

From: Jane Lin, University of Illinois at Chicago

PI on ICT sponsored project entitled “Transportation Conformity Particulate Matter Hot-Spot Air Quality Modeling”

To: CMAP Interagency Consultation Meeting on November 4, 2011

Re: Determination of Urban/Rural Population as defined in EPA PM hotspot conformity guidance and AERMOD implementation guidance for AERMOD modeling purpose

Date: October 28, 2011

(I) Background Information:

The issue pertains to one of the required input parameters, namely *Urban Population*, to the AERMOD modeling for PM hotspot conformity analysis. Urban Population is used in AERMOD to determine the urban heat island effect on pollutant concentration levels.

In the U.S. EPA’s “Transportation Conformity Guidance for Quantitative Hot-spot Analyses in PM2.5 and PM10 Nonattainment and Maintenance Areas” (EPA-420-B-10-040, December 2010), it states that (p. 89 – 90):

“7.5.5 Specifying urban or rural sources

In addition to surface characteristics, night-time dispersion in urban areas can be greater than in surrounding rural areas with similar surface characteristics as a result of the ‘urban heat island effect.’

The implications for highway and transit projects are that the same emissions in a rural area will undergo less dispersion than the same source in an urban area, all other factors (e.g., surface characteristics, meteorology) being equal. For the purposes of a hot-spot analysis, then:

- *In urban areas, sources should generally be treated as urban.*
- *In isolated rural nonattainment and maintenance areas (as defined by 40 CFR 93.101), sources should be modeled as rural.*
- *Near the edge of urban areas, additional considerations apply that should be addressed through the interagency consultation process.*

Modeling sources as urban or rural can have a large impact on predicted concentrations. Both AERMOD and CAL3QHCR can account for the urban/rural differences in dispersion. When sources are modeled as urban in AERMOD, the urban area’s population is a necessary input.

For projects near or beyond the edge of an urbanized area, there may be situations where the build and no-build scenarios result in different degrees of urbanization. In these situations, sources in the build scenario might be treated as urban, while in the no-build they are treated as rural. Local data on such cases may not be universally available, although some planning agencies have adopted models that may allow the impacts of projects on population growth to be described. Given the potentially large impact of modeling sources as either urban or rural, all

available information on population growth in the greater area around the project should be used when modeling projects near or beyond the edge of an urbanized area.

When using AERMOD, consult the latest version of the AERMOD Implementation Guide for additional information, including instructions on what type of population data should be used in making urban/rural determinations. When using CAL3QHCR, consult Section 7.2.3 of Appendix W for guidance on determining urban sources. Refer to Appendix J for additional information on how to handle this data for each model.”

In the latest AERMOD Implementation Guide (March 19, 2009), it states that (p.15) -

“ 5.2 SELECTING POPULATION DATA FOR AERMOD’S URBAN MODE (10/19/07)

For relatively isolated urban areas, the user may use published census data corresponding to the Metropolitan Statistical Area (MSA) for that location. For urban areas adjacent to or near other urban areas, or part of urban corridors, the user should attempt to identify that part of the urban area that will contribute to the urban heat island plume affecting the source(s). If this approach results in the identification of clearly defined MSAs, then census data may be used as above to determine the appropriate population for input to AERMOD. Use of population based on the Consolidated MSA (CMSA) for applications within urban corridors is not recommended, since this may tend to overstate the urban heat island effect.

For situations where MSAs cannot be clearly identified, the user may determine the extent of the area, including the source(s) of interest, where the population density exceeds 750 people per square kilometer. The combined population within this identified area may then be used for input to the AERMOD model. Users should avoid using a very fine spatial resolution of population density for this purpose as this could result in significant gaps within the urban area due to parks and other unpopulated areas, making it more difficult to define the extent of the urban area. Population densities by census tract should provide adequate resolution in most cases, and may still be finer resolution than desired in some cases. Since census tracts vary in size and shape, another acceptable approach would be to develop gridded estimates of population data based on census block or block group data. In such cases, a grid resolution on the order of 6 kilometers is suggested. Plotting population density with multiple “contour” levels, such as 0-500, 500-750, 750-1000, 1000-1500, etc., may also be beneficial in identifying which areas near the edge of the urban complex to include even though the population density may fall below the 750 threshold. The user should also bear in mind that the urban algorithms in AERMOD are dependent on population to the one-fourth power, and are therefore not highly sensitive to variations in population. Population estimates to two significant figures should be sufficiently accurate for application of AERMOD.”

(II) FHWA recommendation for determination of urban population for AERMOD modeling of PM hotspot analysis in practice

According to the input received from FHWA, for projects located in a Metropolitan Statistical Area (MSA), use the population for the entire MSA. For situations where MSAs cannot be

clearly defined, then determine the extent where the population density exceeds 750 people/km². It's the combined population within this extended area that is used in AERMOD, not just the population of the census tracts in which the project is located. Preceding all of this, the area should first be classified whether it's urban or rural to determine if AERMOD's urban mode applies.

(III) Unanswered issues in determining urban population

Given the information provided in both EPA PM guidance and AERMOD guide as well as FHWA's recommendation, the unanswered issue is how to define the extent of an urban area where the population density exceeds 750 people/km². Using the Chicago six-county region as an example (see Figure 1), there are some isolated census tracts with population density >750 persons/km² (with dark brown color). Should they be included as part of the urban extent? If they are included, it seems an odd way to draw the boundary. If they are not included, then what is the rule of thumb (if any) for which ones to include and which ones not to - again where to draw the boundary?

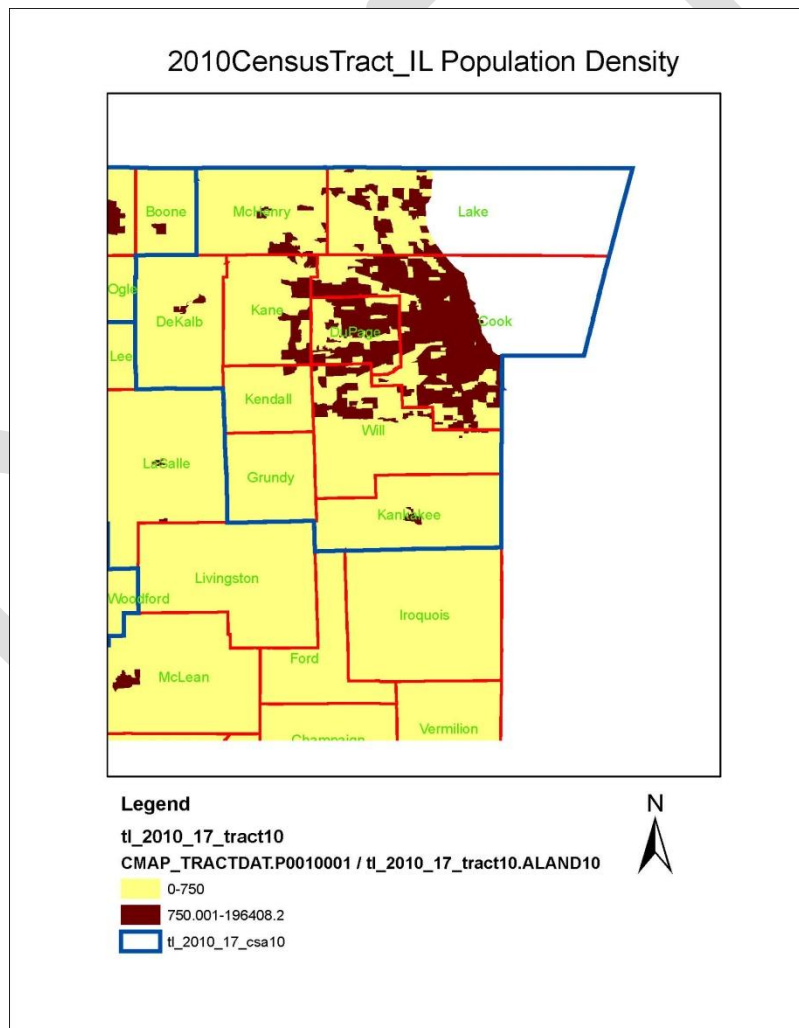


Figure 1. 2010 Census Tract Population Density in Northern Illinois
 (Note: Red lines define the county boundary and blue lines define the Chicago MSA)

Furthermore, according to the PM hotspot guideline, it seems to indicate that if the project is located near the edge of urban areas, even if the tract population density is not quite classified as "urban", i.e., below 750 persons/km², we should still model those sites as urban. So again, where to draw the line for urban versus rural population?

The EPA PM hotspot guidance also suggests the urban population input be determined through the interagency consultation team.

(IV) Desired outcome

The project team hopes an agreed upon procedure for determination of urban/rural population for the Chicago Metropolitan region can be reached by the interagency consultation team at the end of this meeting. This procedure will be used for all future PM hotspot conformity analyses in Illinois.

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