APPENDIX G

REPORTING TRAVEL DATA IN AIR QUALITY NONATTAINMENT AREAS

INTRODUCTION

The HPMS is a consistent, efficient mechanism through which travel tracking information can be developed. To minimize burden and avoid duplication of efforts by States, MPOs, and local governments for travel monitoring and data reporting, EPA has chosen to rely on the HPMS as the principal tool for meeting the Environmental Protection Agency's (EPA's) travel monitoring needs.

The requirements for travel estimates for National Ambient Air Quality Standards (NAAQS) nonattainment areas as designated by EPA were developed in response to the Clean Air Act Amendments (CAAA) of 1990. Specific EPA travel monitoring requirements for designated NAAQS nonattainment areas can be found in Section 187, Vehicle Travel Forecasting and Tracking Guidance (*Federal Register*, March 19, 1992, Volume 57, No. 54). This guidance calls for States/MPOs having affected urbanized nonattainment areas to estimate total annual vehicular highway travel using HPMS procedures.

HPMS data are also used in establishing regional transportation-related emissions for transportation conformity purposes in accordance with the Transportation Conformity Rule, 40 CFR parts 51 and 93. Estimated vehicle-miles of travel (VMT) based on the HPMS are used for calibration and validation of base-year network-based travel models when required in nonattainment or maintenance areas.

For conformity purposes, locally developed county-based programs and other procedures different from the HPMS procedures are permitted subject to interagency consultation procedures. See 40 CFR Parts 51 and 93, Transportation Conformity Rule Amendments: Flexibility and Streamlining (*Federal Register*, August 15, 1997, Volume 62, N. 158) for further details. In general, it is the State's responsibility to negotiate specific departures from use of the HPMS to track travel change with EPA and FHWA field offices through the interagency consultation procedures cited above. Where HPMS is used for travel tracking purposes, States should establish the following in cooperation with EPA and FHWA field offices:

- The specific areas for which travel data will be required.
- The type of nonattainment area pollutants that require travel information.
- The severity classifications for which travel data will be required.

To meet the Clean Air Act requirements, travel data are to represent total travel within the NAAQS nonattainment area boundary surrounding affected urbanized areas. The design of the HPMS permits its use for these purposes only in those NAAQS nonattainment areas that contain one or more complete urbanized area(s). The HPMS sample is not valid if an urbanized area is split by a nonattainment area boundary or if parts of an urbanized area are included in multiple nonattainment areas. Within any nonattainment area boundary, the land area outside of the FHWA-approved adjusted urbanized area boundaries classified as rural or small urban (places between 5,000 to 49,999 population) is referred to as the donut area.

Travel estimates within NAAQS nonattainment areas are derived using HPMS procedures for higher functional systems. However, it is important to note that procedures for estimating travel on the rural

minor collector and local functional systems, while important for tracking nonattainment area travel, are not specified in the Manual or by FHWA. Travel on these lower systems is developed using State and local methods and procedures and reported to the HPMS as summary data (see Chapter III).

NAAQS NONATTAINMENT AREA CODES

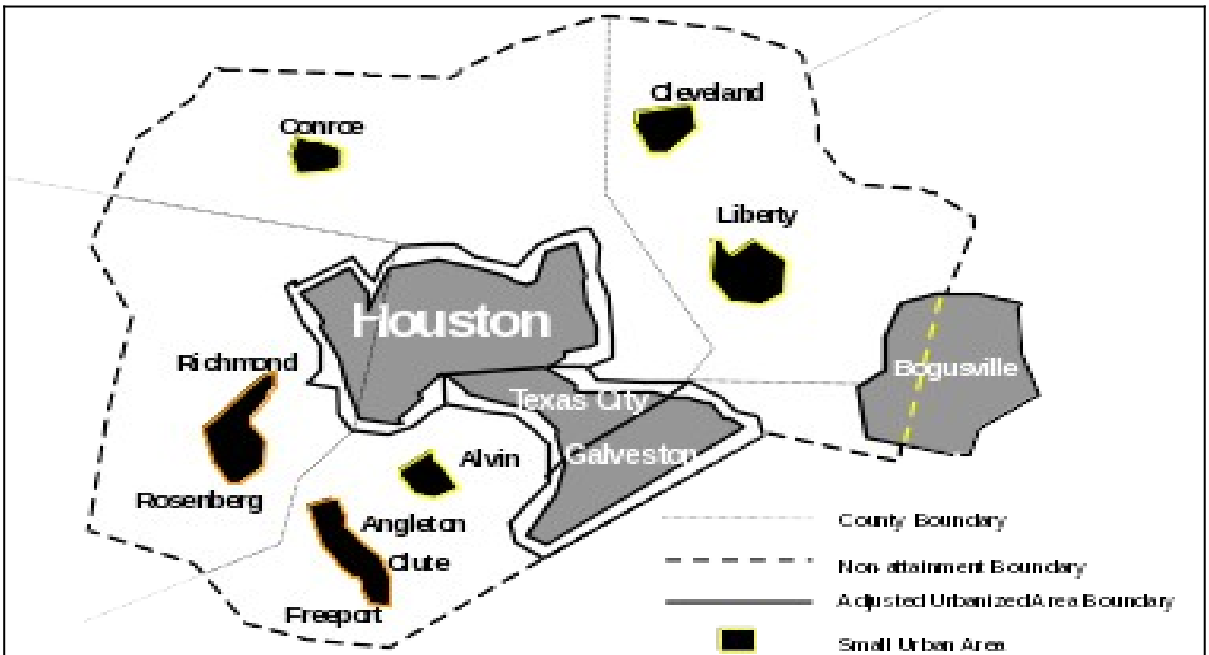
The three-digit urbanized area codes shown in Appendix B are used for nonattainment area coding in HPMS. Assign NAAQS nonattainment area codes (Item 16) following these general rules:

- If a named NAAQS nonattainment area includes only one urbanized area, the nonattainment area code is the same as the urbanized area code;
- If a named NAAQS nonattainment area includes more than one urbanized area, the nonattainment area code used for each urbanized area within the named NAAQS nonattainment area is that of the primary urbanized area;
- For rural and small urban areas outside the boundaries of the FHWA-approved adjusted urbanized area(s) but within a named NAAQS nonattainment area, the nonattainment area code is that of the primary urbanized area.

Use this coding consistently for summary data as well as for universe, standard sample, and supplementary sample sections. When the primary urbanized area in a nonattainment area is in another State, the assigned NAAQS nonattainment code must be for the primary urbanized area in the adjoining State.

An NAAQS nonattainment area is illustrated for "Houston" in Figure G-1. It consists of the urbanized areas of Houston (the primary urbanized area), Texas City, Galveston, six small urban areas and the remaining rural area. All of the data for the urbanized areas, small urban areas, and rural areas within the NAAQS nonattainment area must be coded with the FHWA urbanized area code of Houston (015) as the nonattainment area code. The table below contains the proper coding for a universe, standard sample, or supplementary sample section and for required summary data fields. A fictitious urbanized area (Bogusville) is shown in Figure G-1, straddling the Houston nonattainment area boundary. As previously noted, HPMS cannot be used to produce travel estimates for split urbanized areas. The nonattainment area code for this area should be coded "000"; any air quality travel estimates for Bogusville must be done outside of HPMS.

Houston NAAQS Nonattainment Area		
Urbanized Area Code	**Nonattainment Area Code**	**Location**
015	015	Houston Urbanized Area
137	015	Galveston Urbanized Area
250	015	Texas City Urbanized Area
999	000	Bogusville
000	015	Small Urban Area
000	015	Rural Area



Urbanized Area Code	Non-attainment Area Code	Location
015	015	Houston Urbanized Area
137	015	Galveston Urbanized Area
250	015	Texas City Urbanized Area
000	015	All Small Urban Areas
000	015	All Rural Area
999	000	Bogusville

Figure G-1. Houston NAAQS Nonattainment Area

For all road segments outside of nonattainment areas, code "000" in the nonattainment area data item.

DONUT AREA SAMPLING PROCEDURES

GENERAL

The following discussion outlines procedures for developing a sample panel of highway sections that can be used to estimate travel for certain functional systems in the donut area of an NAAQS nonattainment area. The donut area sample panel is a combination of existing standard sample sections and randomly selected supplementary sample sections in the donut area.

Donut area sample procedures use:

- the same methodology for selecting the standard sample panel (Chapter VII),
- the HPMS standard stratification levels, and

- established HPMS sampling procedures.

These procedures require that all urban and NAAQS nonattainment area boundaries be clearly established based on the latest FHWA-approved, adjusted urban area boundaries and agreed-upon nonattainment area boundaries. They also require an up-to-date functional classification of all roadways within the donut area. Finally, these procedures also depend on the existence of accurate length and road section information within the donut area boundary. The donut area sampling procedures apply only to roads functionally classified as rural and small urban minor arterial, rural major collector, and small urban collector within the donut area boundary.

DONUT AREA BOUNDARY

The development of the donut area sample depends on established, up-to-date, and recognizable boundaries. The FHWA approved, adjusted urban area boundaries and the NAAQS nonattainment area boundaries of each donut area should be available on State or MPO maps. The adjusted boundaries of urbanized and small urban areas in the nonattainment area must be based on the latest Decennial Census.

STANDARD SAMPLE REVIEW

The donut area sample panel is comprised of:

- Existing standard sample sections in the donut area; and,
- Supplementary sample sections if needed to achieve the required travel estimate precision in the donut area.

The first step in designing a donut area sample panel is to optimize the standard sample panel using the HPMS sample adequacy software and the procedures described in Chapter VII and Appendices C and D. The donut area sampling methodology requires an up-to-date and error-free standard sample panel without boundary, volume group, or universe definition problems; the existing standard sample panel must also meet the established HPMS precision criteria. Proceeding to develop a donut area sample panel without a clean standard sample panel and a well-defined universe will result in inaccurate information.

DONUT AREA SAMPLING UNIVERSE

The universe to be sampled consists of all highway sections within State boundaries that are functionally classified as rural minor arterial, rural major collector, small urban minor arterial, and small urban collector. In addition, they are located within the defined nonattainment boundary and are outside of all urbanized area boundaries.

In cases where donut areas cross State lines, all State portions must be sampled. The involved States should coordinate the sample size calculation using the whole donut area universe (all States combined), and then sample a minimum of each State's pro rata share of the required samples based on the existing universe length in each State for each donut functional system and volume group stratum. Expansion factors are developed based on the universe and sampled length within each individual State.

DONUT AREA UNIVERSE STRATIFICATION

The functional system strata are designed to maintain consistency with the standard sample, but combine rural and small urban sections for sampling efficiency. The donut area universe is stratified into two donut functional systems (donut minor arterial and donut collector) and five volume group stratifications. This results in 10 possible donut panel strata (two donut functional systems and five volume groups).

The donut minor arterial system consists of both the small urban and rural minor arterial systems. The donut collector system consists of the rural major collector and the small urban collector systems. The volume group strata have been defined to minimize the number of strata and help reduce the overall sample size. The volume group categories are as follows:

Volume Group	AADT
1	1 to 2,499
2	2,500 to 4,999
3	5,000 to 9,999
4	10,000 to 14,999
5	15,000 or higher

These volume groups should be representative of minor arterial and collector sections in most donut areas. In larger nonattainment areas, Volume Group 5 may include a greater volume range than the lower volume groups. This will not pose a problem if the functional class definition used by the State conforms with the standard definition; where it does not, or where other special circumstances exist, the volume groups may be expanded or changed. If other volume groups are selected, the AADT limits of the volume groups must be reported to FHWA with the HPMS submittal.

PREPARING THE DONUT AREA UNIVERSE SAMPLING FRAME

A universe sampling frame is a listing or file of all the sections from which a sample panel is selected. A complete inventory must be undertaken to determine the length of roadway in each stratum and to identify the universe sampling frame elements (sections). To create the sampling frame, all donut area roadways in the two donut area functional systems must be broken down into road sections by the five volume groups; samples will be selected from these strata. The information needed for each road section includes:

- nonattainment area code
- inventory route number
- functional system code
- AADT estimate
- donut area sample panel volume group
- length of section
- beginning and ending section kilometerpoints (milepoints) [or other termini point definition]

Since the donut area sample is used for estimating travel, each universe sampling frame section should be as homogenous as possible with respect to AADT. In theory, each AADT change necessitates the

creation of a new road section. In practice, a new road section should be created when the AADT changes by 10 percent or more. Road sections may correspond to major intersections or access points where AADT changes are estimated to exceed 10 percent of the traffic. Knowledge of the road system, and exercise of engineering judgment, may be necessary in some situations. Donut area samples may be split to maintain traffic homogeneity. However, the need to split samples in the future can be minimized by keeping the original donut universe sampling frame sections relatively short in length.

Existing universe sections in donut areas may be used as a sampling frame. However, since they may have been defined according to different criteria, a thorough examination is required to ensure that the section breaks are at reasonable positions along the roadway and appropriately reflect AADT change points.

PRECISION LEVEL SPECIFICATION

The objective of the HPMS is to achieve estimates of travel within the donut areas at a 90-10 confidence (precision) level. Most of the total travel for the donut area is developed from the principal arterial universe data (which has no sampling error). The precision of the donut area sample is set at 90-10 to ensure that the travel developed from the expanded sample will meet this objective. While travel for the lower level systems (local and minor collector) is determined from procedures external to the HPMS and has an unknown precision level, it represents very little of the total travel in the donut area.

DONUT AREA SAMPLE SELECTION PROCESS

GENERAL

The donut area sample selection process consists of:

- Determining the AADT variability (coefficient of variation) of the universe sampling frame sections,
- Applying the sample size equations (Appendix D),
- Determining how many sections from the standard sample are available,
- Randomly selecting supplementary sample sections,
- Examining the sample for representation validity, and
- Computing the expansion factors.

Each of these steps is discussed in detail in the following paragraphs.

DETERMINING STRATUM VARIABILITY

The determination of sample size is dependent on the variability of the characteristic to be measured – AADT, in this case. The basic purpose of the sample is to estimate travel and the only characteristic available to estimate sampling frame variability is AADT. Variability is estimated by computing the coefficient of variation (C.V.) of AADT. The C.V. is the ratio of the standard deviation to the mean.

A preliminary estimate of the C.V. for the established traffic volume groups can be determined by estimating the standard deviation as one-sixth of the range, and the mean as the midpoint of the range.

For example, for Volume Group 1, the standard deviation is estimated at 417 (dividing the range 2,500 by 6), the mean is estimated at 1,250 (the midpoint of the range between 1 and 2,499), and the C.V. is .33 (417/1,250). C.V. estimates from this procedure assume a normal distribution throughout the range, which is not likely to be the case for traffic volumes. If, for example, the mean were 1,000 rather than 1,250, the C.V. estimate would be .42. Since sample size is directly related to the C.V., the use of these conservative values help to ensure achievement of the desired precision.

Assuming that the AADT values assigned to each section are fairly accurate, estimates of the C.V., the standard deviation, and the mean are common values that can be computed directly from the sampling frame using HPMS software or other spreadsheet, database or statistical packages.

DETERMINING STRATUM SAMPLE SIZE

The procedures and equations for determining stratum sample size are included in Appendix D. The values to be used for the donut area sample size calculation are:

Z = 1.645 (for 90-percent confidence)
d = .10 (for the desired precision rate of 10 percent)
N = the number of universe sections available in the donut area sample stratum
C = the C.V. calculated as stated above for the donut area sample stratum

A sample size calculation must be done for each donut panel stratum that contains universe sections. The minimum number of samples in each stratum is three; if less than three sections exist in a stratum, sample all.

Once a sample size is determined for each stratum, all standard sample sections for the donut functional systems are reviewed to determine how many fall within the specific donut area. A map of the donut area marked with the location of existing standard sample sections may be useful in making this review. The number of supplementary samples required is the difference between the stratum sample size computed in the previous step and the number of standard samples available. For example, if the computed sample size in the first donut area stratum is 50 and 30 standard samples are available, then 20 supplementary samples are needed.

RANDOM SAMPLE SELECTION PROCESS

The standard sample sections should be eliminated from each universe sampling frame stratum prior to selecting the supplementary sample. This will require identifying the standard samples, establishing the termini points of each section, and appropriately reducing the universe sampling frame stratum size. The existing standard sample stratum sections will reduce an equal number of universe sampling frame stratum sections. For example, if 30 standard sample sections are available in a stratum and 500 sections existed in the universe sampling frame for the same stratum, the modified universe sampling frame stratum will consist of 470 sections.

The supplementary sample is selected using simple random sampling procedures. The selection procedure can be applied after the modified universe sampling frame stratum is prepared by using computerized selection techniques available with most statistical packages or by using the manual method described below.

Manual method: After removal of the standard sample sections, all road sections remaining in the universe sampling frame stratum are assigned a unique, sequential number beginning with the number 1. If the universe sampling frame for a particular stratum has 500 remaining sections, for example, then numbers 1 through 500 are assigned to the sections available for sampling.

At this point, use a table of random numbers to select the supplementary sample from the universe sampling frame; discard duplicate or missing random numbers or random numbers out of the universe sampling frame stratum range. Repeat this step until the number of required supplementary samples plus the number of existing standard samples is at least equal to the required sample size for each stratum.

JUDGING THE VALIDITY OF THE SAMPLE

The manner in which the donut area sample panel is selected does not follow a strictly theoretical random sampling application. A random standard sample from one sampling frame has been combined with a random supplementary sample from another. When the donut sample is larger than the existing standard sample and the supplementary sample has been picked randomly, the result will likely be a fairly representative sample panel. However, when the supplementary sample is small or nonexistent due to the availability of many standard samples, the resulting combined sample may not be statistically representative of the donut area. This is more likely to occur in large donut areas covering several small urban areas or large rural areas, and may result in biased estimates of travel.

As a validity check, the standard and supplementary sample section locations should be reviewed on a map of the donut area. If the combined donut area sample is not well dispersed over the geography and routes of the donut area, or if sampled sections are concentrated in one part of the area such as in the small urban areas or in one sector of the donut area, then the sample panel may not be representative.

A determination of the validity of the donut area sample panel must be made; if the donut area sample is not representative, then steps should be taken to reselect supplementary samples or increase the sample size.

COMPUTATION OF DONUT EXPANSION FACTORS

The donut area sample panel uses its own volume groups and expansion factors to produce the desired travel estimates. The HPMS sample methodology expands the sample based on the ratio of universe length to sample length for each sample stratum. This process results in a single computation for each stratum and allows simple checking since expansion factors are unique for each stratum. For example, if the stratum universe length is 250 and the stratum sample length is 50, the donut area expansion factor for the stratum is 5 (250/50). This expansion procedure provides a clear length check; when the sample length is computed and expanded, it must equal the universe length for the stratum. The sum of the expanded lengths for each volume group in the donut minor arterial and collector systems must equal the total universe length for the donut functional systems.

The HPMS donut area sample section that is also a standard sample section has two expansion factors. The standard sample expansion factor is used to expand data in the standard sample; the donut area expansion factor is used to expand the sample section AADT to an estimate of travel for the donut functional system.

ESTIMATING TOTAL TRAVEL IN THE DONUT AREA

Travel estimates within the NAAQS donut area are derived from universe data for the principal arterial functional system; from the combined donut area sample for the rural minor arterial, small urban area minor arterial, rural major collector, and small urban area collector systems; and from State/local summary travel estimates for the small urban and rural local systems and the rural minor collector system.

The travel estimate from universe data is simply computed by multiplying the AADT times the section length for each section and summing the results for all sections. Travel estimates from summary data are used as provided by the States for the rural minor collector and the small urban and rural local systems. The travel estimate from the donut area sampled systems is computed by multiplying the AADT by the section length and by the donut area expansion factor for each sample section and summing these values for all donut area sample sections. The sum of these three estimates is the travel estimate for the donut area portion of the NAAQS nonattainment area.

To obtain the total travel estimate for the NAAQS nonattainment area, the urbanized area travel total for the urbanized area(s) contained within the NAAQS nonattainment area must be added to the total donut area estimate to obtain the areawide NAAQS nonattainment area travel total.

If the required travel estimate is to be stated as an annual (rather than daily) value, the daily result acquired above is to be multiplied by 365 (366 in leap years).

MAINTAINING THE SAMPLE

The universe sampling frame sections and length and sample stratum makeup will change over time and begin to invalidate the sample panel as a result of travel growth, development within the donut area, etc. Several sample maintenance steps are advised:

- A sample panel reevaluation should be carried out every 3 years, at a minimum, to ensure that the sample panel remains representative of the universe in the donut area;
- If universe sections or donut area samples have a change in AADT that causes a shift of sections from one volume group to another, recalculate the expansion factors for the next HPMS submittal;
- AADT on the universe sampling frame sections needs to be monitored to ensure that sections are maintained in the proper stratum. If the universe length is not correctly stratified, the expansion factors will not be correct and the resulting travel estimates will be biased;
- An expansion factor maximum of 99.999 should be maintained; additional samples should be chosen as necessary to keep the expansion factor below this maximum;
- A minimum of three samples per stratum must be maintained.