QUALITY ASSURANCE PLAN FOR DEVELOPMENT OF A RESIDENTIAL
WOOD COMBUSTION EMISSIONS INVENTORY FOR THE MANE-VU
STATES

Prepared by
E.H. Pechan & Associates, Inc.

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for the
Mid-Atlantic/Northeast Visibility Union

_____   Date _____
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I. QUALITY ASSURANCE PLAN FOR RESIDENTIAL WOOD

This Quality Assurance Plan (QAP) specifies how data quality objectives of accuracy, completeness, and representativeness will be met in developing a residential wood combustion (RWC) emissions inventory for the Mid-Atlantic/Northeast Visibility Union (MANE-VU) Regional Planning Organization (RPO).

A series of checklists will be prepared to implement the quality assurance (QA) steps. The QA checklists will include information on the specific QA item, the date that the QA check was performed, and the person who performed the QA check. The QA is detailed below.

A. Project Management

Specific project management elements are discussed below.

    1. Distribution List

     Annie Baumann, MARAMA Project Manager
     Susan Wierman, MARAMA Executive Director
     Bill Gillespie, MARAMA Quality Assurance Officer
     James H. Wilson, Pechan Corporate QA Coordinator
     Stephen Roe, Pechan Project Manager
     Randy Strait, Pechan QA Reviewer

    2. Project / Task Organization

Ms. Annie Baumann, Air Quality Specialist for the Mid-Atlantic Regional Air Management Association (MARAMA), will be the primary technical contact for this contract. Ms. Susan Wierman, Executive Director of MARAMA, will provide project oversight. MARAMA's Quality Assurance Manager (QAM), Bill Gillespie, will be involved in all quality assurance and quality control (QA/QC) activities.

Pechan's QA/QC policy requires that all work be documented, defensible, of known and acceptable quality, and consistent with all contract requirements. This policy is implemented through an integrated three-tiered approach that includes corporate, department, and program elements. At the corporate level, Pechan management provides oversight of the QA/QC program and approves and enforces the overall program. To assist in implementing these functions, Pechan maintains a corporate QA/QC unit that monitors the program, prepares guidelines, and conducts independent program audits. The Pechan Corporate QA/QC Program is implemented through the Corporate QA/QC Plan and corporate guidelines. The corporate plan is an internal document that states the corporate policy and the requirements for department and project plans. The plan is supplemented by guidelines that are used to develop or update department plans and standard operating procedures (SOPs). Department management ensures the technical and fiscal quality of work through management oversight of projects assigned to the department and work performed by department staff; establishes and enforces department plans; approves project

plans, budgets and schedules; and ensures a thorough technical and department management review of work

The Pechan Corporate QA/QC Coordinator, Mr. James H. Wilson, is responsible for QA/QC functions throughout the firm, and has the necessary authority and independence to identify, report, and correct any existing quality problems. The Pechan QA reviewer for this contract will be Mr. Randy Strait.

Pechan's Project Manager, Mr. Stephen Roe, will direct all residential wood emission inventory development tasks for this project. Mr. Roe will ensure that all support staff are familiar with and understand the data quality objectives, and the procedures to be followed for meeting the objectives, as well as the requirements of the QA plan (e.g., completion of QA/QC forms). Mr. Roe will also provide oversight of Pechan's survey subcontractor, Population Research Systems (PRS). Dr. Leslie Derbin will provide QA review of all work products developed by PRS. Dr. Katrin Ewald will manage the survey work conducted by PRS.

3. Problem Definition / Background

The purposes of the project are to conduct a survey to obtain residential wood combustion activity data and to prepare residential wood combustion emission inventories for the MANE-VU RPO. This project addresses residential wood combustion by rural, suburban, and urban residents in home fireplaces, woodstoves, and other wood burning equipment. A 2002 emission inventory will be developed at the MANE-VU census tract level. The inventory deliverables will include annual emission estimates for criteria and toxic air pollutants and temporal allocation profiles for the development of hourly emission estimates to support regional scale air quality modeling. Phase I of the project produced a work plan for conducting surveys. Phase II tested the survey instrument and developed the final sample frame. In Phase III, the survey will be conducted and an improved emission inventory will be prepared.

4. Project/Task Description

The description of this project by task can be found in the document: "Final Report for Work Plan for a Survey to Determine Residential Wood Combustion and Open Burning Activity" (Pechan, 2001). Details on the development of the survey sample frame were provide in Technical Memorandum #1 for this project (Pechan 2002a). Technical Memorandum #2 provides documentation of the format of the activity data to be used to construct a residential wood consumption model (Pechan 2002b). Information on the pilot survey and the final survey instrument is provided in Technical Memorandum #3 (PRS and Pechan 2003).

5. Data Quality Objectives

The main data quality objectives (DQOs) that Pechan will work to fulfill include:

- Accuracy –

    RWC activity data will be collected using computer-assisted telephone interviewing (CATI) which is the most efficient and accurate data collection method available. Accuracy stems from: presentation of interview questions on a computer screen which

reduces missing data, ensuring that only relevant questions are asked of respondents through programmed skip patterns, the ability of interviewers to probe and clarify responses ensuring that responses are correctly recorded, and setting explicit ranges for each question to reduce out-of-range responses.

Interviewer monitoring, which is conducted during every shift by PRS CATI laboratory monitoring/supervisory staff, provides verification of 20% of data collected at the time of collection. PRS uses a remote monitoring system that allows monitors to simultaneously listen to conversations between respondents and interviewers and to view the responses as they are keyed into the CATI system. Interviewer monitoring provides verification of data collected because the monitor is both listening to interviews and watching as the interviewers type responses into CATI.

PRS will examine data on a regular basis to ensure high quality data collection. After the first day of the live study (after the pilot study), PRS will download data into SPSS software so that frequencies can be run by the PRS project manager to verify that data are being correctly captured for each activity variable. Each week, the CATI laboratory manager will make revisions to the dataset based on interviewer-submitted data correction sheets, which identify any data entry errors that were made during data collection or any out-of-range responses. The PRS project manager will run frequencies on a monthly basis so that data can be inspected and cleaned.

To ensure the accuracy of emissions estimates,100% of the procedures/calculations used in calculating emissions will be checked by the staff members generating the emissions data. Sample calculations will be documented covering all equipment types. Calculations will be spot-checked by the project manager.

- Completeness –

    CATI data collection generates much higher completion rates because interview questions are presented visually on a computer screen which reduces missing data. Completeness of data collected will be visually examined when the PRS project manager runs frequencies. Frequencies include the number, type, and percent of responses made as well as the number of missing cases per question. In order to obtain the most complete consumption data per piece of equipment, PRS interviewers will receive extensive training from Pechan and PRS on how to effectively collect this information from respondents. PRS will use experienced interviewers for this project to ensure high quality data collection.

    Pechan will review the emissions generated using the activity data developed from the PRS survey to indicate any significant missing source categories for a particular county or census tract. For example, Pechan will indicate which counties appear to be missing specific equipment types that would be expected to occur in that county (e.g. fireplaces). As another example, certain equipment types (e.g. wood-fired boilers/furnaces) would not be expected to occur in urbanized areas.

- Representativeness –

The study sampling frame was developed to gather a representative sample of the MANE-VU RPO (Pechan, 2001). A total of 1,464 interviews (including the pilot study) will be dispersed across 11 states and the District of Columbia. The sampling frame includes all relevant drivers of residential wood consumption including: latitude (northern versus southern versus middle latitude), general land use/cover (urban versus rural versus suburban; forested versus non-forested rural areas), and dwelling type. A total of 24 quota cells with 61 responses per cell were established for the study. This minimum sample size per cell assures a confidence level of 95% and a within cell precision level of ±13 (Pechan, 2001).

Completion of the quota cells will be checked on a daily basis by the PRS project manager and the PRS CATI laboratory manager by examining the CATI study disposition report which documents the outcome of each telephone call. Review of the disposition report allows PRS staff to assess the degree to which each quota cell is being filled on a daily basis.

Activity data derived from the PRS survey will be reviewed by the Pechan Project Manager for reasonableness.

- Comparability – The MANE-VU RWC emissions inventory will be compared to the most recent versions of the 1999 NEI and the 2002 NEI. Significant differences between these inventories will be evaluated. This evaluation will include source classification, pollutant coverage, emission factors, and activity data.

   6. Documents and Records

Pechan maintains a records management system to ensure that completed work meets EPA documentation requirements. Pechan also maintains a record-keeping plan to identify and file information. The company assigns unique control numbers to all documents and records prepared for and delivered to EPA. These numbers link the materials to the correct contract and work assignment, and are used to store the materials in hard copy and electronically in chronological order. The records management coordinator at each Pechan office location assigns the control numbers and maintains these files. Pechan's Contracts Administrator also stores hard copy or electronic versions of all documents and records submitted as contract deliverables as part of the company's contract files.

The Pechan Project Manager will be responsible for the following document and records management activities:

- Determining all deliverables under a project, including work plans, progress reports, and all technical products;

- Determining the time lines for various stages of the document (that is, outline, draft, and final);

- Determining the appropriate review cycle (internal versus external review);

- Determining the appropriate reviewers; and

- Ensuring that all documents and records are incorporated into Pechan's filing system and are distributed to the appropriate recipients.

B. Data Generation and Acquisition

Telephone interviews will be administered by trained interviewers within the PRS CATI laboratory using a computer-programmed telephone interview. Each interviewer will receive four hours of project-specific training to familiarize them with the study goals, project procedures, and interview content. During the training, interviewers will read aloud the interview and will review the Frequently Asked Questions (FAQs), which PRS and Pechan will prepare. Interviewers will engage in supervised role-play to become familiar with the instrument and will review the instrument several times on CATI to gain on-screen familiarity.

PRS checks for duplicates in the sample before it is loaded into CATI and checks to ensure that duplicate interviews are not conducted. Interviewing hours will be 3 P.M. to 9 P.M. EST weekdays, 10 A.M. to 3 P.M. EST on Saturday, and 3 P.M. to 9 P.M. EST on Sunday. The total number of call attempts to each respondent will be 6. PRS will attempt up to one refusal conversion (attempt to gather a response from an initial refusal) for each household in which a refusal has been recorded. An interviewer (other than the interviewer who received the refusal), with a proven track record of successful refusal conversions, will attempt each refusal conversion.

Interviewers are monitored during each shift. The PRS staffing ratio of interviewers to monitors is 6:1. Each individual interviewer is monitored for 15 calls or one completed interview two to three times per week to ensure that they are adhering to proper data collection procedures and are collecting high quality data. Interviewers are not aware when they are being monitored.

Monitoring reports are prepared each shift by the monitoring supervisor. Monitoring results are shared with interviewing staff on a monthly basis. They are counseled about any needed improvements and are given additional training if necessary. If an interviewer does not meet quality standards, s/he is removed from a project.

Quota cells will be checked on a daily basis by the PRS project manager and CATI laboratory manager. As the study nears completion, priority will be placed on completing hard-to-fill cells (e.g., multi-family dwellings in rural areas).

Data correction sheets will be submitted by interviewers on a daily basis. Information from those sheets will be entered into the dataset on a weekly basis by the CATI laboratory manager so that data can be cleaned. The project manager will run frequencies on a monthly basis so that data quality can be assessed.

C. Assessment and Oversight

Pechan uses assessments to evaluate and improve the quality of environmental data operations. The assessments are an independent process of evaluating the project to ensure that specified requirements of the project are being fulfilled. Pechan will perform periodic audits of

data quality, and will coordinate with MARAMA's QAM to allow for ongoing oversight of project quality.

D. Data Review and Validation

1. Survey and Activity Data Review

As previously mentioned, data quality will be assured through the use of the CATI system which minimizes data outliers through the use of set variable response ranges. Data quality will also be assured by monitoring interviewers during every shift. CATI reduces missing data because only a minimal number of questions are presented on the CATI computer monitors simultaneously reducing the possibility that an interviewer will neglect to ask a particular question. Finally, any data entry problems that may occur will be quickly and easily fixed through the use of interviewer-prepared data correction sheets and correction of the dataset by the CATI laboratory manager.

The initial statistical analysis of data will be carried out by PRS. PRS will conduct univariate (one variable) descriptive analysis of data and will produce frequencies (counts and percentages) as well as means, medians, and standard deviations (as appropriate) for each study variable. The RWC Emissions Inventory requires collecting a great deal of open-ended, qualitative data so that information about consumption patterns can be gathered.

Open-ended data will be presented to Pechan as text. The Pechan Project Manager together with the PRS Project Manager will code this information for inclusion in the dataset. Once the open-ended data are integrated into the final dataset by the PRS Project Manager, she will again run frequencies, means, medians, and standard deviations for review by Pechan.

The next step will be for the Pechan Project Manager, the PRS Project Director, and the PRS Project Manager to meet with the PRS sub-contractor biostatistician to assess whether any quota cells should be collapsed and whether sample weights need to be calculated. If data require weighting, the PRS Project Manager will calculate and apply the weights to the dataset under the supervision of the biostatistician. Frequencies, means, medians, and standard deviations will again be run on these weighted data. A final dataset with the calculated weights attached would be included as a final PRS deliverable, if appropriate.

Once all of the survey data has been appropriately reviewed, a wood consumption activity model will be developed, including annual wood consumption and user fraction. Pechan will spot check activity data for the following:

- Have wood consumption values and user fraction been estimated for all equipment types in all regions, land use categories, and housing types?

- Has the appropriate statistic been selected for each activity data element (i.e., mean for a normal distribution, median for a highly-skewed distribution)?

- Are activity values reasonable when comparing across regions, land use categories, and housing types? (For example, is wood consumption greater in the north than in the south?)

The staff member performing these QC checks will make a list of the items checked. If requested, Pechan will also provide the final QC'd activity model to MARAMA for further review.

> 2. Emission Factors

Emission factors will be taken from the latest EPA guidance. This guidance includes any updates to AP-42, the EIIP document for RWC, and recently completed testing. For example, Pechan is aware that EPA recently conducted testing of RWC, primarily to gather new data on toxic air pollutants. The inventory will include emissions of all criteria pollutants, their precursors, and toxic air pollutants, where emission factors are available. Pechan will review the selected emission factors to ensure that the most recent guidance updates and any newly developed emission factors have been included.

> 3. Residential Wood Emissions

Once the residential wood combustion emissions have been calculated, Pechan will first perform spot checks covering random counties and census tracts. Hand calculations will be performed covering all equipment types to ensure that the appropriate emission factors and activity data have been matched and that the emissions calculation equation was applied properly. These checks will be repeated for all pollutants.

> Pechan will prepare the following summaries in its QC of the emissions:

- annual and monthly emissions by state and equipment type for each pollutant and corresponding amount of wood burned;
- annual and monthly emissions by equipment type for each pollutant and corresponding amount of wood burned; and
- annual emissions and amount of wood burned by county and pollutant.

By including the activity data in each of these summaries, Pechan will be able to estimate an equivalent emission factor for each of these groupings in a spreadsheet. This is a helpful tool in assessing whether the emission factors and activity have been properly combined.

> **4.** Final Emission Inventory Check

After development of the emission estimates, the following items will be checked prior to providing the inventory to MANE-VU:

- Does the state and county Federal Information Processing Standards (FIPS) code exist? Make sure that all FIPS state and county codes are legitimate by comparing the county FIPS codes in the data base with the National Institute of Standards and Technology (NIST) Federal Information Processing Standards Publications (FIPS PUBS);

- Are there duplicate records in the database? The appropriate unique identifiers are state FIPS, county FIPS, SCC, start date, end date, and emission types. The combination of the start date, end date, and emission type define annual versus seasonal and daily

emissions in accordance with the National Emission Inventory (NIF) Input Format. The QA check for unique records will be to run a grouping query on these fields, and then compare the number of records returned to the total number of records in the data base (without grouping). Pechan will run this check and identify any duplicate records. These records will be investigated and corrected or removed if necessary;

- Are there any emission estimates that seem to be unexpectedly high or low relative to other records in the inventory? For each pollutant, Pechan will rank emission records in descending order and review the top and bottom sets of records to identify any potential outliers;

- Are all primary particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers ($PM_{2.5}$) emissions equal to PM_{10} emissions? These records will be investigated and corrected as necessary. Because tests have shown that virtually all of the particles emitted from RWC are less than 2.5 microns, EPA assumes primary PM_{10} and $PM_{2.5}$ area equal;

- As an overall check, Pechan will review state and SCC-level annual emission summaries. Pechan will verify that emissions as reported by state and by SCC are reasonable and expected for 2002.

    5. Final Review

The Pechan Project Manager will review the checklists developed for the QA plan. The Project Manager will ensure that all checklists have been completed and signed. In addition, the Project Manager will perform spot checks of several different components of the emission inventories. The tests will be random so that other staff conducting the QA will not know what QA steps will be repeated. All data products and reports will also be reviewed by the Pechan QA reviewer before delivery.

References

Pechan, 2001. *Final Report for Work Plan for a Survey to Determine Residential Wood Combustion and Open Burning Activity,* prepared by E.H. Pechan & Associates, Inc., prepared for MARAMA, July 2001.

Pechan, 2002a. *Technical Memorandum No. 1: MANE-VU Residential Wood Combustion EI Project: Sample Frame Development,* prepared by E.H. Pechan & Associates, Inc., prepared for MARAMA, December 2002.

Pechan, 2002b. *Technical Memorandum No. 2: MANE-VU Residential Wood Combustion EI Project: Format for Activity Data in the Wood Consumption*, prepared by E.H. Pechan & Associates, Inc., prepared for MARAMA, December 2002.

PRS and Pechan, 2003. *Technical Memorandum No. 3: MANE-VU Residential Wood Combustion EI Project: Pilot Survey and Final Survey Instrument*, prepared by Population Research Systems and E.H. Pechan & Associates, Inc., prepared for MARAMA, January 2003.