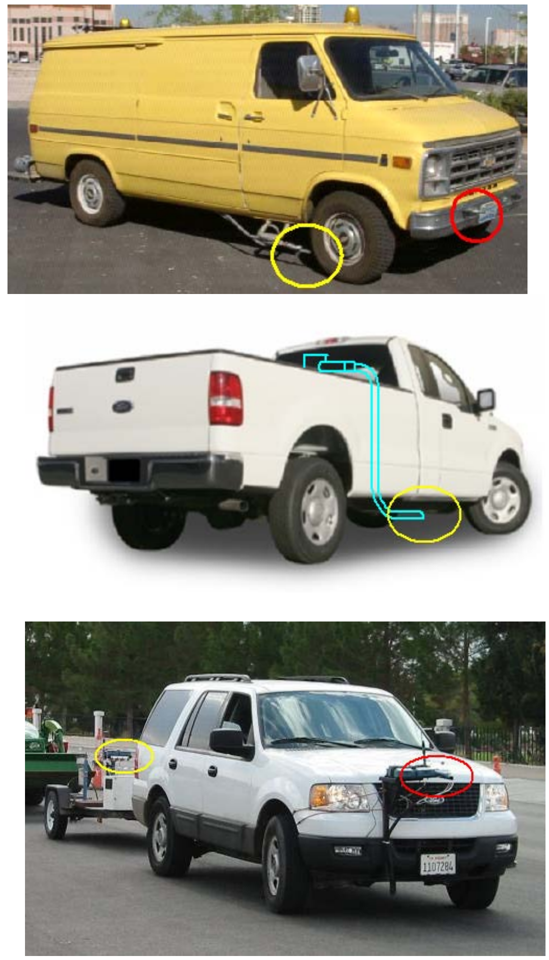

Figure 1 - Inlet Placements

6.6 GPS system. A GPS system with latitude and longitude data output capabilities should be collocated with the continuous particle monitor in order to spatially and temporally resolve the continuous particle monitor data points within the roadway system. The GPS should also have the capability to generate the speed, direction of travel, and rate of acceleration/deceleration in the same time resolution as the continuous particle monitor (usually in 1-sec intervals).

6.7 Data Logger. A data logging system such as a computer is connected to the continuous particle monitor and the GPS system to log monitor and GPS data sets in real time and create emissivity maps (see Section 12.4).

6.8 Test Vehicle. A vehicle should be equipped with all of the above instruments and accessories, with special care given to the fixed positioning of the inlet probe. Because the paved road dust emissions are also dependent on the fleet average vehicle weight, it is important that the weight of the test vehicle correspond closely to the fleet average vehicle weight for the application locality. Typically a light-duty van or truck satisfies this requirement.

6.9 Power Source. Although the critical components of the mobile monitoring instruments are equipped with internal batteries, an additional power source, such as a generator, may be needed to provide power for any flow generation devices (blowers or dilution systems) supporting the mobile monitor.

7.0 Reagents and Standards. [Reserved]

8.0 Sample Collection, Preservation, Storage, and Transport.

8.1 Develop Mobile Monitor Configuration.

8.1.1 Decide whether to use a previously established configuration or construct a new design. If a previously established configuration is selected, its corresponding calibration factor may be used as long as the validity of the calibration factor is upheld, as described in section 9.4. For a new design, a new calibration factor must be determined using the procedure described in section 10.

8.1.2 Steps in Designing a New Configuration.

8.1.2.1 Acquire a particle monitor, GPS system, data logger, and test vehicle.

8.1.2.2 Calibrate the particle monitor to a Federal Reference Method sampler for the particle size range of interest in a controlled test environment. Apply the calibration factor to all data output from the particle monitor to convert apparent concentration values to true concentration values.

8.1.2.3 Determine an appropriate location for the sampling inlet on the outside of the vehicle (see section 6.4.1).

8.1.2.4 Design the inlet probe and sampling line in compliance with any specifications from the particle monitor manufacturer.

8.1.2.5 Decide how to synchronize the particle monitor output with the GPS output and to merge the files in the data logger.

8.1.2.6 Provide a supplementary power source if necessary.

8.1.2.7 Calibrate the new mobile monitoring system to an accepted reference method, preferably roadside plume profiling, as described in section 10. Once the calibration factor is determined, that factor should be applied to the emissivity maps created by sampling representative roads within a roadway network.

8.2 Select Sampling Sites and Conditions

8.2.1 Choosing Representative Roads within a Roadway Network.

8.2.1.1 Mobile monitoring should be performed on roadway segments that represent the dominant contributors to the road dust emissions inventory. Of the four roadway classifications (local, collector, arterial, and freeway), emphasis should be placed on arterial and collector roadways because they typically have significant traffic levels combined with significant silt loadings. Generally, local roads do not have enough traffic to make a significant contribution to emission totals, and freeways are found to be clean enough as to not contribute significantly to emission totals. Collector and arterial roadways are the primary sources of PM emissions within a roadway network. Within each category, roadways that are well travelled should be chosen as representative contributors to dust emission totals.

8.2.1.2 Care should be taken to make sure that dust emissivity “hot spots” are included in sampling representation (test vehicle travel route) in proportion to their frequency of occurrence within a specific roadway category. Hot spots are places where road surface dust loadings are elevated because of local effects such as track-out from unpaved roads or construction activities onto paved roads. Hot spots tend to be associated with industrial operations or land development activities involving road or building construction. Hot spots contribute to emission totals at a level that is much greater than normally represented by the length of roadway involved.

8.2.2 Criteria for When to Collect Samples.

8.2.2.1 Time of Day. Based on safety considerations, sample collection should be performed during daylight hours that avoid periods of traffic congestion. Ideally sampling would occur between 10 am and 2 pm.

8.2.2.2 Precipitation Events. Sampling should not occur when roads are wet or icy. After a precipitation event, no sampling should occur until the roads have had ample time to dry out.

8.3 Logging Data. A data logger, such as a computer, should be connected to the Continuous Particle Monitor and the GPS system to accumulate data in real time. These data inputs should be saved in original form to the data logger as well as to external media (e.g. CD, flash drive, or network folder) for back-up. Data collected at vehicle speeds below 10 mph should be flagged as non-representative.

8.3.1 Data Analysis. Dust plume concentration data from the mobile monitoring system (given in mg/m^3 and collected at 1-sec intervals) should be averaged over stretches of continuous travel within a given category of roadway, for example, between major intersections. Any data collected for vehicle speeds below 10 mph should be excluded from averaging. Similarly, data collected for vehicle speeds outside the preferred range corresponding to system calibration conditions should be flagged separately for special consideration. The average concentration values for road segments within a given roadway category should be converted to equivalent emission factors for the particle size range of interest.

9.0 Quality Control.

9.1 Miscellaneous Quality Control Measures.

9.1.1 Vehicle Speed Ranges. All monitoring data associated with vehicle speeds less than or equal to 10 mph should be excluded from analysis. This includes stop-and-go traffic conditions and sharp corners. Similarly, all "fringe" monitoring data collected outside of the speed range under which the mobile monitoring configuration was calibrated should be evaluated for special analysis according to predetermined criteria. Although less reliable, fringe data tend to have lower significance in an emissions inventory because the largest component of traffic-entrained dust emissions is associated with the core speed range typically represented in calibration tests.

9.1.2 Wind Speed Ranges. The acceptable ambient wind speed range is –calm to 15 mph. If wind gusts above 15 mph are observed, testing should not proceed until wind speed subsides.

9.1.3 Acceleration/Deceleration. Travel routes and monitoring periods should be selected so that acceleration/deceleration criteria are met. A mobile system should avoid acceleration/deceleration rates exceeding 1.3 mph/s as more extreme rates can cause particles from brake and tire wear to bias the results.

9.1.4 Wheel Angle (applicable to front wheel probe locations only). Travel routes should be selected so that wheel angle criteria are met. If the sampling inlet is within 2 inches of the tire surface, the wheel angle should not exceed 3 degrees in relation to the straight forward position.

9.2 Continuous Particle Monitor.

9.2.1 Zero check. Follow standard calibration verification procedure recommended by instrument manufacturer or by system designer for custom applications.

9.2.2 Flow check. Follow standard calibration verification procedure recommended by instrument manufacturer or by system designer for custom applications.

9.3 Synchronize Continuous Particle Monitor and GPS system Time Stamps. Set internal clocks for each instrument and periodically note way points at ends of travel routes when test vehicle is stopped to confirm synchronization.

9.4 Validity of Calibration Factor. Any calibration factor developed for a specific test vehicle/sampling configuration should remain valid in different regions of the country, unless (a) the road dust characteristics are significantly different, or (b) the fleet average weight for traffic on paved roads in the study location is significantly different. The difference in road dust characteristics between the calibration area and the application area can be determined by resuspending representative road surface samples from each area. A well-mixed environmental chamber is normally used for this experimentation. The difference is significant if, after normalization to the same silt content, the resuspension fraction of the sample from the application area differs by more than 30 percent in comparison to the resuspension fraction from the calibration area, for the particle size fraction of interest. Similarly, the fleet average vehicle weight in the application should be within 20 percent of the weight of the test vehicle, taking into account the 1.5 power of the weight correction term in the AP-42 emission factor equation for paved roads.

10.0 Calibration and Standardization.

A calibration factor is needed for each mobile monitoring configuration (test vehicle and sampling system), to convert the relative dust emission intensity (measured in terms of dust plume concentration) to an equivalent emission factor for the specified particle size range. Calibration of a mobile monitoring configuration is accomplished by establishing a relationship between the mobile monitor concentration and the equivalent emission factor. Roadside plume flux profiling (traditionally referred to as exposure profiling) is the recognized standard method for calibrating mobile monitoring systems. Three or more test sites (or independent sets of test conditions) should be used for the calibration program, so that a range of road and traffic conditions is represented.

10.1 Calibrating the Continuous Particle Monitor (CPM) to a Federal Reference Method (FRM). The CPM should be collocated with a FRM in a controlled test environment in order to find a calibration factor to correct the CPM reading to a true PM mass concentration measurement.

10.2 Roadside Plume Profiling Calibration Test Site Requirements.

10.2.1 The microscale prevailing wind direction during the test period must be approximately perpendicular to the road orientation at the test site, i.e., within 45 degrees.

10.2.2 The test site cannot have trees, buildings, or other obstructions in close proximity to the roadway (unobstructed wind flow).

10.2.3 The test site must not have significantly elevated topography in close proximately to the roadway on either side.

10.2.4 The test site must have access areas on the downwind side of the road for placement of equipment and crew and on the upwind side for equipment.

10.2.5 The test site must be located where there is negligible interference from any upwind source of PM in the particle range of interest.

10.2.6 The test site must have an uninterrupted, relatively straight travel distance of about ¾ of a mile without any dust controls.

10.2.7 The test site should be blocked off from all traffic except for the test vehicle. In the case of divided roads with a sufficiently wide median to accommodate profiling equipment and crew, only one direction of traffic needs to be blocked off.

10.2.8 The grade of the road at the test site must be small so that vehicle exhaust emissions are negligible in relation to road dust emissions.

10.3 Roadside Plume Profiling Result. See references 17.1-17.3 for method description. The result of this method will yield an emission factor in units of g/vmt (grams per vehicle mile traveled) to be correlated with the average of concentration values measured by the mobile monitor as it passes by the profiling test equipment.

10.4 Test Vehicle Speed – Calibration Tests. Because the mobile monitor response has been shown to vary directly with the speed of the test vehicle, it is important to perform the calibration tests at documented vehicle speeds. However, the calibration factor can incorporate a range of test vehicle speeds that are representative of the paved roadway system in the locality of interest.

10.5 Mobile Monitoring Data Set. The data set obtained from the mobile monitor will yield an average concentration value in units of mg/m^3. The data points obtained by the mobile monitor will typically be given in 1-sec intervals. The number of data points collected will depend on the speed of the sampling vehicle. Data points should be collected for ¼ of a mile on either side of the roadside plume profiling tower. The data points used for this calibration can be chosen using GPS coordinates as end points of the test road segment over which the test vehicle speed is maintained at a constant value.

10.6 Derivation of Linear Calibration Factor. A mobile monitoring test is defined as a series of passes in front of the plume profiling tower at a given test site that meets the criteria specified in the previous section. The vehicle may pass in a 1-way or 2-way travel mode. The test vehicle speed range over which the calibration is developed should be divided into 3 equally distributed values, and each speed value should be tested separately. For each calibration, at least 3 mobile monitoring test sites or sets of conditions at the same site must be employed. Variations of test conditions at a given site can be achieved by spreading soil or other representative aggregate material at a uniform rate over the test road segment and allowing the fresh loading to be redistributed by natural traffic prior to the calibration test series. The individual concentration data points for each mobile monitoring test will be averaged, and then compared to the plume profiling result. At least 3 profiling test series must be performed to find a linear calibration factor. See Table 1 in Section 18.0.

11.0 Analytical Procedure.

11.1 Vehicle Class-Roadway Type Combinations based on the National Mobile Inventory Model (NMIM). See Table 2 in section 18.0 for the 18 Vehicle Class-Roadway Type Combinations.

11.1.1 Vehicle Miles Traveled (VMT) by Vehicle Class-Roadway Type Combinations. The procedures for gathering these data and processing them into the required scales and vehicle classes are described in detail in the National Emissions Inventory (NEI) documentation.

11.1.2 Collecting and Reducing Data based on Vehicle Class-Roadway Type Combinations. Emission estimates for entrained road dust within an inventory area are found by multiplying emission factors in lb/VMT (or g/vkt) for each roadway category by VMT values for that category. In turn, the VMT values for a given averaging period (daily, weekly or annually) are obtained by multiplication of traffic counts on representative road segments within a roadway category by the lengths of the segments. The full emission inventory for a defined study locality is complete when all active road segments that pass a significance test have been represented in the calculations. It is assumed that traffic-entrained dust emissions are negligible when traffic speeds are below 10 mph, requiring that this adjustment be made to the emission inventory by subtracting VMT components associated with traffic congestion.

11.2 Inventory Evaluation Month and Calendar Year. MOBILE6 specifies a calendar year and an evaluation month of either January or July. These two parameters determine the fleet composition for which emission factors are generated. For each month of a given inventory year, NMIM writes the MOBILE6 input file using the combination of calendar year and evaluation month shown in Table 3, section 18.0.

12.0 Data Analysis and Calculations.

12.1 Correlating GPS and CPM Data. Because time synchronization between the GPS and CPM is such a critical element for accurately mapping spatial changes in emissions, care should be taken to ensure that the GPS and CPM timestamps are correctly correlated. The easiest way to accomplish this is to begin and end data collection on both systems at exactly the same time, allowing the first and last points to be synchronized. If this method is not practical, most CPMs feature an analog voltage out that corresponds directly to the instantaneous measured concentration value so that, if the test vehicle is stationary, the measured emission rate (voltage) will drop to a constant background value. Then, the timestamps of the period of constant voltage from the CPM can be associated with the timestamps of the GPS data when the test vehicle position is constant.

12.2 Data Reduction. In accordance with the quality control methods prescribed in section 9.0, the data set of concentration values obtained for a particular road segment should be reduced to omit the data points for vehicle speeds below 10 mph, acceleration/deceleration rate exceeding 1.3 mph/s, or wheel angle 3 degrees for wheel well probe locations only. The average of the resultant set of concentration values is to be used in the conversion to an emission factor for the particle size range of interest..

12.3 Deriving Emission Factors. To determine the emission factor for a representative road segment, the concentration values of all valid data points from the continuous monitor over a specific road segment are averaged. See References 17.2 and 17.5 for examples of this procedure. For the most systems, the concentration values are measured directly by the CPM. Then, the calibration factor for the mobile monitor is used to convert the average concentration measured by the monitor into an emission factor for that road segment.

12.4 Creating Emissivity Maps. Emissivity is a term used to indicate emission potential, expressed either as test vehicle plume concentration or equivalent emission factor. In order to generate temporally and spatially justified emissivity maps, GPS location data can be correlated with the time-synchronized CPM emission factors to map the emission potential over a whole segment of road. In order to minimize the noise in individual concentration values, it is recommended that running average of an odd number of concentration values (typically three or five) be used per point on the emissions map. These values can then be used to generate overlays on satellite images or other GIS maps. An example emissivity map is shown in Figure 2 from Reference 17.5, where the emissivity is given in units of g/vkt.

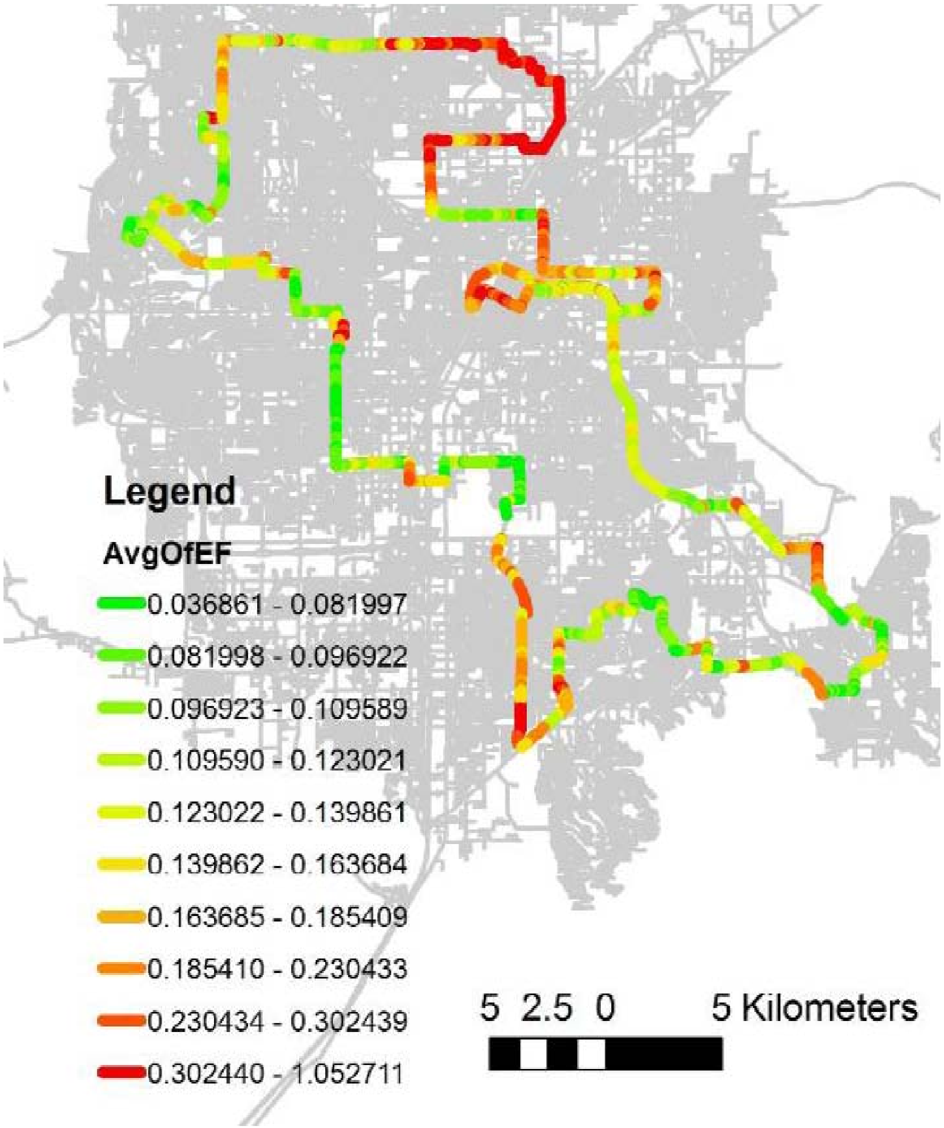

Figure 2 - Example Emissivity Map

12.5 Converting to Class-Specific Emission Factors. The process described in section 12.1 can be repeated for each road class to determine emission factors for each category of roads for which an emission factor needs to be determined.

13.0 Method Performance.

13.1 Reliability.

13.1.1 Test Vehicle Speed. To the extent possible, the speed of the calibrated mobile monitoring test vehicle should be restricted to the value or range of values for which the calibration was developed. However, mobile monitoring data may be collected outside of the calibrated speed range but with somewhat less reliability unless supplementary data on speed applicability of a calibration can be used to demonstrate that the full reliability applies. For example, in the case of the mobile monitoring technologies demonstrated in the Clark County study, the monitors were calibrated over a speed range of 25 mph to 45 mph, but monitoring over a speed range of 10 mph (the effective dust entrainment threshold) to 60 mph will still provide useful data.

13.1.2 Test Vehicle Weight. Because the paved road dust emissions are also dependent on the fleet average vehicle weight, it is important that the weight of the test vehicle correspond closely to the fleet average vehicle weight for the application locality. If this criterion is not met, a correction to the emission factor will need to be made based on collocated roadside profiling or on the current AP-42 relationship between emissions and fleet average vehicle weight.

13.2 Validity. Any calibration factor developed for a specific test vehicle/sampling configuration should remain valid in different regions of the country, unless (a) the road dust characteristics are markedly different, or (b) the fleet average weight for traffic on paved roads in the study location is different. In either case, a new calibration factor must be developed, unless prior studies have generated test data that can be used to make reliable adjustments to the original calibration factor. For example, a well mixed environmental chamber with approved reference particulate samplers can be used to compare the properties of (a) entrained dust from a new roadway study area and (b) entrained dust from the locality where the mobile monitor calibration was performed.

13.3 Uncertainty. The primary source of uncertainty in the mobile monitoring method is the calibration factor for the specific test vehicle/sampling system configuration. This uncertainty can be evaluated in terms of the agreement between emission projected from the mobile monitoring method and the emission factors measured by the reference method (roadside plume flux profiling)

13.3.1 Statistical Analysis. In the statistical analysis process, a method of cross-validation is used, which involves removing one test data point (pair of projected and observed emission factors) from the data set and using the best-fit linear relationship determined from the remaining points to project the missing emission factor. A reference level of uncertainty is obtained from a similar analysis of the test data set used to derive the AP-42 emission factor equation for paved road dust. See Reference 17.2 for more detail on comparative levels of uncertainty between (a) the AP-42 emission factor for paved roads and (b) prototype mobile monitoring systems.

13.3.2 Case Study. In the uncertainty analysis of TRAKER and SCAMPER mobile monitoring configurations tested in the Clark County study, a higher percentage of mobile monitoring test results fall within the specified factor as compared to the AP-42 test data. This indicates a lower level of uncertainty for mobile monitoring as compared to the traditional AP-42 method when actual silt loading values are used in predicting the measured emission factors. If default silt loading values are used in predicting road dust emission factors with the AP-42 emission factor equation, an even higher level of uncertainty would be expected. This analysis clearly indicates that linear equations used to generate the calibration factors for the TRAKER and SCAMPER systems on average have lower uncertainty than the AP-42 emission factor equation for paved roads. This is not surprising when it is realized that the AP-42 equation was developed from test data collected under a much broader range of conditions at many locations across the country.

13.3.3 Spatial Resolution. Even if it were to be assumed that the uncertainty levels of the two methods are similar, there is a second significant source of uncertainty in the traditional AP-42 method that has no uncertainty counterpart in the mobile monitoring method. Whereas the AP-42 method requires a priori judgments as to where to collect silt loading samples, the mobile monitoring method provides for rapid characterization of a large segment of a roadway system. Even if only an uncalibrated mobile monitor were available in a particular study area, it could be used as an effective tool to locate silt loading collection points in implementing the traditional AP-42 method.

14.0 Pollution Prevention. [Reserved]

15.0 Waste Management. [Reserved]

16.0 Alternative Procedures.

16.1 Calibration of Mobile Monitor against AP-42 Silt Loading Emission Factors.

16.1.1 AP-42 Silt Loading Result. See reference 17.6 for method description. The result of this method will yield an emission factor in units of g/vmt (grams per vehicle mile traveled).

16.1.2 Mobile Monitoring Data Set. The data set obtained from the mobile monitor will yield an average concentration value in units of mg/m^3. The data points obtained by the mobile monitor will typically be given in 1-sec intervals. The number of data points collected will depend on the speed of the sampling vehicle. Data points should be collected for ¼ of a mile on either side of the silt loading sampling location. The data points used for this calibration can be chosen using GPS coordinates as end points.

16.1.3 Derivation of Linear Calibration Factor. If conditions do not allow for calibration to the plume profiling method, the results of an AP-42 silt-loading study could serve as the basis for calibrating mobile monitoring concentrations to emission factors. Silt loading measurements would be input to the AP-42 emission factor equation in order to determine emission factors for each test site.

16.1.4 Uncertainty. The method would have a much higher uncertainty because it would combine the uncertainties of the mobile monitoring method with the traditional AP-42 method.

16.2 Utilizing Mobile Monitoring to Optimize Silt Loading Sampling Locations. An uncalibrated mobile monitoring system to perform AP-42 silt loading test procedures. The number of locations depends on the size of the roadway network to be characterized.

17.0 References.

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17.2 C. Cowherd, Jr, *Technical Support Document for Mobile Monitoring Technologies*, Prepared for Clark County Department of Air Quality and Environmental Management, January 2009.

17.3 Pyle, B. E. and J. D. McCain, *Critical Review of Open Source Particulate Emission Measurements -- Part II: Field Comparison*. Work Assignment 002, EPA Contract 68-02-3936. 600S286072. February 1986. http://www.osti.gov/energycitations/product.biblio.jsp?osti_id=7172830

17.4 EPA, *Air Superfund National Technical Guidance Study Series Volume 2 Estimation of Baseline Air Emissions At Superfund Sites 450189002* http://www.p2pays.org/ref/10/09762.pdf

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17.6 EPA Office of Transportation and Air Quality. *National Inventory Model (NMIM), a Consolidated Emissions Modeling System for MOBILE6 and NONROAD*. EPA 420-R-05-024. December 2005. http://www.epa.gov/otaq/models/nmim/420r05024.pdf.

17.7 EPA Office of Air Quality Planning and Standards. *Compilation of Air Pollutant Emission Factors (AP-42)* Fifth Edition, Research Triangle Park NC, 1995.

17.8 Ftiz, Dennis R. Draft Final Report, *Measurements of PM10 Emission Factors from Paved Roads in Clark County, NV*, Prepared for Clark County Department of Air Quality Management's Roadway Dust Sampling Evaluation Phase II, 2005.

18.0 Tables, Diagrams, Flowcharts, and Validation Data.

Table 1 - Calibration Data Flow

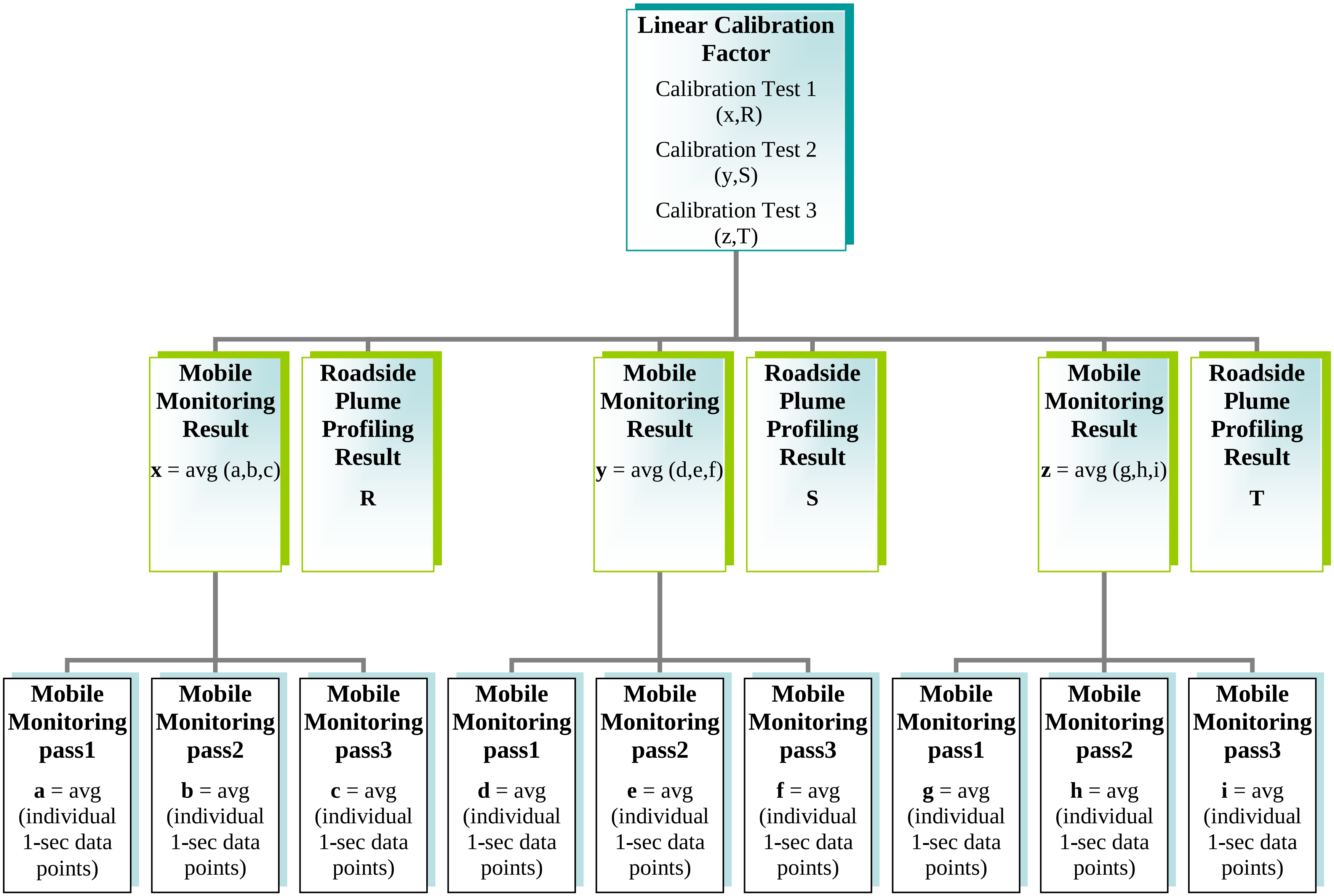

Table 2 - Mobile 6 Vehicle and Road Classifications

M6 Vtypes	Road Types	M6 Ftype
LDV	Rural Interstate	Freeway
LDT		
HDV		
LDV	Urban Interstate	
LDT		
HDV		
LDV	Urban Freeways & Expressway	
LDT		
HDV		
LDV,LDT	Rural Principal Arterial	Arterial
LDV,LDT	Rural Minor Arterial	
HDV	Rural Principal Arterial	
LDV,LDT	Rural Major Collector	
LDV,LDT	Rural Minor Collector, Rural Local	
HDV	Rural Minor Arterial	
LDV,LDT	Urban Principal Arterial, Urban Minor Arterial, Urban Collector	
HDV	Rural Major Collector, Rural Minor Collector, Rural Local	
HDV	Urban Principal Arterial, Urban Minor Arterial, Urban Collector	

* Reference MOBILE6.2 User Guide, Appendix B

LDV = MOBILE6 Vehicle Types 1 and 16.
LDT = MOBILE6 Vehicle Types 2-5.
HDV = MOBILE6 Vehicle Types 6-15.

Table 3 – Mobile6 Month and Year Conventions

NMIM Month of Inventory Year Y	MOBILE6 calendar year	MOBILE6 evaluation month
1	Y	1
2	Y	1
3	Y	1
4	Y	7
5	Y	7
6	Y	7
7	Y	7
8	Y	7
9	Y	7
10	Y+1	1
11	Y+1	1
12	Y+1	1