

MANE-VU  
Mid-Atlantic/Northeast Visibility Union

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**Test Survey and Revised Work Plan for  
Open Burning Emissions Inventory  
Development**



Acadia National Park on a clear day



- and on a hazy, polluted day.

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

**January 31, 2002**

*for the*  
Mid-Atlantic/Northeast Visibility Union

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## Mid-Atlantic/Northeast Visibility Union

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*Prepared by*  
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Submitted to the United States Environmental Protection Agency, Region III  
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## **About MANE-VU**

The Mid-Atlantic/Northeast Visibility Union (MANE-VU) was formed by the Mid-Atlantic and Northeastern states, tribes, and federal agencies to coordinate regional haze planning activities for the region. MANE-VU members include Connecticut, Delaware, the District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, the Penobscot Indian Nation, Rhode Island, the St. Regis Mohawk Tribe, and Vermont. Also participating as non-voting members of MANE-VU are the U.S. Environmental Protection Agency (EPA), the National Park Service, the U.S. Fish and Wildlife Service, and the U.S. Forest Service.

MANE-VU was formed to encourage a coordinated approach to meeting the requirements of EPA's regional haze rules and reducing visibility impairment in major national parks and wilderness areas in the Northeast and Mid-Atlantic region. MANE-VU provides technical assessments and assistance to its members, evaluates linkages to other regional air pollution issues, provides a forum for discussion, and encourages coordinated actions. MANE-VU also facilitates coordination with other regions.

The Ozone Transport Commission Executive Staff Office provides management and administration for MANE-VU. The Mid-Atlantic Regional Air Management Association and the Northeast States for Coordinated Air Use Management conduct MANE-VU's technical projects.

## **TEST SURVEY AND REVISED WORK PLAN FOR OPEN BURNING EMISSIONS INVENTORY DEVELOPMENT**

Preparation of this report was made possible by grants from the U.S. Environmental Protection Agency (EPA) to the Ozone Transport Commission (OTC).

OTC is coordinating efforts for the Mid-Atlantic/Northeast Visibility Union (MANE-VU) to reduce regional haze in the Mid-Atlantic and Northeast region and is collaborating in that effort with the Mid-Atlantic Regional Air Management Association (MARAMA) and the Northeast States for Coordinated Air Use Management (NESCAUM).

This report was prepared by E.H. Pechan and Associates, Inc. (Pechan) under contract to MARAMA. Funds for preparation of this report were provided to MARAMA by MANE-VU. The primary author of this report was Ms. Kirstin Thesing of Pechan. Project oversight was provided by Ms. Tara Marie Kully and Ms. Susan Wierman of MARAMA.

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## **Disclaimer**

This report was sponsored by the Mid-Atlantic/Northeast Visibility Union (MANE-VU) and prepared by E.H. Pechan and Associates, Inc. under contract to the Mid-Atlantic Regional Air Management Association (MARAMA). The opinions, findings, conclusions, and recommendations are those of the author and do not necessarily represent the views of MANE-VU and MARAMA. MANE-VU and MARAMA, their officers, employees, contractors, and subcontractors make no warranty, expressed or implied, and assume no legal liability for the information in this report. MANE-VU and MARAMA have not approved or disapproved this report, nor has MANE-VU and MARAMA passed upon the accuracy or adequacy of the information contained herein.

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## Contents

<b><u>Section</u></b>	<b><u>Page</u></b>
Disclaimer .....	vi
Acknowledgements.....	vii
Tables and Figures .....	x
Acronyms and Abbreviations .....	xi
Executive Summary .....	xiii
I. INTRODUCTION .....	1
II. CONTACT LIST .....	1
III. RESULTS OF TEST SURVEY .....	1
A. Residential MSW and Yard Waste.....	3
B. Yard Waste.....	6
C. Land Clearing Debris.....	6
D. Construction and Demolition Waste .....	10
E. Rule Effectiveness .....	10
F. Survey of Solid Waste Agencies.....	15
IV. RECOMMENDED EMISSION ESTIMATION METHODS .....	17
A. Residential MSW and Yard Waste.....	17
B. Land Clearing Debris.....	27
C. Construction and Demolition Waste .....	29
V. DRAFT WORK PLAN .....	34
A. Introduction.....	34
B. Technical Approach.....	34
Task 1. Project Management .....	34
Task 2. Survey of Open Burning Activity .....	34
Task 3. Control Data Base Development .....	37
Task 4. Emissions Inventory Development.....	37
Task 5. Reporting.....	38
VI. REFERENCES .....	39
APPENDIX A - SURVEY INSTRUMENT .....	A-1
PART 1. INTRODUCTION.....	A-2
PART 2. HOUSEHOLD WASTE BURNING ACTIVITY .....	A-4
PART 3. BRUSH OR LEAF WASTE BURNING ACTIVITY .....	A-5
APPENDIX B - LIST OF CONTACTS .....	B-1
APPENDIX C - RULE EFFECTIVENESS EVALUATION FORM .....	C-1

## Tables and Figures

	<u>Page</u>
Table III-1. Summary of State and Tribal Open Burning Survey Needs.....	2
Table III-2. Response Rate for Original Household Waste Burning Activity Survey.....	4
Table III-3. Response Rate for Questions in Revised “PART 2, HOUSEHOLD WASTE BURNING ACTIVITY” Survey .....	5
Table III-4. Response Rate for Original Brush Waste Burning Activity Survey .....	7
Table III-5. Response Rate for Land Clearing Debris Burning Activity Survey .....	8
Table III-6. Response Rate for Construction/Demolition Waste Burning Activity Survey.....	11
Table III-7. Results of Test Survey for Rule Effectiveness .....	12
Table III-8. State Solid Waste Contacts.....	16
Table III-9. State-Specific MSW Generation and Disposal Information.....	18
Table IV-1. 1990 Census Block Group Housing Unit Data for New Castle County, Delaware..	21
Table IV-2. Percent of Total Estimated Building-Related Construction and Demolition Debris Generation, 1996 (roadway, bridge, and land clearing debris not included).....	30
Table IV-3. Management of Building-Related Construction and Demolition Debris in the United States, 1996.....	30
Table IV-4. Preliminary Assumptions for Percentage of Construction and Demolition Waste Open Burned .....	32
Table V-1. Contacts for Residential Open Burning Activity Questionnaire.....	35
Table V-2. State/Regional Contacts for Open Burning Rule Effectiveness Questionnaire.....	36
Figure IV-1. Census Tract by Housing Unit Type for New Castle County, Delaware .....	24

## Acronyms and Abbreviations

BEIS	Biogenic Emission Inventory System
BELD2	Biogenic Emissions Landcover Database, Version 2
BOC	Bureau of the Census
BYB	Backyard Burning
C&D	Construction and Demolition
CE	Control Efficiency
CO	Carbon Monoxide
EIIP	Emission Inventory Improvement Program
EPA	United States Environmental Protection Agency
ft <sup>3</sup>	Cubic Feet
HAP	Hazardous Air Pollutant
lbs	Pounds
MANE-VU	Mid-Atlantic/Northeast Visibility Union
MARAMA	Mid-Atlantic Regional Air Management Association
MSW	Municipal Solid Waste
MTCS	Municipal Trash Collection Service
NA	Not Applicable
NEI	National Emissions Inventory
NYDEC	New York Department of Conservation
Pechan	E.H. Pechan & Associates, Inc.
RE	Rule Effectiveness
RP	Rule Penetration
SCC	Source Classification Code
STF	Summary Tape File
tpy	Tons Per Year
yr	Year
wk	Week



## Executive Summary

This report summarizes the results of a test survey that E.H. Pechan and Associates, Inc. (Pechan) conducted to obtain information about four categories of open burning, including household waste, yard waste, land clearing debris and construction and demolition waste burning. The purpose of this survey was to test a form designed to collect activity estimates that would form the basis of an improved open burning emission inventory. This report describes recommended emission estimation methods for each open burning category, and also includes a work plan that outlines the tasks to be followed for developing an emissions inventory.

The domain of the inventory encompasses Connecticut, Delaware, the District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, the Penobscot Indian Nation, Rhode Island, the St. Regis Mohawk Tribe, and Vermont. These entities make up the Mid-Atlantic/Northeast Visibility Union (MANE-VU).

Household waste burning test surveys were completed for 1 tribe, 1 air quality region in New York, 4 counties, and 16 local areas. Household waste burning activity for a jurisdiction was typically expressed in terms of the number of households that burn waste, or the number of permits issued to households. The total amount of waste burned, or the amount of waste per burn, was typically not known. However, the frequency of burning (i.e., how many times per week or month) was provided by some respondents. The draft survey instrument for obtaining activity data for areas where household waste burning is allowed was revised based on the experience of administering the draft survey. Pechan tested the revised survey instrument (presented in Appendix A of the work plan), on a separate, smaller sample of respondents, which resulted in a higher response rate.

Yard waste burning test surveys were performed for approximately 60 respondents. For yard waste burning, the survey respondents typically estimated activity in terms of the number of households that burn waste, or the number of permits issued to households. Estimated dimensions for individual burns were typically provided. In addition, the survey respondents we tested were knowledgeable about the seasonality of burning practices, and could provide a breakdown of the seasonal percentages of annual activity. The draft survey instrument for yard waste was revised based on the experience of administering the draft survey (see Appendix A of the work plan). Parts 3 and 4 were combined to shorten the duration of the survey, and because many respondents could not make a distinction between brush and leaf burning activity. Pechan was not able to test the revised yard waste survey instrument, due to limitations in calendar time to conduct another round of testing.

In some cases, a jurisdiction may encompass both urban/suburban or suburban/rural areas. If possible, activity for these different areas within a jurisdiction should be determined, since it is likely to vary for these areas. This will prevent unrealistic emissions from being assigned to large metropolitan areas such as New York City or Philadelphia, Pennsylvania. The survey instrument has been revised to request this information. For some counties, all households may or may not have access to municipal trash collection service (MTCS), but in many cases, this service varies by town within a county, and even by areas within a town, depending on the routes covered by the waste collectors and haulers. We wanted to research the availability of these data

for potential use as a scaling surrogate, since an open burning survey performed for the state of Maine established a correlation. The level of effort to obtain this information at the necessary geographic level is expected to be significant and is not recommended for a multi-state area. This is why other surrogates already compiled at the Census tract and block level are recommended for use in scaling survey results.

For the states that allow land clearing debris burning, Pechan contacted over 30 state and local fire safety and environmental agency personnel to obtain information on the availability of data characterizing land clearing debris burning activity. Few land clearing debris burn permits request fuel loading information. Those jurisdictions that view this category as a priority emission source category should require that this information be included in all of their future land clearing debris burn permits. In the absence of these permit data, Pechan recommends estimating land clearing debris burning emissions using EPA's National Emissions Inventory (NEI) for this category as the basis. Information on local controls can be applied to adjust uncontrolled emissions.

Pechan contacted approximately 20 state and local fire safety and environmental agency personnel to obtain information on the availability of data to estimate construction and demolition waste burning activity. Because most construction and demolition burning permits did not appear to include the data necessary to develop emission estimates, areas that believe this to be a significant category should require that information on fuel loading and type of waste be included in all of their future construction and demolition burn permits. As an alternative method, Pechan recommends estimating construction and demolition waste burning emissions using a top-down method adjusted for known local practices or prohibitions. In addition, percentages or amounts of construction and demolition waste burned may be refined through further discussions with solid waste contacts.

For areas that ban open burning, Pechan conducted a rule effectiveness (RE) survey. Pechan administered this survey by faxing or emailing the form, since the respondents often wanted to look up information. Rule effectiveness test surveys were completed for 19 local areas, 4 regions, and 6 states. For many test areas, the RE was well below 100 percent as calculated from the survey. With a possible maximum score of 100 for each open burning category, the average score for each category was approximately 40 percent. Based on the response rate for certain questions, Pechan proposes revisions to the survey instrument, which can be found in Appendix C.

## **I. INTRODUCTION**

This report summarizes the results of a test survey that E.H. Pechan & Associates, Inc. (Pechan) conducted for four categories of open burning, including household waste, yard waste, land clearing debris and construction and demolition (C&D) waste burning. The intent of the survey form used in this test is to collect activity estimates that will form the basis of an improved open burning emission inventory for the Mid-Atlantic/Northeast Visibility Union (MANE-VU). MANE-VU includes the States of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont. Also included are the District of Columbia, Penobscot Indian Nation, and St. Regis Mohawk Tribe.

## **II. CONTACT LIST**

Pechan completed a contact list to identify the agencies and individuals that are responsible for and knowledgeable about residential open burning activity within a particular jurisdiction. Contact lists for local agencies in the States of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, Rhode Island, and Vermont are provided in Attachment B. Pechan had recommended purchasing a comprehensive listing of local fire stations. The “National Directory of Fire Chiefs and Emergency Medical Service Administrators” is published by the National Public Safety Information Bureau and is available for purchase for \$99. Upon further investigation, however, Pechan does not recommend purchasing this directory to obtain contacts for the remaining states (i.e., New York and Pennsylvania), since these are not believed to be the appropriate contacts to survey in these states. Appropriate contacts for these states can be more readily obtained by telephoning the local government offices. See Table V-1 (page 35) for the appropriate contacts for these states.

## **III. RESULTS OF TEST SURVEY**

Table III-1 (page 2) presents the test survey matrix for the MANE-VU states and tribes. For those states/tribes where open burning of a certain type is permitted, a test survey of the activity was conducted. For those states/tribes where open burning of a certain type is prohibited, a rule effectiveness (RE) test survey was performed.

We performed a test survey of 4 counties in Maryland, 5 municipalities in New Hampshire, 1 New York Department of Conservation (NYDEC) region in New York, 6 municipalities in Pennsylvania, 5 municipalities in Rhode Island, and the St. Regis Mohawk Tribe to collect activity data for the burning of residential municipal solid waste (MSW). Connecticut, Delaware, the District of Columbia, Massachusetts, New Jersey, Allegheny County, Pennsylvania, Philadelphia, Pennsylvania, and Vermont, were surveyed for RE since they have statewide or local rules in place prohibiting the burning of household waste.

To estimate yard waste burning activity, we surveyed 11 municipalities in Connecticut, 7 municipalities in Delaware, 9 municipalities in Maine, 5 counties in Maryland, 7 municipalities in Massachusetts, 5 municipalities in New Hampshire, 2 NYDEC regions in New York, 2 municipalities and 1 county in Pennsylvania, 3 municipalities in Rhode Island, 6 municipalities

**Table III-1. Summary of State and Tribal Open Burning Survey Needs**

State	No. of Counties	No. of Counties with Completed Tests	Survey Household Waste Burning for	Survey Yard Waste Burning for	Survey Land Clearing Burning for	Survey C&D Waste Burning for
Connecticut	8	6	RE	Activity	RE	RE
Delaware	3	3	RE	Activity	RE	RE
District of Columbia	1	1	RE	RE	RE	RE
Maine	16	8	Scale previous survey	Activity	Activity	Activity
Maryland	24	5	Activity	Activity	Activity	Activity
Massachusetts	14	5	RE	Activity	RE	RE
New Hampshire	10	5	Activity	Activity	Activity	Activity
New Jersey	21	1	RE	RE	RE	RE
New York	62	8	Activity	Activity	Activity	Activity
Pennsylvania	65	10	Activity	Activity	Activity	Activity
Pennsylvania - Philadelphia	1	1	RE	RE	RE	RE
Pennsylvania - Allegheny	1	1	RE	RE	Activity	Activity
Penobscot Indian Nation	Tribe in ME	0	Activity	Activity	Activity	Activity
Rhode Island	5	3	Activity	Activity	Activity	RE
St. Regis Mohawk	Tribe in NY	1 Tribe	Activity	Activity	Activity	Activity
Vermont	14	2	RE	Activity	Activity	Activity

in Vermont, and the St. Regis Mohawk Tribe. The District of Columbia, New Jersey, Allegheny County, and Philadelphia do not allow the burning of yard waste; they were surveyed for RE.

To estimate land clearing debris burning activity, we surveyed 8 municipalities in Maine, 4 counties in Maryland, 8 counties and 2 NYDEC regions in New York, 4 municipalities in New Hampshire, 1 municipality in Vermont, 1 municipality in Rhode Island, Allegheny County, and the St. Regis Mohawk Tribe. Connecticut, Delaware, the District of Columbia, Massachusetts, New Jersey, Philadelphia, Pennsylvania, were surveyed for RE since they have statewide or local rules in place prohibiting the burning of land clearing waste.

To estimate C&D waste burning activity, we surveyed 3 municipalities in Maine, 3 municipalities in New Hampshire, 8 counties and 2 NYDEC regions in New York, Allegheny County, and the St. Regis Mohawk Tribe. Connecticut, Delaware, the District of Columbia, Massachusetts, New Jersey, Philadelphia, Pennsylvania, and Rhode Island were surveyed for RE.

General findings of the test survey include:

- Some states and respondents consider open burning as a collective of the various open burning categories defined by the Environmental Protection Agency (EPA). Even if a permit

is issued, it may not identify what type of open burning is permitted. A survey respondent may know that the majority of permits issued were for a certain type of burning, but the actual number of category-specific burns is not something that they track.

- For residential MSW burning, survey respondents could provide information on any open burning prohibitions, the number of households burning, the frequency of burning, and the solid waste disposal options (curbside pickup, transfer station, etc.). Most respondents, however, could not provide the mass of waste burned in their jurisdiction, or an estimate of the average amount of waste per burn.
- For yard waste burning, survey respondents could provide information on any open burning prohibitions, the number of households burning, the frequency of burning, and seasonal variations in burning. A higher number of respondents (i.e., compared to residential MSW) provided an estimate of the average amount of waste per burn. For some areas that allow both leaf and brush waste burning, respondents could not provide estimates for the number of households burning each of these types of yard waste.
- For residential MSW burning, Pechan tested the revised survey instrument (presented in Appendix A of the work plan), which resulted in a higher response rate. Pechan was not able to test the revised yard waste survey instrument, due to limitations in calendar time to conduct another round of testing.
- Although permits may be issued by some states for the burning of land clearing and C&D waste, the agencies that issue these permits do not consistently require information on fuel loading (i.e., amount of mass burned) or the area that is cleared.
- In more rural areas it may be hard to reach the identified respondents. Reaching fire marshals or fire officials in rural areas was more difficult than for more populated areas, because the rural stations are typically not manned all day. This was especially true for Pennsylvania and New York. As such, calling the town offices to try to find an individual that is knowledgeable may be the best procedure to locate and contact potential local survey respondents.
- The contact lists were revised to reflect the contact believed to be appropriate for each town or municipality within a state. However, in performing future surveys and calling potential respondents, one should expect that some percentage of listed contacts will not be correct.

#### **A. Residential MSW and Yard Waste**

Household waste burning test surveys were completed for 1 tribe, 1 air quality region in New York, 4 counties, and 16 local areas (see the start of Section III for a breakout over the region). Household waste burning activity for a jurisdiction was typically expressed in terms of the number of households that burn waste, or the number of permits issued to households. The total amount of waste burned, or the amount of waste per burn, was typically not known. However, the frequency of burning (i.e., how many times per week or month) was provided by

some respondents. Table III-2 shows the Part 2 survey, and indicates the response rate for each question in parentheses to the right of the question.

**Table III-2. Response Rate for Original Household Waste Burning Activity Survey**

1. *What is your estimate of the total number of households burning waste for both permitted and unpermitted burns?* \_\_\_\_ number \_\_\_\_ don't know **(64%)**
2. *What is your estimate of the number of burn barrels being used in your jurisdiction?*  
\_\_\_\_ number \_\_\_\_ don't know **(0%)**
3. *What is your estimate of the number of households that burn waste?* \_\_\_\_ number \_\_\_\_ don't know **(9%)**
4. *Does your jurisdiction issue permits for household waste burning?* Y/N  
If Y, go to Questions 4 and 5. If N, go to Question 6. **(18%)**
5. *What is your estimate of the total number of burn barrels for both permitted and unpermitted burns?*  
\_\_\_\_ number \_\_\_\_ don't know **(27%)**
6. *Please estimate how frequently households burn household waste.*  
\_\_\_\_ number of times per \_\_\_\_ (fill in time period) \_\_\_\_ don't know **(18%)**
7. *What would you estimate is the average amount of waste per burn?* \_\_\_\_ amount \_\_\_\_ don't know **(9%)**
8. *What percentage of burning is conducted in:*  
  
 Winter (December, January, February)? \_\_\_\_  
 Spring (March, April, May)? \_\_\_\_  
 Summer (June, July, August)? \_\_\_\_  
 Autumn (September, October, November)? \_\_\_\_  
 Don't know \_\_\_\_ **(18%)**
9. *Does the jurisdiction have a municipal trash collection service?* Y/N **(82%)**
10. *Does the jurisdiction have a transfer station?* Y/N **(27%)**
11. *Does the jurisdiction provide any other waste disposal options (e.g., recycling)?* Y/N  
If Y, what are they? **(9%)**

The draft survey instrument for obtaining activity data for areas without bans on household waste burning was revised based on the experience of administering the draft survey. Part 1, Introduction, was shortened and revised to avoid repetition. For Part 2, questions were revised for clarity and were modified to most efficiently request the necessary information. The revised survey instrument is presented in Appendix A. For residential MSW burning, Pechan tested the revised survey instrument (presented in Appendix A of the work plan), on a separate, smaller sample of respondents, which resulted in a higher response rate, as shown in Table III-3.

**Table III-3. Response Rate for Questions in Revised “PART 2, HOUSEHOLD WASTE BURNING ACTIVITY” Survey**

1. *What is your estimate of the number of households that burn household waste or trash in your jurisdiction?* **(90%)**  
 \_\_\_\_ number \_\_\_\_ don't know (If don't know, go to 1a, otherwise go to Question 2)

NOTE: The response may be based on the respondent's knowledge of burning practices, or based on the number of permits if permits are issued. If open burning is not allowed, this may be based on the number of households conducting illegal burns.

- 1a. *What is your estimate of the percentage of the households that burn household waste in your jurisdiction?* **(10%)**  
 \_\_\_\_ percent

2. *If your jurisdiction covers a combination of urban, suburban and/or rural areas, can you provide an estimate of the activity that is occurring in one area versus the other?* **(30%)**

Rural \_\_\_\_ Number or percentage of households burning  
 Suburban \_\_\_\_ Number or percentage of households burning  
 Urban \_\_\_\_ Number or percentage of households burning

3. *Please estimate how frequently households burn household waste.* **(60%)**  
 \_\_\_\_ number of times per \_\_\_\_ (fill in time period) \_\_\_\_ don't know

4. *Does this frequency vary for urban, suburban or rural areas that may be within your jurisdiction?* **(20%)**  
Y/N If Y, please explain.

5. *What would you estimate is the average amount of waste per burn?* \_\_\_\_ amount \_\_\_\_ don't know **(10%)**

6. *What percentage of burning is conducted in:* **(40%)**  
 Winter (December, January, February)? \_\_\_\_  
 Spring (March, April, May)? \_\_\_\_  
 Summer (June, July, August)? \_\_\_\_  
 Autumn (September, October, November)? \_\_\_\_  
 Don't know \_\_\_\_

7. *Does the jurisdiction have a municipal trash collection service?* Y/N **(100%)**

8. *Does the jurisdiction have a transfer station?* Y/N **(90%)**

9. *Does the jurisdiction provide any other waste disposal options (e.g., recycling)?* Y/N **(100%)**  
 If Y, what are they?

10. *Are you familiar with open burning practices of surrounding jurisdictions?* Y/N **(80%)**  
*Are they similar to or different than your jurisdiction?* Similar/different  
 If different, please explain.

## **B. Yard Waste**

Yard waste burning test surveys were performed for approximately 60 respondents (see the start of Section III for a breakout over the region). For yard waste burning, the survey respondents typically estimated activity in terms of the number of households that burn waste, or the number of permits issued to households. Estimated dimensions for individual burns were typically provided. In addition, the survey respondents we tested were knowledgeable about the seasonality of burning practices, and could provide a breakdown of the seasonal percentages of annual activity. Table III-4 shows the Part 3 survey, and indicates the response rate for each question in parentheses to the right of the question.

The draft survey instrument for yard waste was revised based on the experience of administering the draft survey. Parts 3 and 4 were combined to shorten the duration of the survey, and because many respondents could not make a distinction between brush and leaf burning activity. In addition, the order of the questions were revised to first ask the respondent about the burning of brush waste at residences, followed by the questions of whether municipal burns were conducted (since this is less common in most areas). The revised survey instrument is presented in Appendix A. Pechan was not able to test the revised yard waste survey instrument, due to limitations in calendar time to conduct another round of testing.

## **C. Land Clearing Debris**

For the states that allow land clearing debris burning, Pechan contacted over 30 state and local fire safety and environmental agency personnel to obtain information on the availability of data characterizing land clearing debris burning activity (see the start of Section III for a breakout over the region). The majority of respondents stated that this activity is regulated in their jurisdiction by the issuance of burn permits. However, survey respondents were generally unable to identify whether the permits included information on the amount of waste burned, or the composition of the waste burned. In addition, none of the burn permits that Pechan obtained as part of this survey effort included information about the amount of waste to be burned. Table III-5 shows the survey questions and indicates the response rate for each question in parentheses.

Although the number of burn permits issued is generally available for each jurisdiction, this information by itself is insufficient for characterizing the level of land clearing debris burning activity. This information could be used to estimate the level of this activity if the average amount of debris burned (i.e., the “fuel loading”) was available. Only one survey respondent (for Calvert County, Maryland) clearly stated that their burn permits requested information on the amount of area to be cleared. It may be worthwhile to review the permits for this area to determine if this information was consistently reported. However, it may not be valid to use this information to develop an average fuel loading estimate for use in other jurisdictions. It is likely that the information for this one county would not be representative of land clearing debris burning activity in other areas of the country.

### Table III-4. Response Rate for Original Brush Waste Burning Activity Survey

1. *Does your jurisdiction collect brush waste from households for transfer to a central location for burning?* Y/N If Y, go to Question 2. If N, go to Question 7. **(58%)**

NOTE: A jurisdiction may collect brush waste, but may not burn the brush to dispose of the waste. The question's intent is to establish whether the municipality conducts centralized burns.

2. *Does your agency issue permits for each municipal burn?* Y/N If N, go to Question 5. **(25%)**
3. *Please indicate whether your permits include the following:* **(8%)**

Amount of waste burned Y/N \_\_\_\_ don't know  
 Composition of waste burned Y/N \_\_\_\_ don't know  
 Date of burn Y/N \_\_\_\_ don't know  
 Duration of burn Y/N \_\_\_\_ don't know

4. *May we obtain copies of the permits or any summaries of the permit data that you maintain?* Y/N **(2%)**

NOTE: Depending on what information is established to be included in the permit, the surveyor may or may not need to ask Questions 5 and 6.

5. *What is your estimate of the number of municipal brush waste burns?*  
 \_\_\_\_ number \_\_\_\_ don't know **(7%)**
6. *What is your estimate of the average fuel loading for all burns?*  
 \_\_\_\_ amount per burn \_\_\_\_ don't know **(5%)**
7. *For brush waste burning at residential properties, what is your estimate of the number of households that burn brush waste?*  
 \_\_\_\_ number \_\_\_\_ don't know **(75%)**
8. *Does your jurisdiction issue permits for household brush waste burning at residential properties?* Y/N If Y, go to Question 9. If N, go to Question 10. **(45%)**
9. *What is your estimate of the total number of households burning brush waste for both permitted and unpermitted burns?* \_\_\_\_ amount \_\_\_\_ don't know **(40%)**
10. *Please estimate how frequently residences burn brush waste.*  
 \_\_\_\_ number of times per \_\_\_\_ (fill in time period) \_\_\_\_ don't know **(12%)**
11. *What would you estimate is the average amount of waste per burn?* \_\_\_\_ amount \_\_\_\_ don't know **(28%)**

**Table III-5. Response Rate for Land Clearing Debris Burning Activity Survey**

- 1. *Do you issue permits for land clearing debris burning?* Y/N If N, go to question 4. **(62%)**
- 2. *Please indicate whether your permits include the following:*
  - Amount of waste burned Y/N \_\_\_\_ don't know **(12%)**
  - Composition of waste burned Y/N \_\_\_\_ don't know **(3%)**
  - Date of burn Y/N \_\_\_\_ don't know **(9%)**
  - Duration of burn Y/N \_\_\_\_ don't know **(12%)**

- 3. *May we obtain copies of the permits or any summaries of the permit data that you maintain?* Y/N **(6%)**

NOTE: Depending on what information is established to be included in the permit, the surveyor may or may not need to ask Questions 4, 5, and 6.

- 4. *What is your estimate of the number of land clearing burns?* \_\_\_\_ number \_\_\_\_ don't know **(76%)**

NOTE: The following question only needs to be asked if permits are issued.

- 5. *What is your estimate of the number of total burns, including permitted and non-permitted burns?* \_\_\_\_ number \_\_\_\_ don't know **(26%)**

- 6. *What would you estimate is the average amount of waste per burn?* \_\_\_\_ amount \_\_\_\_ don't know **(9%)**

NOTE: If respondent cannot provide information to Questions 2 through 6, proceed with Question 7, otherwise go to Question 9.

- 7. *Do you have estimates of the number of acres cleared due to the following types of construction?*

- Residential construction \_\_\_\_ acres \_\_\_\_ don't know **(2%)**
- Nonresidential construction \_\_\_\_ acres \_\_\_\_ don't know **(0%)**
- Road construction \_\_\_\_ acres \_\_\_\_ don't know **(0%)**
- Total construction \_\_\_\_ acres \_\_\_\_ don't know **(0%)**

- 8. *For what percentage of acres cleared in your jurisdiction was open burning used to dispose of the waste (i.e., percentage burned out of percentage generated for each category):* **(0%)**

- Residential construction \_\_\_\_% \_\_\_\_ don't know
- Nonresidential construction \_\_\_\_% \_\_\_\_ don't know
- Road construction \_\_\_\_% \_\_\_\_ don't know
- Total construction \_\_\_\_ acres \_\_\_\_ don't know

9. *What percentage of land clearing burning is conducted in:* (50%)

Winter (December, January, February)? \_\_\_\_\_

Spring (March, April, May)? \_\_\_\_\_

Summer (June, July, August)? \_\_\_\_\_

Autumn (September, October, November)? \_\_\_\_\_

Don't know \_\_\_\_\_

10. *Does your jurisdiction have restrictions on placing land clearing debris in a landfill?* Y/N (50%)  
If Y, what are they?

11. *Do you require the use of an air curtain destructor for burning land clearing debris?* Y/N (38%)

Because of the lack of data provided by the survey respondents and the fact that few land clearing debris burn permits request fuel loading information, Pechan suggests that jurisdictions that view this as a priority emission source category should require that this information be included in all of their future land clearing debris burn permits. In addition, information on the type of material burned (e.g., hardwood waste; conifer wood waste) should also be required so that the best possible match can be made with available emission factors.

#### **D. Construction and Demolition Waste**

Pechan contacted approximately 20 state and local fire safety and environmental agency personnel to obtain information on the availability of data to estimate C&D waste burning activity (see the start of Section III for a breakout over the region). Most respondents indicated that this activity is regulated in their jurisdiction by the issuance of burn permits. However, similar to land clearing burning activity, survey respondents were generally unable to identify whether the permits included information on the amount of waste burned or the composition of the waste burned. In addition, the example burn permits obtained did not require the amount of waste burned to be reported. Table III-6 shows the survey questions and indicates the response rate for each question in parentheses.

Because most C&D burning permits did not appear to include the data necessary to develop emission estimates, areas that believe this to be a significant category should require that information on fuel loading and type of waste be included in all of their future C&D burn permits. Discerning at least between construction versus demolition waste would be useful, since construction waste tends to be comprised of more combustible materials than demolition waste.

#### **E. Rule Effectiveness**

Pechan had planned to administer this test survey over the phone. However, we administered this survey by faxing or emailing the form, since the respondents often wanted to look up information. Rule effectiveness test surveys were completed for 19 local areas, 4 regions, and 6 states as identified at the beginning of this section. Rule effectiveness surveys for local areas were performed when the activity survey respondents indicated that a rule or regulation had been enacted in their jurisdiction. Table III-7 shows a summary of the results of the RE survey, presenting an average score for all test survey respondents. For many test areas, the RE was well below 100 percent as calculated from the survey. With a possible maximum score of 100 for each open burning category, the average score for each category was approximately 40 percent. Based on the response rate for certain questions, we propose revisions to the survey instrument. The following summarizes the revisions we propose.

- Questions 2a – 2d were ineffective. “Spot checking” is either not done often or respondents were not able to estimate the percentage of spot checks. We believe a more appropriate question is “For *type of burning*, what percentage of households or activity within your jurisdiction violate an open burning rule or regulation annually?” This question would also be weighted higher (50 points maximum for <1 percent violations).

**Table III-6. Response Rate for Construction/Demolition  
Waste Burning Activity Survey**

1. *Do you issue permits for construction/demolition waste burning?* Y/N If N, go to question 4. **(37%)**  
 2. *Please indicate whether your permits include the following:* **(5%)**

Amount of waste burned Y/N \_\_\_\_ don't know  
 Composition of waste burned Y/N \_\_\_\_ don't know  
 Requirement that the wood be untreated Y/N \_\_\_\_ don't know  
 Date of burn Y/N \_\_\_\_ don't know  
 Duration of burn Y/N \_\_\_\_ don't know

3. *May we obtain copies of the permits or any summaries of the permit data that you maintain?* Y/N **(5%)**

NOTE: Depending on what information is established to be included in the permit, the surveyor may or may not need to ask Questions 4, 5, and 6.

4. *What is your estimate of the number of construction/demolition burns?*  
 \_\_\_\_ number \_\_\_\_ don't know **(79%)**

NOTE: The following question only needs to be asked if permits are issued.

5. *What is your estimate of the number of total burns, including permitted and non-permitted burns?*  
 \_\_\_\_ number \_\_\_\_ don't know **(11%)**

6. *What would you estimate is the average amount of waste per burn?* \_\_\_\_ amount \_\_\_\_ don't know **(0%)**

7. *What percentage of construction/demolition burning is conducted in:* **(21%)**

Winter (December, January, February)? \_\_\_\_  
 Spring (March, April, May)? \_\_\_\_  
 Summer (June, July, August)? \_\_\_\_  
 Autumn (September, October, November)? \_\_\_\_  
 Don't know \_\_\_\_

8. *Does your jurisdiction have restrictions on placing construction/demolition waste in a landfill?* Y/N  
 If Y, what are they? **(32%)**

### Table III-7. Results of Test Survey for Rule Effectiveness

1. *What has been the nature and extent of source education on requirements of the regulation? (Please indicate all that apply.)*

<u>          </u> Individual mailings on compliance requirements	7	
<u>          </u> Educational opportunities for general public or municipalities	7	
<u>          </u> General notices in newspapers	3	
<u>          </u> Inform public on state/regional agency website	3	
<u>          </u> None	0	
Average Score		<u>          </u> 6

For the following questions, please indicate the most appropriate response from the choices provided after each question.

2a. *For residential municipal solid waste, what percentage of households in your jurisdiction area typically are spot checked annually?*

<u>          </u> >30 percent	20	
<u>          </u> 10-30 percent	15	
<u>          </u> 5-9 percent	10	
<u>          </u> 1-4 percent	5	
<u>          </u> <1 percent or don't know	0	
Average Score		<u>          </u> 5

2b. *For residential yard waste burning, what percentage of households in your jurisdiction area typically are spot checked annually?*

<u>          </u> >30 percent	20	
<u>          </u> 10-30 percent	15	
<u>          </u> 5-9 percent	10	
<u>          </u> 1-4 percent	5	
<u>          </u> <1 percent or don't know	0	
Average Score		<u>          </u> 10

2c. *For land clearing debris burning, what percentage of sources in your jurisdiction typically are spot checked annually?*

<u>          </u> >30 percent	20	
<u>          </u> 10-30 percent	15	
<u>          </u> 5-9 percent	10	
<u>          </u> 1-4 percent	5	
<u>          </u> <1 percent or don't know	0	
Average Score		<u>          </u> 8

2d. For construction/demolition debris burning, what percentage of sources in your jurisdiction typically are spot checked annually?

_____ >30 percent	20
_____ 10-30 percent	15
_____ 5-9 percent	10
_____ 1-4 percent	5
_____ <1 percent or don't know	0
	Average Score _____ 6

3. What percentage of the past year's spot checks indicated compliance?

_____ 100 percent	30
_____ 90-99 percent	25
_____ 50-89 percent	20
_____ 25-49 percent	10
_____ 1-24 percent	5
_____ <1 percent or don't know	0
_____ Not applicable since no spot checks were done	0
	Average Score _____ 10

4. Has formal documented enforcement action been taken against sources found to be out of compliance?

_____ Not applicable since no inspected sources have been found to be out of compliance	10
_____ Yes, for all noncomplying sources	10
_____ Yes, in 50 to 99 percent of the cases	5
_____ Yes, in <50 percent of the cases	2
_____ Never, or don't know	0
	Average Score _____ 6

5. Have enforcement actions for sources in this source category been publicized in the media (newspaper, TV, radio, trade journals), either through news stories or paid advertisements?

_____ Not applicable since no inspected sources have been found to be out of compliance	5
_____ Yes, in every case	5
_____ Yes, in 50 to 99 percent of the cases	3
_____ Yes, in <50 percent of the cases	1
_____ Never, or don't know	0
	Average Score _____ 1

6. Have follow-up inspections been made on sources which were found to be out of compliance?

_____ Not applicable since no inspected sources have been found to be out of compliance	10
_____ Yes, in 100 percent of the cases	10
_____ Yes, in 50 to 99 percent of the cases	5
_____ Yes, in <50 percent of the cases	2
_____ Never, or don't know	0
	Average Score _____ 6

7. *Does your regulation contain uncorrected deficiencies as specified in the SIP-call follow-up letter from the EPA Regional Air Division Director to the State Air Program Director?*

<u>        </u> Yes	0
<u>        </u> No	5
<u>        </u> Don't know	5
Average Score	<u>        </u> 5

After the questionnaire has been completed, total the scores to determine RE for each category.

TOTAL SCORE = RE:	
Residential MSW	<u>        </u> 37
Yard waste	<u>        </u> 41
Land clearing	<u>        </u> 41
C/D Waste	<u>        </u> 39

- Eliminate Question 3 related to spot checks.
- Question 7 was eliminated. No respondent answered “Yes” to this question. We recommend asking, “Does your jurisdiction maintain and publicize a call-in number to handle complaints about illegal or questionable open burning incidents? This is then followed by a variation of the existing question 6, “Have follow-up inspections been made on households or activity for which citizens have placed complaints?”
- The option to answer a question as “Don’t know” has been separated from “never” for all questions. It may be reasonable that if a respondent answers “Don’t know” more than twice, the survey results should be discounted and a more knowledgeable contact should be pursued. One does not want to penalize an area by rating their rule lower, based primarily on the fact that the respondent does not have answers to the majority of the questions.
- No revisions recommended for Questions 1, 4, and 5.

For Questions 2a through 2d, we may want to ask for the respondent to provide the number of illegal burns or violations per year, as opposed to a percentage. The number of violations in a given area may present an acceptable alternative for determining RE for an area. For example, for a given jurisdiction, we could use the number of violations per households, and the anticipated number of burns in that area if burning were allowed (i.e., the no. of burns per household in a similar area without a rule). RE can then be estimated as follows:

$$RE = \frac{(\text{Number of anticipated burns} - \text{Number of violations})}{(\text{Number of anticipated burns})}$$

These estimates could be compared to the RE value estimated from the RE survey that follows EPA’s protocol, and if determined to be representative, could be used directly as the RE value. The revised RE questionnaire is presented in Appendix C.

#### **F. Survey of Solid Waste Agencies**

For residential household waste burning, if an area has municipal trash collection service (MTCS), the likelihood or incidence of burning is expected to be less. In the report, *State of Maine 1997 Backyard Trash Burning (BYB) Study*, a correlation was established between MTCS and a low burn-barrel-to-resident ratio (i.e., in areas with MTCS, the ratio was lower than those areas with only a transfer station, which was lower still than areas without a MTCS or transfer station) (ME DEP, 1997). In some states, if an area has MTCS, open burning of household waste is prohibited. So defining these areas for a state allows one to establish those areas for which 100 percent control should be applied. We contacted state solid waste agencies to determine whether counties/jurisdictions had either public or private MTCS. Table III-8 provides the final state solid waste agency contacts. We established that for many states, this information could only be obtained by contacting individual jurisdictions, or the individual waste

**Table III-8. State Solid Waste Contacts**

State	Contact	Affiliation	Address	Phone Number
Connecticut	Judy Belaval	Solid Waste Program Bureau of Waste Management CT Recycling Office	79 Elm St. Hartford, CT 06106-5127	(860) 424-3237
Delaware	Tom Huska	Delaware Solid Waste Authority	1128 S. Bradford Street P.O. Box 455 Dover, DE 19903 <a href="http://www.dswa.com">www.dswa.com</a>	(302) 739-5361
Maine	Hank Tyler	Division of Solid Waste Facilities Regulations Bureau of Remediation and Waste Management ME Department of Environmental Protection	State House, Station #17 Augusta, ME 04333	(207) 287-7720
Maryland <sup>1</sup>	Kelly Schaefer Dave Mrgich	Solid Waste Program MD Department of the Environment	2500 Broening Hwy. Baltimore, MD 21224 <a href="http://www.mde.state.md.us">www.mde.state.md.us</a>	(410) 631-3314 (410) 631-3421
Massachusetts	Jim Miller	Division of Business Compliance MA Department of Environmental Protection	One Winter St., 9th Floor Boston, MA 02108	(617) 292-5574
New Hampshire	Christopher Way	Solid Waste Compliance Section Waste Management Division NH Department of Environmental Services	6 Hazen Dr. Concord, NH 03301-6509	(603) 271-6847
New Jersey	Celia Chee-Wah	Bureau of Recycling and Planning Division of Solid and Hazardous Waste NJ Department of Environmental Protection	401 E. State St., PO Box 414 Trenton, NJ 08625	(609) 984-2080
New York	Frank Murphy	New York State Department of Environmental Conservation	625 Broadway Albany, NY 12233-7253	(518) 402-8678
Pennsylvania	Carl Hersch	Municipal and Residual Waste Division Bureau of Land Recycling and Waste Management PA Department of Environmental Protection	Rachel Carson State Office Building, PO Box 8471 Harrisburg, PA 17105-6239	(717) 783-2388
Penobscot Indian Nation	Not available			
Rhode Island	John Trevor	RI Resource Recovery Corp.	<a href="http://www.rirrc.org">www.rirrc.org</a>	(401) 942-1430, ext. 112
St. Regis Mohawk Tribe	Laura Weber	Director of Solid Waste Management Program Environment Division	412 State Route 37 Akwesasne, NY 13655	(518)358-5937 ext. 32
Vermont	Vicky Veins	Waste Management Division Solid Waste Management Program VT Department of Environmental Conservation	103 S. Main St. Waterbury, VT 05671-0404	(802) 241-3448

<sup>1</sup>See Appendix B for local municipal trash collection service contacts for the State of Maryland.

haulers that serve an area. Therefore, we were not able to develop a comprehensive data base that contains this information by county or jurisdiction.

For some counties, all households may or may not have access to MTCS, but in many cases, this service varies by town within a county, and even by areas within a town, depending on the routes covered by the waste collectors and haulers. We wanted to research the availability of these data for potential use as a scaling surrogate (since the Maine survey established a correlation). The level of effort to obtain this information at the necessary geographic level is expected to be significant and is not recommended for a multi-state area. This is why other surrogates already compiled at the Census tract and block level are recommended for use in scaling survey results (see Section IV, Recommended Emission Estimation Methods). For potential use in developing activity data based on MSW generation rates, we determined whether state-specific MSW generation data are available (see Table III-9).

#### **IV. RECOMMENDED EMISSION ESTIMATION METHODS**

The recommended emission estimation methods presented below for residential open burning provide for the development of emission estimates at the subcounty level (e.g., at the Census Tract or Census block level). MANE-VU has indicated that estimating emissions at the subcounty detail is a critical aspect of the inventory in order to discern urban and rural activity. As such, the emission estimation procedures presented reflect activity variations for these areas within a county.

##### **A. Residential MSW and Yard Waste**

###### *Uncontrolled emission estimates*

To estimate uncontrolled emissions, one would ideally calculate the mass of waste burned per unit time for specific geographic areas. The test survey indicated that the actual amount of mass burned by all residences in an area is not typically known. As such, Pechan recommends the following approach, which accounts for data that was most readily and most frequently provided by test survey respondents.

###### *Residential MSW*

To estimate the mass of waste burned, Pechan recommends using the following equation:

$$Wt = H * Bt * M$$

where:

- Wt = Mass of waste burned per time period
- H = Number of households that burn (Question 1, Part 2 of survey)
- Bt = Number of burns per time period (Question 3, Part 2)
- M = Mass of waste per burn (Question 5, Part 2)

**Table III-9. State-Specific MSW Generation and Disposal Information**

State	MSW Data Available for State?	Description of Information
Connecticut	N	
Delaware	Y	Amount of MSW disposed in landfills and recycled.
District of Columbia	Y	Amount of MSW generated and MSW per capita generation rates.
Maine	Y	Amount of MSW generated and MSW per capita generation rates by municipality.
Maryland	Y	Statewide amount of MSW generated and statewide per capita generation rate.
Massachusetts	Y	Amount of MSW recycled, disposed and generated (recycled + disposed) by municipality. MSW per capita generation rates by municipality.
New Hampshire	Y	Statewide amount of MSW recycled, composted, disposed, and amount of C&D waste generated. Statewide MSW per capita generation rate.
New Jersey	N	
New York	N	
Pennsylvania	Y	Amount of MSW generated, recycled and disposed by county. MSW per capita generation rates by county.
Penobscot Indian Nation	Y	Amount of MSW generated and MSW per capita generation rates by municipality (available from State of Maine).
Rhode Island	Y	Amount of MSW generated and MSW per capita generation rates by municipality. Statewide recycling amounts broken out by type of waste.
St. Regis Mohawk	N	
Vermont	Y	Statewide amount of MSW generated and statewide per capita generation rate. Statewide generation amounts for recycled materials and C&D waste as reported by solid waste facilities.

The following represents an example based on information provided by a test survey respondent for household waste burning in a suburban area:

Estimate of number of households that burn = 450

Estimate of the frequency of burning = 1 burn per week (wk)

Estimate of the average amount of waste per burn = 1/2 of a 55 gallon drum, or 3 cubic feet (ft<sup>3</sup>)

resulting in:

$$\begin{aligned} 450 \text{ households} * 1 \text{ burn/wk} * 3 \text{ ft}^3/\text{burn} * 8.28 \text{ pounds (lbs)/ft}^3 &= 11,178 \text{ lbs/wk} \\ &= 581,256 \text{ lbs/year (yr)} \\ &= 290 \text{ tons waste burned/yr} \end{aligned}$$

If a value for the volume of waste is provided (e.g., 1/2 of a 55 gallon drum, or 3 ft<sup>3</sup>), the volume needs to be converted to mass using an assumed density of the waste. In this example, 8.28 lbs/ft<sup>3</sup> is assumed to be an uncompressed density for paper waste, since the area in this example only allows paper product burning. The assumed density may be different for other areas, depending on the types of materials that may be burned.

One would then develop a mass per household factor as follows:

$$\begin{aligned} \text{Total number of households (obtained from BOC)} &= 1,062 \\ \text{Mass of waste burned/household} &= 0.27 \text{ tons/household/yr} \end{aligned}$$

To use the data in conjunction with survey results for other areas, one would look up the survey area to determine how the area is defined (i.e., urban versus rural) according to the Bureau of the Census (BOC), either before or following the survey. This is most easily accomplished by first looking up the jurisdiction in BOC's Summary Tape File 3A (STF3A), according to county, and then place name. (NOTE: If the area is not a specific place as defined by BOC, one may need to look at a map to determine the area of the jurisdiction). Obtaining a population estimate from the respondent (Question 5 of Introduction) also allows one to use this as a cross check to verify the survey area as defined by BOC. Because we want to potentially use the activity as the basis for emission estimates for other areas, it is critical to establish the geographic area that the survey results represent. In some cases, a jurisdiction may encompass both urban/suburban or suburban/rural areas. If possible, activity for these different areas within a jurisdiction should be determined, since it is likely to vary for these areas. This will prevent unrealistic emissions from being assigned to large metropolitan areas such as New York City or Philadelphia, Pennsylvania. The survey instrument has been revised to request this information.

The Census generally defines an area as urban or rural based on population density. For Census 2000, urbanized areas are classified as either "inside urbanized area" or "inside urbanized cluster." An "inside urbanized area" consists of a densely settled territory that contains 50,000 or more people, while an "inside urbanized cluster" contains at least 2,500 people but fewer than 50,000 people (i.e., suburban areas). Both urbanized areas and urban clusters encompass densely settled territory that represents a cluster of block groups each containing at least 1,000 people per square mile, as well as the surrounding block groups that have a population density of at least 500 people per square mile, and less densely blocks that are used to connect discontinuous areas with qualifying densities. For the 1990 Census, urban areas were classified as either "inside urbanized areas" (same as Census 2000) or "outside urbanized areas," (now called "inside urbanized cluster" for Census 2000). In addition, for the 1990 Census, rural areas were broken out according to "rural farm" or "rural non-farm." For the Census 2000, all areas not classified as urban are "rural." As such, the calculations presented based on 1990 Census data may change once updated designations are obtained from the Census 2000 (e.g., an area classified as "rural non-farm" in 1990 may be classified as "inside urbanized cluster" for 2000 if the area experienced population growth).

Data on the number of housing units can be obtained at the Census block level, Census block group level (a combination of multiple blocks), Census tract level, Place level, and County level. Data for the number of rural and urban households at the Census block group level representing Census 2000 results will not be available until May or June of 2002.

Because the urban/rural Census 2000 data are not yet available, Pechan has purchased the STF3A data series for the 1990 Census of Housing and Population for the States of Connecticut, Delaware, District of Columbia, Maine, Maryland, Rhode Island, and Vermont, which provides demographic and housing unit data for areas according to Census block group level (BOC, 1992; BOC, 1995). These data were purchased to establish the feasibility of using these data for allocating activity to portions of a county. Table IV-1 shows an example of Census 1990 data for New Castle County, Delaware that shows the number of households (down to the Census Block Group level) classified as inside urbanized area or outside urbanized area, and rural (nonfarm or farm). As seen from the data, the distinctions between the two urban areas and the two rural areas are generally consistent among Census block, but start to vary at the Census tract level. Figure IV-1 presents the same housing unit data for New Castle County at the Census tract level. Once the Census 2000 data are available and obtained, the data would be analyzed to determine what spatial level of detail is required.

Once the established number of survey respondents are contacted, the survey data would be compiled and statistically-analyzed to develop activity factors representing the mass of waste burned per household. For example, the survey responses in rural areas would be compared to responses from urbanized areas (e.g., using analysis of variance) to determine if these two populations are statistically different. Comparisons might also be made in areas with rules versus those without. Comparisons of different geographic areas (e.g., states) might also be performed to determine whether patterns of waste burning are significantly different. As warranted by the statistical analysis, area-specific factors would be developed for rural areas, inside urbanized clusters, and inside urbanized areas. The results can be used for other areas by multiplying the number of single-family housing units per area by these activity factors.

After the activity factors have been selected for the various geographic areas, those factors would be applied to both surveyed and remaining non-surveyed areas. For example, according to Table IV-1, the number of households classified as “urban outside” for Middletown town is 1,345. Assume the statistical analysis of the survey data resulted in an area-specific activity factor of 0.27 tons paper waste burned per household for “outside urbanized areas.” Applying this factor to the number of housing units in Middletown town results in:

$$0.27 \text{ tons/household} * 1,475 \text{ households} = 398.3 \text{ tons waste}$$

Then, to estimate annual carbon monoxide (CO) emissions, apply EPA-recommended emission factor for CO of 85 lbs/ton:

$$(398.3 \text{ tons waste burned/yr} * 85 \text{ lbs CO/ton}) / 2000 \text{ lbs/ton} = 16.9 \text{ tons CO/yr}$$

**Table IV-1. 1990 Census Block Group Housing Unit Data  
for New Castle County, Delaware**

STATE FIPS	CNTY FIPS	CNTY NAME	PLACE	PLACE NAME	TRACT	BLOCK GROUP	Number of Housing Units			
							Urban Inside	Urban Outside	Rural Farm	Rural Non-Farm
10	003	New Castle	01400	Arden village	0111	1	9	0	0	0
10	003	New Castle	01400	Arden village	0111	2	37	0	0	0
10	003	New Castle	01400	Arden village	0111	3	193	0	0	0
10	003	New Castle	01530	Ardencroft village	0111	2	109	0	0	0
10	003	New Castle	01660	Ardentown village	0111	1	120	0	0	0
10	003	New Castle	01660	Ardentown village	0111	3	13	0	0	0
10	003	New Castle	01660	Ardentown village	011204	1	0	0	0	0
10	003	New Castle	01660	Ardentown village	011204	2	0	0	0	0
10	003	New Castle	04650	Bellefonte town	0105	3	14	0	0	0
10	003	New Castle	04650	Bellefonte town	0106	1	272	0	0	0
10	003	New Castle	04650	Bellefonte town	0106	2	237	0	0	0
10	003	New Castle	19730	Delaware City	0164	3	0	0	0	0
10	003	New Castle	19730	Delaware City	0165	1	0	0	0	359
10	003	New Castle	19730	Delaware City	0165	2	0	0	3	296
10	003	New Castle	24540	Elsmere town	0123	1	346	0	0	0
10	003	New Castle	24540	Elsmere town	0123	2	302	0	0	0
10	003	New Castle	24540	Elsmere town	0123	3	367	0	0	0
10	003	New Castle	24540	Elsmere town	0124	1	158	0	0	0
10	003	New Castle	24540	Elsmere town	0124	2	434	0	0	0
10	003	New Castle	24540	Elsmere town	0124	3	377	0	0	0
10	003	New Castle	24540	Elsmere town	0124	4	487	0	0	0
10	003	New Castle	47030	Middletown town	0166	3	0	24	0	0
10	003	New Castle	47030	Middletown town	0167	1	0	1029	0	0
10	003	New Castle	47030	Middletown town	0167	2	0	422	0	0
10	003	New Castle	47030	Middletown town	0168	1	0	0	0	0
10	003	New Castle	50670	Newark city	013603	9	465	0	0	0
10	003	New Castle	50670	Newark city	0142	1	254	0	0	0
10	003	New Castle	50670	Newark city	0142	9	0	0	0	0
10	003	New Castle	50670	Newark city	0143	1	619	0	0	0
10	003	New Castle	50670	Newark city	0143	3	103	0	0	0
10	003	New Castle	50670	Newark city	0143	9	231	0	0	0
10	003	New Castle	50670	Newark city	014402	1	335	0	0	0
10	003	New Castle	50670	Newark city	014402	2	1161	0	0	0
10	003	New Castle	50670	Newark city	014403	1	512	0	0	0
10	003	New Castle	50670	Newark city	014403	2	272	0	0	0
10	003	New Castle	50670	Newark city	014403	3	681	0	0	0
10	003	New Castle	50670	Newark city	014404	1	128	0	0	0
10	003	New Castle	50670	Newark city	014404	2	290	0	0	0
10	003	New Castle	50670	Newark city	014404	3	255	0	0	0
10	003	New Castle	50670	Newark city	014404	4	206	0	0	0
10	003	New Castle	50670	Newark city	014501	1	860	0	0	0
10	003	New Castle	50670	Newark city	014502	1	257	0	0	0
10	003	New Castle	50670	Newark city	014502	2	471	0	0	0
10	003	New Castle	50670	Newark city	014702	4	131	0	0	0
10	003	New Castle	50670	Newark city	014703	1	127	0	0	0
10	003	New Castle	50670	Newark city	014703	2	11	0	0	0
10	003	New Castle	50670	Newark city	014803	9	482	0	0	0
10	003	New Castle	50670	Newark city	014804	9	9	0	0	0
10	003	New Castle	50800	New Castle city	0158	1	0	0	0	0
10	003	New Castle	50800	New Castle city	0159	2	27	0	0	0
10	003	New Castle	50800	New Castle city	0161	1	643	0	0	0
10	003	New Castle	50800	New Castle city	0161	2	435	0	0	0
10	003	New Castle	50800	New Castle city	0162	1	283	0	0	0
10	003	New Castle	50800	New Castle city	0162	2	340	0	0	0

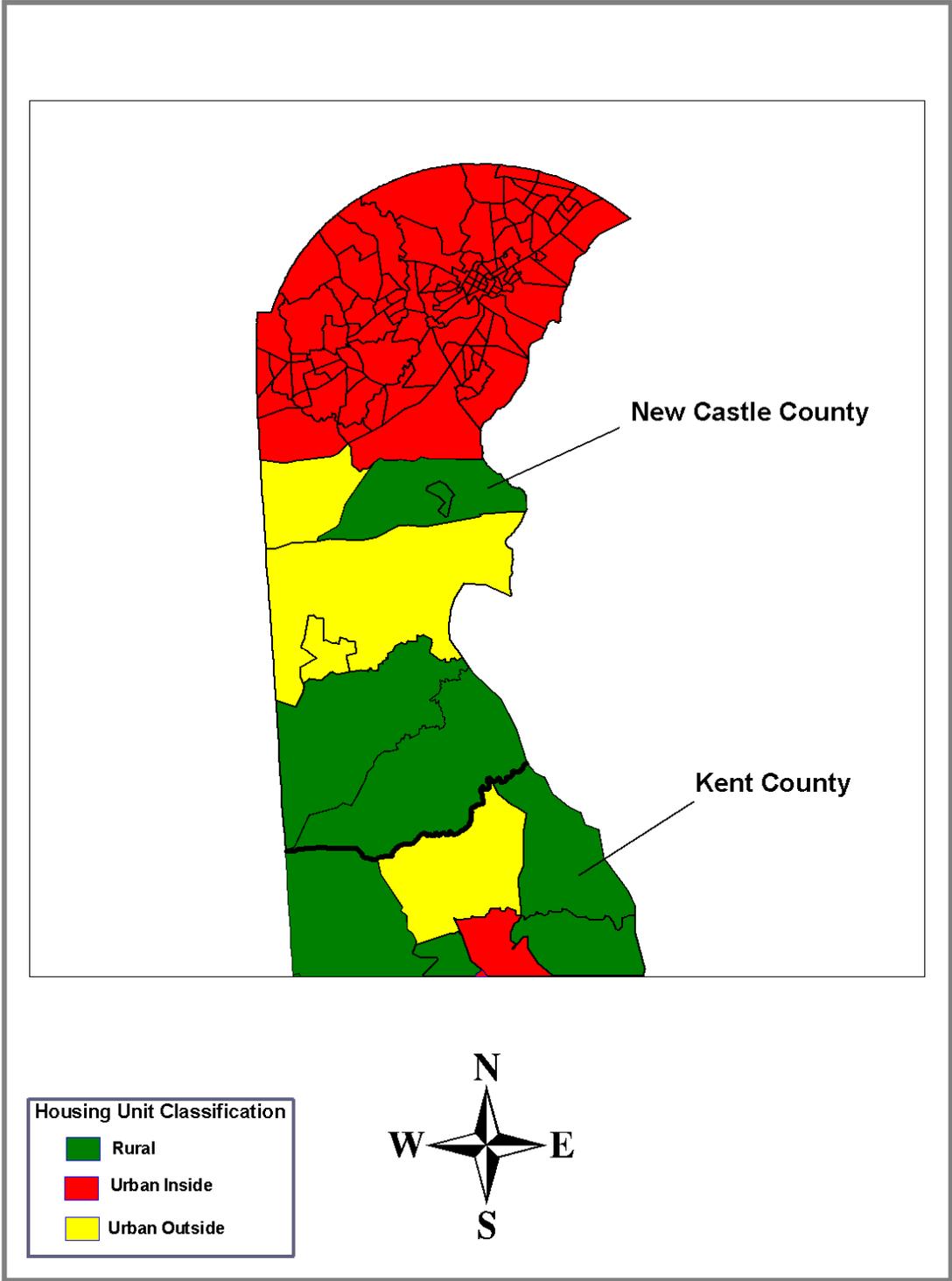
**Table IV-1 (continued)**

STATE FIPS	CNTY FIPS	CNTY NAME	PLACE	PLACE NAME	TRACT	BLOCK GROUP	Number of Housing Units			
							Urban Inside	Urban Outside	Rural Farm	Rural Non-Farm
10	003	New Castle	50800	New Castle city	0162	3	278	0	0	0
10	003	New Castle	50800	New Castle city	0163	9	0	0	0	0
10	003	New Castle	51190	Newport town	0128	1	190	0	0	0
10	003	New Castle	51190	Newport town	0128	2	344	0	0	0
10	003	New Castle	51190	Newport town	0129	2	13	0	0	0
10	003	New Castle	51190	Newport town	0129	3	6	0	0	0
10	003	New Castle	51190	Newport town	0129	9	0	0	0	0
10	003	New Castle	54050	Odessa town	0166	3	0	0	0	146
10	003	New Castle	54050	Odessa town	0168	2	0	0	0	0
10	003	New Castle	67310	Smyrna town	0169	1	0	0	0	0
10	003	New Castle	67310	Smyrna town	0169	2	0	0	0	0
10	003	New Castle	72510	Townsend town	0168	1	0	0	0	187
10	003	New Castle	77580	Wilmington city	0001	1	62	0	0	0
10	003	New Castle	77580	Wilmington city	0001	2	85	0	0	0
10	003	New Castle	77580	Wilmington city	0001	3	61	0	0	0
10	003	New Castle	77580	Wilmington city	0001	4	155	0	0	0
10	003	New Castle	77580	Wilmington city	0001	5	12	0	0	0
10	003	New Castle	77580	Wilmington city	0002	1	352	0	0	0
10	003	New Castle	77580	Wilmington city	0002	2	264	0	0	0
10	003	New Castle	77580	Wilmington city	0002	3	413	0	0	0
10	003	New Castle	77580	Wilmington city	0002	4	209	0	0	0
10	003	New Castle	77580	Wilmington city	0002	5	379	0	0	0
10	003	New Castle	77580	Wilmington city	0002	6	693	0	0	0
10	003	New Castle	77580	Wilmington city	0003	1	227	0	0	0
10	003	New Castle	77580	Wilmington city	0003	2	332	0	0	0
10	003	New Castle	77580	Wilmington city	0003	3	262	0	0	0
10	003	New Castle	77580	Wilmington city	0003	4	465	0	0	0
10	003	New Castle	77580	Wilmington city	0004	1	547	0	0	0
10	003	New Castle	77580	Wilmington city	0004	2	680	0	0	0
10	003	New Castle	77580	Wilmington city	0004	3	462	0	0	0
10	003	New Castle	77580	Wilmington city	0005	1	414	0	0	0
10	003	New Castle	77580	Wilmington city	0005	2	448	0	0	0
10	003	New Castle	77580	Wilmington city	0005	3	271	0	0	0
10	003	New Castle	77580	Wilmington city	0005	4	343	0	0	0
10	003	New Castle	77580	Wilmington city	0006	1	0	0	0	0
10	003	New Castle	77580	Wilmington city	000601	1	263	0	0	0
10	003	New Castle	77580	Wilmington city	000601	2	325	0	0	0
10	003	New Castle	77580	Wilmington city	000601	3	411	0	0	0
10	003	New Castle	77580	Wilmington city	000602	1	570	0	0	0
10	003	New Castle	77580	Wilmington city	000602	2	430	0	0	0
10	003	New Castle	77580	Wilmington city	000602	3	448	0	0	0
10	003	New Castle	77580	Wilmington city	0007	1	298	0	0	0
10	003	New Castle	77580	Wilmington city	0007	2	321	0	0	0
10	003	New Castle	77580	Wilmington city	0008	1	81	0	0	0
10	003	New Castle	77580	Wilmington city	0008	2	53	0	0	0
10	003	New Castle	77580	Wilmington city	0009	1	323	0	0	0
10	003	New Castle	77580	Wilmington city	0009	2	450	0	0	0
10	003	New Castle	77580	Wilmington city	0009	3	271	0	0	0
10	003	New Castle	77580	Wilmington city	0010	1	257	0	0	0
10	003	New Castle	77580	Wilmington city	0011	1	1276	0	0	0
10	003	New Castle	77580	Wilmington city	0011	2	442	0	0	0
10	003	New Castle	77580	Wilmington city	0011	3	821	0	0	0
10	003	New Castle	77580	Wilmington city	0012	1	234	0	0	0
10	003	New Castle	77580	Wilmington city	0012	2	240	0	0	0
10	003	New Castle	77580	Wilmington city	0012	3	342	0	0	0
10	003	New Castle	77580	Wilmington city	0013	1	594	0	0	0
10	003	New Castle	77580	Wilmington city	0013	2	260	0	0	0

**Table IV-1 (continued)**

STATE FIPS	CNTY FIPS	CNTY NAME	PLACE	PLACE NAME	TRACT	BLOCK GROUP	Number of Housing Units			
							Urban Inside	Urban Outside	Rural Farm	Rural Non-Farm
10	003	New Castle	77580	Wilmington city	0013	3	315	0	0	0
10	003	New Castle	77580	Wilmington city	0013	4	586	0	0	0
10	003	New Castle	77580	Wilmington city	0014	1	457	0	0	0
10	003	New Castle	77580	Wilmington city	0014	2	563	0	0	0
10	003	New Castle	77580	Wilmington city	0015	1	1205	0	0	0
10	003	New Castle	77580	Wilmington city	0016	1	329	0	0	0
10	003	New Castle	77580	Wilmington city	0016	2	389	0	0	0
10	003	New Castle	77580	Wilmington city	0016	3	179	0	0	0
10	003	New Castle	77580	Wilmington city	0016	4	209	0	0	0
10	003	New Castle	77580	Wilmington city	0017	1	200	0	0	0
10	003	New Castle	77580	Wilmington city	0017	2	87	0	0	0
10	003	New Castle	77580	Wilmington city	0017	3	753	0	0	0
10	003	New Castle	77580	Wilmington city	0017	4	377	0	0	0
10	003	New Castle	77580	Wilmington city	0018	1	0	0	0	0
10	003	New Castle	77580	Wilmington city	0019	1	126	0	0	0
10	003	New Castle	77580	Wilmington city	0019	2	282	0	0	0
10	003	New Castle	77580	Wilmington city	0019	3	339	0	0	0
10	003	New Castle	77580	Wilmington city	0020	1	278	0	0	0
10	003	New Castle	77580	Wilmington city	0021	1	159	0	0	0
10	003	New Castle	77580	Wilmington city	0021	2	289	0	0	0
10	003	New Castle	77580	Wilmington city	0021	3	160	0	0	0
10	003	New Castle	77580	Wilmington city	0021	4	325	0	0	0
10	003	New Castle	77580	Wilmington city	0022	1	151	0	0	0
10	003	New Castle	77580	Wilmington city	0022	2	283	0	0	0
10	003	New Castle	77580	Wilmington city	0022	3	279	0	0	0
10	003	New Castle	77580	Wilmington city	0022	4	279	0	0	0
10	003	New Castle	77580	Wilmington city	0023	1	340	0	0	0
10	003	New Castle	77580	Wilmington city	0023	2	391	0	0	0
10	003	New Castle	77580	Wilmington city	0023	3	209	0	0	0
10	003	New Castle	77580	Wilmington city	0023	4	273	0	0	0
10	003	New Castle	77580	Wilmington city	0024	1	446	0	0	0
10	003	New Castle	77580	Wilmington city	0024	2	401	0	0	0
10	003	New Castle	77580	Wilmington city	0024	3	134	0	0	0
10	003	New Castle	77580	Wilmington city	0024	4	464	0	0	0
10	003	New Castle	77580	Wilmington city	0024	5	679	0	0	0
10	003	New Castle	77580	Wilmington city	0025	1	356	0	0	0
10	003	New Castle	77580	Wilmington city	0025	2	173	0	0	0
10	003	New Castle	77580	Wilmington city	0025	3	432	0	0	0
10	003	New Castle	77580	Wilmington city	0025	4	322	0	0	0
10	003	New Castle	77580	Wilmington city	0026	1	30	0	0	0
10	003	New Castle	77580	Wilmington city	0026	2	372	0	0	0
10	003	New Castle	77580	Wilmington city	0026	3	375	0	0	0
10	003	New Castle	77580	Wilmington city	0026	4	224	0	0	0
10	003	New Castle	77580	Wilmington city	0026	5	424	0	0	0
10	003	New Castle	77580	Wilmington city	0027	1	270	0	0	0
10	003	New Castle	77580	Wilmington city	0027	2	478	0	0	0
10	003	New Castle	77580	Wilmington city	0107	5	0	0	0	0
10	003	New Castle	77580	Wilmington city	0107	9	0	0	0	0
10	003	New Castle	77580	Wilmington city	0122	1	0	0	0	0
10	003	New Castle	77580	Wilmington city	0123	1	0	0	0	0
10	003	New Castle	77580	Wilmington city	0124	1	6	0	0	0
10	003	New Castle	77580	Wilmington city	0129	9	0	0	0	0
10	003	New Castle	77580	Wilmington city	0153	9	0	0	0	0

Figure IV-1. Census Tract by Housing Unit Type for New Castle County, Delaware



## ***Yard waste***

For brush waste, the same basic approach used for household waste burning can be followed. Because most test survey respondents were able to provide only average dimensions for a yard waste burn, this estimated volume would need to be converted to mass using an average density. To estimate the mass of waste burned, Pechan recommends using the following equation:

$$Wt = H * Bt * M$$

where:

- Wt = Mass of brush waste burned per time period
- H = Number of households that burn (Question 1, Part 3 of survey)
- Bt = Number of burns per time period (Question 3, Part 3)
- M = Mass of waste per burn (Question 5, Part 3)

The following represents an example based on information provided by a test survey respondent for brush waste burning in a rural area that only allows burning during the fall season.

Estimate of number of households that burn = 260

Estimate of the frequency of burning = 1 burn per month

Estimate of the average amount of waste per burn =  $4 \times 4 \times 3 \text{ ft} = 48 \text{ ft}^3 \times 0.30 = 33.6 \text{ ft}^3$   
(i.e., pile dimensions correspond to volume of  $48 \text{ ft}^3$ , and assuming that approximately 30% of this volume is empty in a pile of brush waste)

Density of brush waste is  $30.25 \text{ lbs/ft}^3$  (Average for Northeast as reported in Table 16.4-5 of the Emission Inventory Improvement Program (EIIP), Open Burning Document)

This results in:

$$\begin{aligned} &260 \text{ households} * 1 \text{ burn/month} * 33.6 \text{ ft}^3/\text{burn} * 30.25 \text{ lbs/ft}^3 = 264,264 \text{ lbs/month, or} \\ &= 132.1 \text{ tons waste burned/month} \\ &= 396.4 \text{ tons waste burned/season (and per year)} \end{aligned}$$

One would then develop a mass per household factor as follows:

$$\begin{aligned} \text{Total number of households in this jurisdiction} &= 550 \\ \text{Mass of waste burned/household} &= 0.72 \text{ tons/household/season (yr)} \end{aligned}$$

Area-specific factors for the mass of waste burned per household would then be developed and applied in a manner consistent with the example provided for household waste burning. For areas where leaf burning activity can be distinguished from brush burning, separate activity factors should be developed to reflect these two types of yard waste. If activity for these types of yard waste cannot be estimated separately, the respondent should be asked to provide an estimate of the percentage of total activity that is corresponding to brush waste burning versus leaf waste burning activity, since the emission factors vary for these types of waste, and the seasonal profiles may differ.

Alternative ways to estimate the activity would be to use the number of households and associated populations from the survey, apply a per capita waste generation rate, and subtract the amount of waste that is known to be disposed of in a manner besides burning. Another alternative may be to perform a case study to determine what the typical mass of waste burned per time period is for rural areas in the Mid-Atlantic and Northeast. This average amount of waste per burn could then be applied to the number of households that burn. These approaches may be suitable if a follow-up survey does not result in a high response rate for estimates of the mass of waste burned, and if we have low confidence in that portion of the survey data.

***Controlled emission estimates***

As part of this project, Pechan set out to establish which areas, either states or specific regions or towns within a state, do not allow open burning according to either a statewide regulation or a local ordinance. For those areas where open burning is determined to be prohibited or banned, controlled emission estimates should be developed that account for the control efficiency (CE), RE, and rule penetration (RP). In the case of household waste and yard waste burning, the control is assumed to be a ban on open burning; therefore CE is 100 percent. For some states that have a statewide rule, 100 percent CE can be assumed for all areas within the state. Other states allow open burning, but only for certain areas. For example, New York allows open burning, but only in areas where a town’s population, including both incorporated and unincorporated areas, does not exceed 20,000. The rules in the States of Maryland and New Hampshire were established to prohibit open burning in areas where public trash service is available (Maryland also prohibits open burning in ozone nonattainment areas during the summer season). However, Pechan was not able to obtain a comprehensive listing of those areas that have public trash service in these two states (see Section III.F). However, a listing of the local MTCS contacts for Maryland from which to obtain these data was compiled and is presented in Appendix B.

If an area has controls or prohibitions on residential burning, emissions can be calculated using the following equation:

$$E_A = (EF_A) * (A) * [(1 - (CE)(RP)(RE))]$$

where:

- $E_A$  = Controlled area source emissions of pollutant A
- $EF_A$  = Uncontrolled emission factor for pollutant A
- $A$  = Category activity
- $CE$  = % Control efficiency/100
- $RP$  = % Rule penetration/100
- $RE$  = % Rule effectiveness/100

Using the activity estimates developed for areas without open burning regulations, uncontrolled activity estimates would then be adjusted using the above equation.

If an RE value was determined for a state or local area, that value should be used in the above equation. Average RE values, like activity, can be developed for similar areas in a state based on urban and rural classifications. If RE has been estimated through the survey for a large region, and the respondent verifies that this value is representative of all areas within their jurisdiction, this value should be used for all areas.

Rule penetration is the percentage of the area source category that is covered by the applicable regulation or is expected to be complying with the regulation. Rule penetration is estimated using the following equation.

$$\text{Rule Penetration} = (\text{Uncontrolled Emissions Covered by Regulation} / \text{Total Uncontrolled Emissions}) * 100$$

From the example in the previous section, annual CO emissions for residential MSW burning in Middletown town, DE were estimated to be 16.9 tons per year (tpy) [i.e., (398 tons waste burned/yr \* 85 lbs CO/ton)/ 2000 lbs/ton]. However, New Castle County does not allow the burning of residential MSW, therefore a CE value of 100 percent needs to be applied. Assume that the RE survey for this area yielded an RE of 84 percent. Rule penetration is assumed to be 100 percent (no exemptions). Controlled emissions are estimated using the following equation:

$$\begin{aligned} E_A &= 16.9 * (1 - (1.0 * 1.0 * 0.84)) \\ &= 2.7 \text{ tpy CO} \end{aligned}$$

## **B. Land Clearing Debris**

The test survey indicated that insufficient data were available from permits to adequately characterize the land clearing debris burning activity. In addition, for some areas in MANE-VU, land clearing debris and slash burning are not always differentiated on permits. As such, Pechan recommends using activity data developed for the National Emissions Inventory (NEI) land clearing debris burning emission estimates as a basis, and: 1) to further refine these estimates using data collected from the RE survey, as well as any exemptions from controls to adjust RP for specific areas; and 2) information on subcounty level construction activity to further spatially refine the activity. This is needed since the NEI activity data for residential construction are based on housing starts at the regional level (e.g., Northeast United States) and allocated to the county using BOC building permit data. NEI activity for road construction (i.e., miles of road constructed at the state level) are also allocated to counties using BOC building permit data. NEI commercial construction activity data are generated from national estimates of construction dollars and allocated to the county level using employment.

Housing units, road miles, and commercial construction dollars are then converted to acres using a conversion factor. County-level emissions from land clearing debris are then calculated by multiplying the total acres disturbed by construction by a county-specific weighted loading factor and the appropriate emission factor. Average loading factors were weighted according to the percent contribution of three types of vegetation (hardwoods, softwoods, and grasses) to the total land area for each county. These data were obtained from Version 2 of the Biogenic Emissions Landcover Database (BELD2) within EPA's Biogenic Emission Inventory System

(BEIS). The NEI approach assumes that all land clearing debris that is cleared is then burned (since no data were available to adjust this assumption).

One option for this category would be for MANE-VU state and tribal contacts to survey agencies that may gather information on residential and commercial construction within their state. Generally, this information is gathered at the county or municipal level, however an effort aimed at gathering information from these agencies would be overly burdensome in some states. Discussions with staff in the Maine State Planning Office indicate that potentially useful information is gathered at the state level in Maine (Von Magnus, 2002). This information includes the number of new housing units or new plumbing hookups at the municipal level. This type of information could be used as a reasonable surrogate to better allocate residential building activity, and hence land clearing and construction waste burning activity. For commercial building activity, useful information may be available from state planning or taxation agencies.

Pechan recognizes that the type of information available in each state is likely to be different. Ideally, the construction data would relate new housing units (commercial construction) to census tracts. However, if the data are only available to the state at the county or municipal level, then this still represents an improvement over the activity data used to construct the NEI. Information gathered by state contacts would be used to either directly calculate land clearing debris burning activity in a given subcounty area (preferred) or to better allocate the NEI activity data.

An alternative method for subcounty allocation of activity would be to use information on housing units at the census tract level between the 1990 census and 2000 census. Census tract level data on housing units (by housing type) would be compared to determine whether a net increase in housing units occurred between these two data sets. Inside urban areas would be taken out of this analysis, as we do not anticipate that land clearing occurs in these areas. While these data are imperfect in determining activity during any specific year (e.g., 2000), they will show where residential construction activity has taken place during this time period. NEI activity data would be allocated to the census tract level for census tracts that have shown a net increase in housing units. Although the data are strictly related to housing units, an assumption would be made that they are also valid for allocating locations of new roads and new commercial construction. Pechan recommends this alternative method only if the states are not able to collect the necessary subcounty activity data.

An example follows that shows how controlled emissions could be estimated using the NEI emission estimates as a basis.

County X in Pennsylvania requires the use of air curtain destructors for land clearing debris burning. Air curtain destructors consist of a burn pit and a device that blows air across and into the pit. The RE survey for this area indicated an RE of 72 percent. Therefore uncontrolled emissions need to be adjusted to account for the use of this control device, as well as the RE. Assume the NEI reports CO emissions for this county to be 2,600 tpy. These estimates should be adjusted using the following equation:

$$E_A = (UE_A) * [(1 - (CE)(RP)(RE)]$$

where:

$E_A$	=	Controlled area source emissions of pollutant A
$UE_A$	=	Uncontrolled emissions for pollutant A
CE	=	% Control efficiency/100
RP	=	% Rule penetration/100
RE	=	% Rule effectiveness/100

resulting in:

$$\begin{aligned} E_A &= 2,600 * (1-(0.37*1.0*0.72)) \\ &= 1,898 \text{ tpy CO} \end{aligned}$$

Note that the CE of 63 percent used in this example is based on results cited for CO emissions in Table 16.4-2 of the EIIP document for open burning (EPA, 1999). Average CO emissions for test burns without a blower are 36.5 lbs/ton, while emissions for test burns with a blower is 23 lbs/ton [i.e.,  $(36.5-23/36.5)*100 = 37$ ]. In addition, RP is assumed to be 100 percent (i.e., there are no exemptions from using an air curtain destructor). Adjustments for RP should be made when there are known exemptions from a regulation. For example, although banned in New Jersey and Delaware, these two states allow land clearing debris to be burned if the land cleared will be used for agricultural purposes.

### **C. Construction and Demolition Waste**

Because default emission estimates for C&D waste have not been developed for EPA's NEI, and because the test survey approach to obtain and use permit data may not be viable, Pechan examined potential alternative emission estimation methods for this category. Due to time and resource constraints, the approaches described below have not been tested, though.

### **Background on Construction and Demolition Waste Generation and Characteristics**

In a recent study prepared for EPA, Franklin Associates estimated the amount of C&D debris generated in 1996 (Franklin, 1998). Based on the results from this study, the estimated 1996 per capita generation rate for C&D debris was 2.8 lbs per person per day. As noted in the study, these estimates do not account for waste from roadway and bridge C&D or from land clearing projects. However, land clearing debris burning is covered by a separate source category, and roadway and bridge C&D debris is not generally comprised of a large percentage of combustible materials.

As identified in Table IV-2, building demolitions in 1996 accounted for an estimated 48 percent of the national C&D waste stream, renovations accounted for 44 percent, and construction accounted for 8 percent. Nonresidential construction accounted for an estimated 57 percent of total C&D waste, while residential construction accounted for 43 percent. The amount of C&D debris actually generated in a specific local area will depend on the economic conditions of the region, the weather, presence of major disasters or special projects, and local regulations. In fast-growing areas, the C&D waste stream from buildings consists primarily of

construction debris, with smaller quantities of demolition debris. By contrast, in many urban areas demolition debris dominates the C&D waste stream. Renovation projects can produce both C&D wastes.

**Table IV-2. Percent of Total Estimated Building-Related Construction and Demolition Debris Generation, 1996 (roadway, bridge, and land clearing debris not included)**

<b>SOURCE</b>	<b>RESIDENTIAL</b>	<b>NONRESIDENTIAL</b>	<b>TOTALS</b>
Construction	11	6	8
Renovation	55	36	44
Demolition	34	58	48
<b>TOTAL</b>	<b>43</b>	<b>57</b>	<b>100</b>

Source: Franklin, 1998.

Table IV-3 displays estimates of how C&D waste was managed in 1996. The most common management practice is landfilling, which includes C&D landfills, MSW landfills, and unpermitted sites. An estimated 35 to 45 percent of building-related C&D waste was discarded in C&D landfills in 1996; another 30 to 40 percent managed on-site (e.g., through burying or burning) or disposed at MSW or unpermitted landfills; and an estimated 20 to 30 percent recovered for processing and recycling. Open burning of C&D debris at construction sites is practiced in many rural areas as well as in some small to medium cities. Information on the amount of C&D debris that is open burned is not available (Franklin, 1998).

**Table IV-3. Management of Building-Related Construction and Demolition Debris in the United States, 1996**

<b>Management Option</b>	<b>Million Tons Per Year</b>	<b>Percent of Total</b>
C&D Landfills	45-60	35-45
MSW Landfills and Other*	40-55	30-40
Recovered for Recycling	25-40	20-30
<b>TOTAL</b>	<b>136</b>	<b>100</b>

\* Includes disposal on-site (including on-site open burning) and at non-permitted sites.

Source: Franklin, 1998.

The composition of C&D debris is highly variable and depends on the type of activity (e.g., wood is typically the largest component of waste material generated at construction and renovation sites, while concrete is commonly the largest component of building demolition debris). The materials most frequently recovered and recycled are concrete, asphalt, metals, and wood. Metals have the highest recycling rates – the Steel Recycling Institute estimates the

recycling rate for C&D steel at about 85 percent (this estimate includes scrap steel from roads and bridges). The number of recycling facilities for C&D debris has been growing rapidly in the last few years. In 1996, it was estimated that there were at least 1,800 operating C&D recycling facilities, including 1,000 asphalt and concrete crushing facilities, 500 wood waste processing facilities, and 300 mixed-waste C&D debris facilities. No information is available on the average throughput of these facilities.

### **Approach for Estimating Construction and Demolition Debris Burning Emissions**

The following describes a preliminary approach for estimating emissions from open burning of C&D debris. This discussion is organized into three sections: (1) a description of two potential methods for developing open burning emissions activity estimates from C&D debris; (2) a description of a preliminary proposed emission factor for C&D debris open burning; and (3) identification of areas for future research.

#### Emissions Activity Data

There are two preliminary methods identified for estimating the level of emissions activity related to C&D debris burning. The *top-down* method can be applied in all areas because it relies on readily available data. The *bottom-up* method, which improves upon the estimates that are generated using the top-down method, can only be applied in areas with sufficient resources for developing area-specific data. It is important to note that time and resource constraints precluded Pechan from testing either of these methodologies with concrete examples. Before implementing either of these approaches, it is important to first identify whether C&D debris burning is prohibited in the area of concern. If such activity is prohibited and there are readily available alternatives (C&D landfills, recovery/processing facilities) available, then it may be appropriate to assume that no C&D burning activity takes place in the area.

#### *Top-Down Approach*

A first attempt at estimating the level of C&D debris burning activity can rely on the use of the data, methodologies, and assumptions developed by Franklin Associates to estimate national C&D waste generation activity estimates (Franklin, 1998). These approaches could be investigated for their potential application to local areas. In cases where sufficient data are not available for directly applying the Franklin Associates' methods, it may be possible to allocate updated national estimates derived from the methods from the Franklin study to local areas based on surrogate indicators of C&D waste activity. Such indicators may include the number or value of residential and nonresidential construction permits (or other information on construction of new housing or commercial units, as described for land clearing debris above). If data for these surrogate indicators are not available for a local area, then it would be possible to estimate local activity by applying the Franklin Associates' national per capita generation estimate (2.8 lbs/person/day) and the national percentages of total C&D waste generation activity that are residential and nonresidential, and that occur from construction, renovation, and demolition activities (see Table IV-3 above).

Table IV-4 presents preliminary assumptions for the percentage of C&D waste that is open burned. These assumptions were developed based on consideration of the following information:

- Thirty to forty percent of total C&D waste is managed either by disposal in MSW landfills or other means, including open burning (Franklin, 1998);
- Nonresidential debris includes a higher percentage of materials that are not burned (e.g., concrete and metal) than residential debris;
- The percentage of total nonresidential activity that takes place in urbanized areas will be greater than the percentage of total residential activity;
- A smaller percentage of total C&D debris is burned in urbanized areas than rural/suburban areas because these areas are more likely to have regulations prohibiting such burning and to have alternatives to burning (landfilling, recycling) available (Taylor, 2001);
- A smaller percentage of wood debris from residential demolition will be recycled versus residential construction because demolition waste requires more effort to separate from other materials than construction waste (Franklin, 1998); and
- A significant fraction of residential renovation debris is discarded by homeowners into the household trash (Franklin, 1998).

**Table IV-4. Preliminary Assumptions for Percentage of Construction and Demolition Waste Open Burned**

<b>Waste Category</b>	<b>Percentage Open Burned</b>
Total Nonresidential	0 to 5
Residential Renovation	0 to 5
Residential Construction	5 to 10
Residential Demolition	10 to 20

Based on the information presented above, there will likely be a need to categorize emissions into the 4 subcategories shown in Table IV-4. This type of categorization will allow for better spatial allocation at the subcounty level (e.g., through the use of housing unit data at the census tract level, land use spatial surrogates that show the location of residential versus commercial areas).

*Bottom-Up Approach*

A second approach to estimating C&D burning activity requires the development of local data. There are two main methods in which these data could be developed. The first method

would rely on data obtained from C&D debris burning permits. These permits would need to require that permit applicants estimate the amount of debris burned. This information could then be compiled and used as a direct estimate of the amount of C&D debris burned unless there is a significant amount of noncompliance with permitting requirements. In such an instance, a state/local agency would need to extrapolate the total amount of debris burned by applying an expansion factor to the permitted amount. This expansion factor would reflect the estimated level of noncompliance with the C&D debris permitting requirements. The test surveys conducted as part of this project showed that this type of information is largely unavailable. Hence, this alternative would only be used in specific areas where states have identified that the information exists.

A second method for developing local-specific C&D debris burning activity estimates relies on estimates compiled through contacts with local C&D contractors. This method should focus on the largest contractors and the specific activities (e.g., demolition versus construction, residential versus nonresidential) that are expected to predominantly contribute to total C&D debris generation and open burning in a given area. The application of this method will require significant resources. It is only recommended for areas where state agency contacts believe that activity is significant.

#### Emission Factors

No information was identified on the emissions characteristics of open burning of C&D debris as part of this study. In lieu of specific data for this activity, Pechan recommends that emission factors for structure fires be reviewed for potential use in estimating emissions from C&D debris burning.

#### Future Research

Although the open burning of C&D waste is not anticipated to be a significant contributor to total emissions in most communities, Pechan identifies the following areas for future research:

- 1) Test the viability of the top-down emissions activity estimation approaches by (a) reviewing the availability of local data from the information sources used by Franklin Associates to develop national estimates; (b) identifying potential surrogates to allocate national activity to local areas and reviewing the availability of these surrogates for a sample of areas; and (c) refining the assumptions concerning percentage of C&D waste burned. Refinements to these assumptions will likely be made through further mining of the solid waste contacts identified in Table III-6.
- 2) Test both of the bottom-up emissions activity estimation methods for a sample of areas to see how viable the approaches are.
- 3) Conduct a thorough review of the availability of source tests or emission factors for C&D debris burning. If none are located, coordinate with EPA, the National Association of Home Builders, and/or the National Association of Demolition Contractors on potential studies to produce emission source tests for samples of C&D debris.

## **V. DRAFT WORK PLAN**

### **A. Introduction**

This Work Plan includes a recommended Technical Approach to develop an open burning emission inventory for the MANE-VU states. Pechan estimates that the time period required to perform this work will be approximately 9 months in duration (based on 3 months to complete the survey and collect data, 1 month to analyze the data, 3 months to develop and quality assure the emissions inventory, and 2 months to develop a report).

### **B. Technical Approach**

#### **Task 1. Project Management**

Under this task, the contractor will participate in conference calls with MARAMA, monitor the project schedule and budget, and prepare monthly progress reports.

#### **Task 2. Survey of Open Burning Activity**

For states that allow residential MSW or yard waste burning, the contractor will survey a sample of municipalities within each state, using the survey provided in Appendix A. The survey will be administered over the phone, but once the appropriate contact is determined, the survey could be faxed or mailed to the respondent. The sample will include municipalities that are classified as inside urbanized areas, inside urbanized cluster (i.e., suburban), and rural. Within the entire MANE-VU region, the contractor will contact 50 respondents within each of these three areas (150 total), since these areas may tend to be comprised of statistically different populations with respect to open burning activity. Since we are not surveying the actual sources themselves (i.e., households), we would not develop a sample frame per se. Potential respondents will be selected from the contact list provided in Tables V-1 and Appendix B. The contractor will purchase the appropriate Census 2000 STF at the Census block level for all MANE-VU states. This data base will be used to: 1) assign survey responses to specific areas as defined by the Census (inside urbanized areas, inside urbanized cluster, or rural); 2) determine the number of housing units per area for use in developing activity factors; and 3) as a means to track survey responses to ensure adequate coverage of the different geographic areas.

For states that prohibit residential open burning, land clearing debris burning, and C&D debris burning, the contractor will perform an RE survey for these states. The contractor will contact the respondents that responded to the original RE survey and will request them to fill out the updated RE form, revised based on the results of the test survey. The updated RE survey form is included in Appendix C. Additional respondents will be selected from the contact list provided in Tables V-1, V-2, and Appendix B. In addition, RE surveys for local areas will be administered when an activity survey respondent indicates that a rule or regulation has been enacted in their jurisdiction.

The contractor will collect and compile survey results into a data base. The data base will contain fields to correspond to the survey questions to allow for statistical analysis.

**Table V-1. Contacts for Residential Open Burning Activity Questionnaire**

State/Tribe	Activity Survey Contact	List Available?	List Obtained? <sup>1</sup>	Comments
Connecticut	Local open burning officials	Yes	Yes	
Delaware	Local fire officials	Yes	Yes	
District of Columbia	NA	NA		
Maine	Local fire officials	Yes	Yes	
Maryland	County open burning officials	Yes	Yes	Affiliation of contacts not always known
Massachusetts	Local fire officials	Yes	Yes	
New Hampshire	Local fire officials	Yes	Yes	Area code for entire state is 603
New Jersey	NA	Yes	Yes	Addresses only, phone numbers not provided. Phone numbers for select fire stations can be obtained from the Fire and EMS Information Network's website <a href="http://db.fire-ems.net/firedept/deptlist/us/nj">http://db.fire-ems.net/firedept/deptlist/us/nj</a>
New York	Local fire officials	Yes	No	New York Department of Conservation Regional contacts were determined to issue and track permits. Local contacts can be determined from City Connections - New York Municipal Directory at: <a href="http://www.cityconnections.com/ny/nymunvu.html">http://www.cityconnections.com/ny/nymunvu.html</a>
Pennsylvania	Local fire officials	Yes	No	PA Department of Environmental Protection Regional Contacts listed. Local contacts can be determined from following web site with links to town and borough officials that can direct one to appropriate open burning contact. <a href="http://w1.igateway.com/clients1/psab/favorites/display/links.htm">http://w1.igateway.com/clients1/psab/favorites/display/links.htm</a> .
Philadelphia	NA	NA		
Pittsburgh	NA	NA		
Rhode Island	Local fire officials	Yes	Yes	
Vermont	Local fire officials	Yes	Yes	
St. Regis Mohawk	Adrian MacDonald	No		
Penobscot Indian Nation	Local fire officials	Unknown		

NA = Not applicable since open burning for all categories is banned

<sup>1</sup> See Appendix B for specific lists of local open burning and fire protection officials.

**Table V-2. State/Regional Contacts for Open Burning Rule Effectiveness Questionnaire**

<b>State</b>	<b>RE Survey Contact</b>	<b>Affiliation</b>	<b>Address</b>	<b>Phone Number</b>	<b>Fax Number</b>
Connecticut	Brian Kenny, Supervising Air Pollution Control Engineer	CT DEP, Bureau of Air Management, Inspection	79 Elm St., Hartford, CT 06106-5127	(860) 424-3448	(860) 424-4179
Delaware	David Fees, Program Manager, Emission Inventories	Division of Air and Waste Management, Enforcement Section		(302) 739-4791	
District of Columbia	Lt. William F. Guffey	D.C. Fire and Emergency Medical Services Department, Fire Prevention Bureau, Office of the Fire Marshall		(202) 727-1600	(202) 727-3238
Maine	Andrew Mendes	Dept of Conservation, MN Forest Service, Forest Protection Division		(207) 287-2275	
Maryland	Herb Janssen, Section Head	Field Services Division, Air Quality Compliance Program	416 Chinquapin Round Road, Annapolis, MD 21401	(410) 631-3220	(410) 631-3202
Massachusetts	Tom Orszak, Environmental Analyst	Western Regional Office, Department of Environmental Protection	436 Dwight Street, Springfield, MA 01103	(413) 755-2252	(413) 784-1149
Massachusetts	Bureau of Waste Prevention	Central Regional Office, Department of Environmental Protection	627 Main Street, Worcester, MA 01608	(508) 792-7650	
Massachusetts	Tom Natario, Environmental Engineer	Northeast Regional Office, Department of Environmental Protection	205 Lowell Street, Wilmington, Massachusetts 01887	(978) 661-7636	
Massachusetts	Joe Leary, Air Quality Permitting	Southeast Regional Office, Department of Environmental Protection	20 Riverside Drive, Lakeville, MA 02347	(508) 946-2831	
New Hampshire	Chief Robert Nelson	Department of Resources and Economic Development, Division of Forests and Lands		(603) 271-2217, ext. 306	
New Jersey	Field Inspectors	NJ DEP, Northern Field Office	1259 Route 46 - Bldg #2, Parsippany, NJ 07054	(973) 299-7700	
New Jersey	Field Inspectors	NJ DEP, Central Field Office	PO Box 407, Trenton, NJ 08625-0407	(609) 584-4100	
New Jersey	Field Inspectors	NJ DEP, Southern Field Office	2 Riverside Dr., Camden, NJ 08103	(856) 614-3601	
New York	NA				
Pennsylvania	NA				
Philadelphia	Thomas Weir	Philadelphia Air Management Services		(215) 685-9436	
Allegheny County	Roger Westman	Allegheny County Health Department		(412) 578-8111	
Rhode Island	NA				
Vermont	Phil Etter	VT DEC, Inspection and Enforcement		(802) 241-3847	

NA – Not applicable since there are no open burning regulations enacted in these states.

### **Task 3. Control Data Base Development**

The contractor will develop a control data base for all MANE-VU states, at the Census block, Census block group, or Census tract level. The contractor will establish what spatial level of detail is required after obtaining and examining the 2000 Census data on rural and urban housing unit classification. This data base will be used as the basis to record state or local ordinances identified to control open burning in an area, either year round or for a specific season. Control efficiencies will be assigned to these areas to reflect either a ban (assume 100 percent) or the requirement to use a control that reduces emissions (e.g., an air curtain destructor or blower for land clearing burning). This data base will also contain information on the RE and RP value for any rules that apply to a specific geographic area as determined by the RE and activity survey under Task 2.

### **Task 4. Emissions Inventory Development**

For residential MSW and yard waste burning, the contractor will start with the results of the survey performed under Task 2 and perform the following steps:

Step 1 – Assemble the survey data by geographic area.

Step 2 – Statistically analyze the data to determine if there are statistically distinct open burning activities occurring in rural, suburban, and urban areas (e.g., using ANOVA). Depending on the robustness of the survey data, an analysis will also be performed to determine if statistically distinct differences occur between states or groups of states.

Step 3 – Develop activity estimates for each distinct area (e.g., mass of waste burned per household, or fraction of households that burn). The activity estimate should be the best estimate of central tendency for the distribution of survey responses for each area (e.g., arithmetic mean, median, geometric mean).

Step 4 – Calculate emissions for each distinct area based on the activity factor, the number of single-family households in that area, a waste generation factor per household (either from the survey or external to the survey), and emission factors.

Using the control data base developed under Task 3 of work plan, controlled emission estimates will be developed for those areas with open burning prohibitions or controls. By matching on state, county, and appropriate subcounty identifier, CE, RE, and RP values will be applied as appropriate.

For land clearing debris burning, the contractor will estimate uncontrolled emissions using EPA's NEI as the basis. Information on local controls and CE values, contained in the data base developed under Task 3, will be applied to the uncontrolled emissions. Rule effectiveness and RP values, if applicable, will also be accounted for. Emissions will be allocated to the subcounty level using data identified by MANE-VU state contacts for allocating emissions to the subcounty level (e.g., data related to new construction or housing starts at the census tract level, municipal level, or similar information). In the event that no information is found by a state contact for

subcounty allocation of emissions, the contractor will use housing unit data from the 1990 and 2000 census to allocate activity based on the change in number of housing units between the two data sets (activity would not be allocated to inside urban areas).

Construction/demolition waste open burning emissions will be estimated using a top-down method adjusted for known local practices or prohibitions. This will involve accounting for open burning regulations and allocating activity to the subcounty level as mentioned for land clearing debris burning above. In addition, percentages or amounts of C&D waste burned may be refined through further discussions with solid waste contacts identified in Table III-6.

Source classification codes (SCCs) will be assigned for each open burning category based on the most current EPA SCC list. SCCs for yard waste burning and land clearing debris burning have recently been added to EPA's official SCC list. For C&D waste burning, the contractor will propose one or more SCCs for States to use in reporting emissions.

Once activity estimates are developed for each SCC, emission factors will be taken from the EIIP document for open burning. The contractor will establish whether any new emission testing for these sources has taken place and will evaluate the data. Finally, some land clearing debris burning requires the use of an air curtain destructor. The contractor will need to research the appropriate CE or controlled emission factor to assume for the use of these devices.

The inventory will include annual and seasonal emission estimates for criteria pollutants and for hazardous air pollutants (HAPS) where emission factors are available. Seasonal estimates for each category will be estimated based on available temporal information obtained from Task 2.

### **Task 5. Reporting**

Once the survey of local officials for residential open burning has been conducted, the contractor will summarize the survey results in a report. The report will present a tabulated summary of the survey results, and will describe how the results will be applied to the remaining non-surveyed areas.

The contractor will submit draft inventory files in a format prescribed by MARAMA. A draft final report will be prepared in Microsoft Word<sup>®</sup> format to describe how the emission estimates were ultimately developed for each state and for each category.

After receiving comments from MARAMA, the contractor will prepare final inventory data bases and will revise the final report. The contractor will also post the results of the survey on the contractor's web site. The contractor will also provide links at this web site relative to what the public can do to reduce air pollution. Links of interest will be provided by the contractor, as well as MARAMA and MANE-VU state staff.

## VI. REFERENCES

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## **APPENDIX A - SURVEY INSTRUMENT**

## PART 1. INTRODUCTION

We are calling on behalf of the State of <name of state> and the Mid-Atlantic/Northeast Visibility Union. The purpose of our call is to ask you some questions concerning open burning activity in your jurisdiction for the year 2001.

1. *Are you knowledgeable about open burning rules, violations, or, and activity within your area?* Y/N

If Y, go to Question #2.

*If N, do you know what local agency tracks open burning regulations and open burning violations?*  
Y/N

If Y, request contact information.

2. *Please indicate whether you can provide information on the following categories of open burning:*

Household waste burning Y/N

Yard waste burning Y/N

Land clearing debris burning Y/N

Construction/demolition debris burning Y/N

NOTE: It may be that there are multiple contacts for obtaining information on the various open burning categories. For example, a contact that can provide information on household waste burning may not be familiar with land clearing debris burning. If the respondent answers N to any of the above categories, request the appropriate contact/agency. If Y to any of the above categories, go to Question 3.

3. *What county are you located in?* \_\_\_\_\_

4. *What specific jurisdiction(s) do you serve?* \_\_\_\_\_

5. *What is the approximate population of the jurisdiction that you serve?* \_\_\_\_\_

6. *Does your jurisdiction have any specific rules or ordinances pertaining to open burning other than a statewide rule?* Y/N

If Y, please specify.

For each rule mentioned above, ask:

- 6a. *Does your rule apply to specific seasons or months of the year?* Y/N

If Y, please provide time period for the rule.

**6b.** *Does the rule apply to a specific area within your jurisdiction? Y/N*

If Y, please describe.

**6c.** *Are there any exemptions from the rule? Y/N*

If Y, please describe.

**6d.** *Is the rule based on a model rule developed by the state? Y/N*

If N, please describe how it differs.

Depending on what categories the respondent is familiar with, as indicated by Question 2, proceed to the appropriate category-specific Part(s) of the survey and ask the respondent all survey questions related to an individual category.

***PART 2. HOUSEHOLD WASTE BURNING ACTIVITY***

***PART 3. BRUSH OR LEAF WASTE BURNING ACTIVITY***

## PART 2. HOUSEHOLD WASTE BURNING ACTIVITY

1. *What is your estimate of the number of households that burn household waste or trash in your jurisdiction?*

\_\_\_\_ number (or percentage) \_\_\_\_ don't know

NOTE: The response may be based on the respondent's knowledge of burning practices, or based on the number of permits if permits are issued. If open burning is not allowed, this may be based on the number of households conducting illegal burns.

2. *If your jurisdiction covers a combination of urban, suburban and/or rural areas, can you provide an estimate of the activity that is occurring in one area versus the other?*

Rural \_\_\_\_ Number or percentage of households burning

Suburban \_\_\_\_ Number or percentage of households burning

Urban \_\_\_\_ Number or percentage of households burning

3. *Please estimate how frequently households burn household waste.*

\_\_\_\_ times per \_\_\_\_ time period (e.g., day, month, year) \_\_\_\_ don't know

4. *Does this frequency vary for urban, suburban or rural areas that may be within your jurisdiction?*  
Y/N If Y, please explain.

5. *What would you estimate is the average amount of waste per burn?* \_\_\_\_ amount (e.g., pounds, portion of a burn barrel) \_\_\_\_ don't know

6. *What percentage of burning is conducted in:*

Winter (December, January, February)? \_\_\_\_

Spring (March, April, May)? \_\_\_\_

Summer (June, July, August)? \_\_\_\_

Autumn (September, October, November)? \_\_\_\_

Don't know \_\_\_\_

7. *Does the jurisdiction have a municipal trash collection service?* Y/N

8. *Does the jurisdiction have a transfer station?* Y/N

9. *Does the jurisdiction provide any other waste disposal options (e.g., recycling)?* Y/N  
If Y, what are they?

10. *Are you familiar with open burning practices of surrounding jurisdictions?* Y/N  
*Are they similar to or different than your jurisdiction?* Similar/different  
If different, please explain.

**PART 3. BRUSH OR LEAF WASTE BURNING ACTIVITY**

NOTE: Based on the test survey, many state or local respondents could not make a distinction between brush and leaf waste burning activity. If leaf waste burning is allowed in a jurisdiction, each question for brush waste should be followed with the question: “Does this hold for leaf waste burning as well?” If response is No, ask question for leaf burning. The one question that will likely generate different responses is Question 6, which addresses seasonal variations in activity.

1. What is your estimate of the number of households that burn brush waste in your jurisdiction?  
 \_\_\_\_ number (or percentage) \_\_\_\_ don't know

NOTE: The response may be based on the respondent's knowledge of burning practices, or based on the number of permits if permits are issued. If open burning is not allowed, this may be based on the number of households conducting illegal burns.

2. If your jurisdiction covers a combination of urban, suburban and/or rural areas, can you provide an estimate of the activity that is occurring in one area versus the other?

Rural \_\_\_\_ Number or percentage of households burning  
 Suburban \_\_\_\_ Number or percentage of households burning  
 Urban \_\_\_\_ Number or percentage of households burning

3. Please estimate how frequently households burn brush waste.  
 \_\_\_\_ times per \_\_\_\_ time period (e.g., day, month, year) \_\_\_\_ don't know
4. Does this frequency vary for urban, suburban or rural areas that may be within your jurisdiction?  
Y/N If Y, please explain.
5. What would you estimate is the average amount of brush waste per burn? \_\_\_\_ amount (e.g., pounds, cubic feet) \_\_\_\_ don't know

6. What percentage of yard waste burning is conducted in:

	<u>For Brush Waste</u>	<u>For Leaf Waste</u>
Winter (December, January, February)? ____	_____	_____
Spring (March, April, May)? ____	_____	_____
Summer (June, July, August)? ____	_____	_____
Autumn (September, October, November)? ____	_____	_____
Don't know ____		

NOTE: The following questions are intended to establish whether the municipality conducts centralized burns.

7. Are there any municipal burnings of brush or leaf waste where the waste is collected from households and transferred to a central location to be burned? Y/N If Y, go to Question 8. If N, go to Question 13.
8. Does your agency issue permits for each municipal burn? Y/N If N, go to Question 11.
9. Please indicate whether your permits include the following:

Amount of waste burned Y/N \_\_\_\_ don't know  
Composition of waste burned Y/N \_\_\_\_ don't know  
Date of burn Y/N \_\_\_\_ don't know  
Duration of burn Y/N \_\_\_\_ don't know

10. *May we obtain copies of the permits or any summaries of the permit data that you maintain?* Y/N

NOTE: Depending on what information is established to be included in the permit, the surveyor may or may not need to ask Questions 11 and 12.

11. *What is your estimate of the number of municipal brush waste burns?*  
\_\_\_\_ number \_\_\_\_ don't know

12. *What is your estimate of the average fuel loading for all municipal burns?*  
\_\_\_\_ amount per burn \_\_\_\_ don't know

13. *Does your jurisdiction provide any other waste disposal options for brush waste?* Y/N  
If Y, what are they?

14. *Are you familiar with open burning practices of surrounding jurisdictions?* Y/N  
*Are they similar to or different than your jurisdiction?* Similar/different  
If different, please explain.

## **APPENDIX B - LIST OF CONTACTS**



## APPENDIX C - RULE EFFECTIVENESS EVALUATION FORM

Name/Title \_\_\_\_\_

Jurisdiction \_\_\_\_\_

Contact Information \_\_\_\_\_

Open Burning Category \_\_\_\_\_

NOTE: Survey administrator should fill in prior to sending to respondent if you know which open burning category the rule covers. Otherwise, explain to the respondent that you are trying to get information for each category-specific rule.

The following questions are multiple choice questions, in which scores are assigned depending on the response. Each question has a certain point value associated with it. The point values are then summed to estimate rule effectiveness.

If the respondent cannot answer the questions readily over the phone without checking in their agency files, you may want to provide the respondent the option of answering the survey electronically, and send it to them via email.

**1.** *What has been the nature and extent of source education on requirements of the regulation? (Please indicate all that apply.)*

- |                          |  |     |
|--------------------------|--|-----|
| <input type="checkbox"/> | Individual mailings on compliance requirements                 | (7) |
| <input type="checkbox"/> | Educational opportunities for general public or municipalities | (7) |
| <input type="checkbox"/> | General notices in newspapers                                  | (3) |
| <input type="checkbox"/> | Inform public on state/regional agency website                 | (3) |
| <input type="checkbox"/> | None   | (0) |
| Score _____              |  |     |

For the following questions, please indicate the most appropriate response from the choices provided after each question. A question only needs to be answered if your jurisdiction has a rule prohibiting or regulating the specific open burning category indicated in bold.

**2a.** *For **residential municipal solid waste**, what percentage of households in your jurisdiction violate an open burning rule or regulation annually?*

- |                          |               |      |
|--------------------------|---------------|------|
| <input type="checkbox"/> | <1 percent    | (50) |
| <input type="checkbox"/> | 1-10 percent  | (40) |
| <input type="checkbox"/> | 10-20 percent | (30) |
| <input type="checkbox"/> | 20-50 percent | (20) |
| <input type="checkbox"/> | 50-80         | (10) |
| <input type="checkbox"/> | >80           | (0)  |
| Score _____              |               |      |

**2b. For residential yard waste burning, what percentage of households in your jurisdiction violate an open burning rule or regulation annually?**

- \_\_\_\_\_ <1 percent (50)
  - \_\_\_\_\_ 1-10 percent (40)
  - \_\_\_\_\_ 10-20 percent (30)
  - \_\_\_\_\_ 20-50 percent (20)
  - \_\_\_\_\_ 50-80 (10)
  - \_\_\_\_\_ >80 (0)
- Score \_\_\_\_\_

**2c. For land clearing debris burning, what percentage of activity in your jurisdiction violate an open burning rule or regulation annually?**

- \_\_\_\_\_ <1 percent (50)
  - \_\_\_\_\_ 1-10 percent (40)
  - \_\_\_\_\_ 10-20 percent (30)
  - \_\_\_\_\_ 20-50 percent (20)
  - \_\_\_\_\_ 50-80 (10)
  - \_\_\_\_\_ >80 (0)
- Score \_\_\_\_\_

**2d. For construction/demolition waste burning, what percentage of activity in your jurisdiction violate an open burning rule or regulation annually?**

- \_\_\_\_\_ <1 percent (50)
  - \_\_\_\_\_ 1-10 percent (40)
  - \_\_\_\_\_ 10-20 percent (30)
  - \_\_\_\_\_ 20-50 percent (20)
  - \_\_\_\_\_ 50-80 (10)
  - \_\_\_\_\_ >80 (0)
- Score \_\_\_\_\_

**3. Does your jurisdiction maintain and publicize a call-in number to handle or respond to complaints about illegal or questionable open burning incidents?**

- \_\_\_\_\_ Yes (10)
  - \_\_\_\_\_ No (0)
  - \_\_\_\_\_ Don't know (0)
- Score \_\_\_\_\_

**4a.** *For residential burning, have follow-up inspections been made on households for which citizens have placed complaints?*

- \_\_\_\_\_ Not applicable since no households have been found to be out of compliance (10)
- \_\_\_\_\_ Yes, in 100 percent of the cases (10)
- \_\_\_\_\_ Yes, in 50 to 99 percent of the cases (5)
- \_\_\_\_\_ Yes, in <50 percent of the cases (2)
- \_\_\_\_\_ Never (0)
- \_\_\_\_\_ Don't know (0)

Score \_\_\_\_\_

**4b.** *For commercial burning, have follow-up inspections been made on activity for which citizens have placed complaints?*

- \_\_\_\_\_ Not applicable since no activity have been found to be out of compliance (10)
- \_\_\_\_\_ Yes, in 100 percent of the cases (10)
- \_\_\_\_\_ Yes, in 50 to 99 percent of the cases (5)
- \_\_\_\_\_ Yes, in <50 percent of the cases (2)
- \_\_\_\_\_ Never (0)
- \_\_\_\_\_ Don't know (0)

Score \_\_\_\_\_

**5a.** *For residential burning, has formal documented enforcement action been taken against households found to be out of compliance?*

- \_\_\_\_\_ Not applicable since no households have been found to be out of compliance (10)
- \_\_\_\_\_ Yes, for all noncomplying sources (10)
- \_\_\_\_\_ Yes, in 50 to 99 percent of the cases (5)
- \_\_\_\_\_ Yes, in <50 percent of the cases (2)
- \_\_\_\_\_ Never (0)
- \_\_\_\_\_ Don't know (0)

Score \_\_\_\_\_

**5b.** *For commercial burning, has formal documented enforcement action been taken against activity found to be out of compliance?*

- \_\_\_\_\_ Not applicable since no activity have been found to be out of compliance (10)
- \_\_\_\_\_ Yes, for all noncomplying sources (10)
- \_\_\_\_\_ Yes, in 50 to 99 percent of the cases (5)
- \_\_\_\_\_ Yes, in <50 percent of the cases (2)
- \_\_\_\_\_ Never (0)
- \_\_\_\_\_ Don't know (0)

Score \_\_\_\_\_

After the questionnaire has been completed, total the scores to determine rule effectiveness for each category. Only one category-specific score should be used from Questions 2, 4, and 5 to determine the total score.

TOTAL SCORE: \_\_\_\_\_ = RE  
(100 points maximum)