Appendix H.4

Pechan, *Development of Growth and Control Inputs for CENRAP 2018 Emissions Draft Technical Support Document* (May 2005).

DEVELOPMENT OF GROWTH AND CONTROL INPUTS FOR CENRAP 2018 EMISSIONS DRAFT TECHNICAL SUPPORT DOCUMENT

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TABLES AND FIGURES

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ACRONYMS AND ABBREVIATIONS

AEO	*Annual Energy Outlook*
AIM	architectural and industrial maintenance
BPA	Beaumont/Port Arthur
CENRAP	Central Regional Air Planning Association
CO	carbon monoxide
CTG	control techniques guideline
DFW	Dallas/Ft. Worth
DOE	U.S. Department of Energy
EGAS	Economic Growth Analysis System
EGUs	electricity generating units
FIFRA	Federal Insecticide Fungicide and Rodenticide Act
HAPs	hazardous air pollutants
HGA	Houston/Galveston Area
IPM	Integrated Planning Model
MERR	mobile equipment repair and refinishing
NAAQS	National Ambient Air Quality Standards
NH_3	ammonia
NO_x	oxides of nitrogen
NSPS	New Source Performance Standards
O_2	oxygen
OSD	ozone season daily
Pechan	E.H. Pechan & Associates, Inc.
PM	particulate matter
PM_{10}	particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers
$PM_{2.5}$	particles with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers
REMI	Regional Economic Models, Inc.
RIA	Regulatory Impact Analysis
RPOs	Regional Planning Organizations
RVP	Reid vapor pressure
SCCs	source classification codes
SIP	State Implementation Plan
SO_x	sulfur oxides
STI	Sonoma Technology, Inc.
TCEQ	Texas Commission on Environmental Quality
TSD	Technical Support Document
USDA	U.S. Department of Agriculture
VMT	vehicle miles traveled
VOC	volatile organic compound

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CHAPTER I. INTRODUCTION

The purpose of this project was to prepare emission growth and control factors that can be applied to the Central Regional Air Planning Association (CENRAP) 2002 base year emission inventory to obtain a 2018 emissions inventory for the CENRAP region. The CENRAP region includes the States and Tribal areas of Arkansas, Iowa, Kansas, Louisiana, Minnesota, Missouri, Nebraska, Oklahoma, and Texas. In addition to the CENRAP States, additional factors were compiled under this project to include the entire CENRAP modeling domain. This includes projected emissions data or projection year growth and control factor data from the other Regional Planning Organizations (RPOs), Canada, and Mexico. All data products were prepared in SMOKE-compatible format.

These projection year growth and control factor data will be used to support air quality modeling and State Implementation Plan (SIP) development and implementation activities for the regional haze rule and fine particulate matter (PM) and ozone National Ambient Air Quality Standards (NAAQS). The data are applicable to all source categories and pollutants included in the CENRAP 2002 emission inventory. This includes the following pollutants: sulfur oxides (SO_x), oxides of nitrogen (NO_x), volatile organic compounds (VOC), carbon monoxide (CO), ammonia (NH_3), and particles with an aerodynamic diameter less than or equal to a nominal 10 and 2.5 micrometers (i.e., primary PM_{10} and $PM_{2.5}$).

This Technical Support Document (TSD) explains the data sources that E.H. Pechan & Associates, Inc. (Pechan) used and the procedures Pechan followed in developing the necessary growth and control data for this project. Appendix A of this document contains the Methods Document that was prepared under this project. The purpose of this TSD is not to duplicate the information contained in that document, but to supplement it with the actual data obtained under this project and to note areas where the methods were modified from those included in the Methods Document. Chapter II of this document presents information on the control factors and growth factors that Pechan developed for the CENRAP States. The methods are presented separately for each of the major source categories. Chapter III of this document presents the data sources and methods that Pechan used to compile the data for areas outside of the CENRAP States, including other RPOs and Canada and Mexico. Issues of concern are discussed in Chapter IV and references are included in Chapter V. Appendix A contains the Methods document prepared for this project and Appendix B contains the Quality Assurance Project Plan for this work.

This TSD is accompanied by a set of SMOKE-formatted modeling files, as well as a set of State-level Excel spreadsheets. The State spreadsheets are included for area source controls, point source controls, VMT growth, area and point source growth factors, and nonroad emissions. These spreadsheets summarize data contained in the modeling files, in a more readable format. The control files also contain 2002 emissions, in most cases, so that the effects of the controls can be estimated, using the 2002 emissions as a base (e.g., without the growth factors applied). These spreadsheets can be used by the States to review the inputs to the SMOKE modeling in more detail and can be used to help in quality assuring the emissions calculated by the SMOKE model.

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CHAPTER II. DEVELOPMENT OF GROWTH AND CONTROL FACTORS FOR THE CENRAP STATES

A. DEVELOPMENT OF GROWTH FACTORS FOR NON-EGU POINT AND AREA SOURCES

This chapter identifies the data sources and methods that Pechan used to develop point and area source emission activity growth factors to support 2018 emission projections for CENRAP. Table II-1 identifies the Regions and States for which Pechan developed emission activity growth factors. It is important to note that this section describes the development of growth factors for all point and area sources in the CENRAP base year inventory. For the EGU sector, CENRAP will be using emission data projected by the Integrated Planning Model (IPM). These IPM projections are not expected to be completed until late in the summer of 2005. Because these data were not available at the time Pechan prepared the point source growth factors, the growth factors Pechan prepared included growth factors for all EGU source classification codes (SCCs) that were included in the base year inventory as described in this section. When the IPM model runs are completed, the IPM-based emissions should overwrite EGU emissions projected with these growth factors. As such, these EGU growth factors should be considered as temporary placeholders.

Table II-1. Regions and States Included in Emission Activity Growth Factor Files

Region	States	Region	States	Region	States
CENRAP	Arkansas	MANE_VU	Connecticut	Midwest RPO	Indiana
	Iowa		District of Columbia		Illinois
	Kansas		Delaware		Michigan
	Louisiana		Massachusetts		Ohio
	Minnesota		Maryland		Wisconsin
	Missouri		Maine		
	Nebraska		New Hampshire		
	Oklahoma		New Jersey		
	Texas		New York		
			Pennsylvania		
			Rhode Island		
			Vermont		

NOTE: growth factors are also included for offshore emission source categories located in the Gulf of Mexico.

In addition to all point and area source categories, it was necessary to develop growth factors for the following nonroad source categories because they are not included in EPA's NONROAD model: railroads, commercial marine vessels, and aircraft.

To identify the State/County/SCC combinations for which growth factors are required, Pechan summarized the CENRAP 2002 base year inventory (Pechan and CEP, 2005) and the base year inventories for MANE-VU and Midwest RPO available from CENRAP's visibility modeling website (CENRAP, 2005).[1] A zip file containing all of the data files titled “NonCENRAP States Inventory SMOKE Input Files” was available at CENRAP’s website (see Table II-2 for list of files contained in the zip file). Because some of these files provide information for States outside of the geographic area of interest, the State/County/SCC summary did not include all of the States reported in these non-CENRAP State files.

Table II-2. Base Year Inventory Files for Non-CENRAP States

File Name	Contents
arinv_nei02_032404_MW_MVU_NOnh3.ida.txt	Midwest RPO and MANE-VU area sources excluding agriculture-related ammonia SCCs and fugitive dust emissions
ar_dust_phaseii_22mar04_USnoCENRAP.ida	U.S. fugitive dust inventory (excluding road dust)
nr_2002_23mar04_MW_MVU.ida	CENRAP, Midwest RPO, and MANE-VU 2002 nonroad mobile inventory
rdinv.pvd_US_${season}02_ida.txt	U.S. annual 2002 paved road dust inventory
rdinv.unp_US_${season}02_ida.txt	U.S. seasonal 2002 unpaved road dust inventory
ptinv_2002NEI_041504_MW_MVU.ida.txt	CENRAP, Midwest RPO, & MANE-VU point source inventory

In addition to the CENRAP web-site files noted above, Pechan was supplied with a separate file that listed SCCs used to report agriculture-related ammonia emissions in the non-CENRAP States (Omary, 2005). Because this file did not contain any geographic identifiers, Pechan developed a comprehensive list of MANE-VU and Midwest RPO State/SCC combinations that may exist in each region’s base year inventory.[2]

The following sections describe the data and methods that were used to prepare emission activity growth factors for the State/County/SCC combinations of interest.

1. Overview

For most source categories, Pechan developed default emission activity growth factors utilizing data and methods that are expected to be incorporated into the final Economic Growth Analysis System (EGAS) Version 5.0. CENRAP selected EGAS 5.0-based growth factors over the growth factors available from EGAS 4.0 because the EGAS 5.0 growth factors will be based on the latest set of economic/demographic projections developed by Regional Economic Models, Inc. (REMI) and the latest energy forecasts prepared by the U.S. Department of Energy (DOE) (Houyoux, 2004; DOE, 2004). In addition, the crosswalk between SCCs and emission activity

[1] Note that projections/growth factors for the following regions were not developed because they were available from other studies: Visibility Improvement State and Tribal Association of the Southeast (VISTAS) and Western Regional Air Partnership (WRAP).

[2] Except for oil and gas production, Pechan did not have access to offshore-specific projections data. Therefore, Pechan assumed that Texas area growth factors could be used to represent growth in all offshore non-oil and gas production SCCs.

growth indicators and the regression equations relating socioeconomic indicators to emission activity levels will both be refined in EGAS 5.0. Furthermore, the REMI economic models in EGAS 5.0 allocate national economic activity based on relative production costs at the 53-sector level rather than the 14-sector level used in EGAS 4.0. Local relative factor costs may be substantially different for a given detailed industry within one of the 14-sectors included in the REMI models in EGAS Version 4.0. However, the 14-sector models cannot model this distinction, since they are constrained by data specified at this level of detail. More accurate regional forecasts result from the more detailed representation of relative cost competitiveness that is available from the EGAS 5.0 REMI models.

Because EGAS represents a default set of growth factors, Pechan investigated alternatives to the EGAS default indicators for the highest-emitting point, nonpoint, and nonroad SCCs in the base year inventory for the CENRAP States.[3] Based on this review, Pechan identified a number of alternatives that were deemed preferable to the EGAS defaults, including:

- Use of regression equations developed for EGAS 5.0, but not incorporated into the beta version (for architectural coating and commercial pesticide application SCCs);[4]
- Replacement of suspect beta EGAS 5.0 growth factors with values deemed to be more reasonable;[5]
- Use of county-level population projections available from each State in the CENRAP region;
- Use of *Annual Energy Outlook* (AEO) projections (for oil and gas production SCCs);
- Use of average historical values (for prescribed burning SCCs);
- Extrapolation of historical trend (for unpaved road SCCs);
- Use of United States Department of Agriculture (USDA) projections of planted acreage for major crops (for crop tilling SCCs);
- Use of onroad vehicle miles traveled projections (for paved road SCCs); and
- Use of USDA livestock projections (for swine, cattle and calves, and poultry SCCs).

[3]Note that this discussion only applies to nonroad SCCs that are not included in the NONROAD model. A separate Pechan memorandum addressed refinements to the NONROAD model default growth information.

[4]The current EGAS 5.0 design does not support incorporation of some of the emission activity forecasting equations that Pechan developed for use in EGAS 5.0.

[5]The beta version of EGAS 5.0 has not yet undergone beta testing to identify/fix suspect values.

Further details on these emission activity growth surrogates are provided in the following section.

2. Alternative Forecast

There are a number of problems and shortcomings of the beta version of EGAS 5.0 that was available during this project's period of performance. Although some of these limitations were known at the time the beta version was released in November 2004 (see http://www.epa.gov/ttn/ecas/EGAS5limitations.pdf), a number of additional problems have since been identified. Therefore, except as noted below, point and non-point source emission projections rely on the methods and data that are expected to be incorporated into the final version of EGAS 5.0 rather than the information in the beta version. The following subsections summarize differences between the information developed for this effort and the EGAS 5.0 beta version.

a. Use of Regression Equations Not Yet Incorporated into EGAS

For certain sectors, Pechan utilized regression equations developed for EGAS 5.0, but not incorporated into the beta version. For the SCCs displayed in Table II-3, Pechan replaced the beta EGAS 5.0 growth factors based on REMI socioeconomic data with growth factors derived from the emission estimation approaches developed for EGAS 5.0 that have yet to be incorporated. The following sections identify the emission activity forecasting methods that were applied to these SCCs.[6]

Table II-3. Additional Source Categories Utilizing Regression Equation Approach

SCC	SCC Description
2401001000	Solvent Utilization; Surface Coating; Architectural Coatings; Total: All Solvent Types
2461800000	Solvent Utilization; Miscellaneous Non-industrial: Commercial; Pesticide Application: All Processes; Total: All Solvent Types
2810030000	Miscellaneous Area Sources; Other Combustion; Structure Fires; Total

i. Architectural Coating

To estimate growth factors representing the future year to base year change in volume of architectural coatings consumed, Pechan developed the following equation by regressing national coating shipments over the period 1981-2001 against data for a number of potential explanatory variables:

$$y = b_0 + b_1 * x + b_2 * LAG(y) \quad \text{(Eq. 1)}$$

[6]Note that there may be other SCCs for which the final version of EGAS 5.0 will incorporate additional regression equations. Pechan will update the growth factor files to reflect the latest available information as to the list of SCCs for which the final EGAS 5.0 will utilize the approaches identified in this section.

where:

y	=	ratio of current year architectural coating shipments to base year shipments
b_0	=	-0.017
b_1	=	0.614
b_2	=	0.437
x	=	current year housing expenditures
LAG(y)	=	ratio of previous year's architectural coating shipments to base year shipments.

This equation is not incorporated into the beta EGAS 5.0 because the program currently does not support equations with lagged variables. In addition to the total volume of coatings used, it is important to reflect any projected change in the solvent content of these coatings because the emission activity for these SCCs is the amount of solvent emitted from these coatings. Therefore, Pechan recommended that EPA incorporate factors into EGAS 5.0 that reflect the projected future year architectural coating solvent content relative to base year solvent content (Pechan, 2004). Although these factors are not incorporated into the beta EGAS 5.0, they are expected to be included in the final EGAS 5.0. Therefore, Pechan obtained data representing the proportion of forecast year total and 2002 total architectural paints shipments that are solvent-based from the Freedonia Group, Inc. (Freedonia, 2002). Based on the available forecast information, Pechan applied a factor of 0.729 to the 2018 growth factor developed from the output of equation 1 for each State. The Freedonia data were reported for 1992 and each fifth year over the period 1996 to 2011. Pechan interpolated between the 2001 and 2006 values to obtain a 2002 value and used the 2011 value for 2018 in lieu of any forecast information beyond 2011.

ii. Commercial Pesticide Application

To estimate the amount of commercial pesticides applied, Pechan computed the following equation by regressing the national volume of active pesticide ingredients applied over the period 1980-1999 against data for a number of potential explanatory variables:

$$LOG(y) = b_0 + b_1 * LAG\,(LOG(y)) + b_2 * LOG(x) \quad \text{(Eq. 2)}$$

where:

LOG(y)	=	ratio of current year log of volume of active pesticide ingredients to base year log of volume of ingredients
b_0	=	-0.003
b_1	=	0.480
b_2	=	0.334
x	=	current year Agricultural Chemicals sector (SIC code 287) employment
LAG(LOG(y))	=	ratio of previous year's log of volume of active pesticide ingredients to base year's log of volume of ingredients.

This equation is not incorporated into the beta EGAS 5.0 because the program currently does not support equations with lagged variables. It is important to reflect any projected change in the solvent content of the pesticides. Therefore, Pechan recommended that EPA incorporate factors into EGAS 5.0 that reflect the ratio of future year volume of solvents per dollar of Agricultural Chemical sector shipments to base year volume of solvents for these shipments (Pechan, 2004). Although these factors are not incorporated into the beta EGAS 5.0, they are expected to be included in the final EGAS 5.0. Therefore, Pechan obtained data representing the proportion of forecast year and 2002 volume of solvents per dollar of Agricultural Chemicals sector shipments from the Freedonia Group, Inc. (Freedonia, 2003). Based on the available forecast information, Pechan applied a factor of 1.048 to the 2018 growth factor developed from the output of equation 2 for each State. Freedonia's solvent content data were reported for each fifth year over the period 1992 to 2012, including 2002. In lieu of any forecast information beyond 2012, Pechan used the 2012 value to represent 2018.

iii. Structure Fires

EPA acknowledges that the structure fires forecast methodology/data were not properly incorporated into the beta version of EGAS 5.0. Therefore, Pechan replaced the beta EGAS 5.0 structure fire growth factors to follow the two-step approach that Pechan developed for use in EGAS 5.0, and, which is expected to be incorporated into the final EGAS 5.0 (Pechan, 2004). This approach relies on an equation that relates the number of housing units to housing expenditures and factors representing the projected change in the number of structure fires per 10,000 housing units. For this study, Pechan applied a factor of 0.905 to the housing unit projections that represents the change in structure fires per 10,000 housing units between 2002 and 2018.

b. Revisions To Beta EGAS 5.0 Regression-Based Growth Factors

Because the EGAS 5.0 emission activity projection equations were developed using national historical data, it is unclear if the EGAS 5.0 equation growth rates will appear reasonable when incorporating State-level values into each equation. Therefore, Pechan reviewed the output for each State to identify potentially anomalous growth factors. Pechan selected growth factors of 2 and 0.2 to represent thresholds in determining suspect values. In cases where State-level values were deemed to be questionable, Pechan implemented one of two types of refinements, depending on the number of States for which the equation-based approach resulted in suspect growth rates. The following summarizes the two types of refinements that were applied.

The first refinement, which was used when the equation output appeared questionable for many States, was to use a combination of national and State REMI data. This approach first projects national growth factors up through 2009 by inputting <u>national</u> values of the independent variable in the emission activity equation. The 2009-2018 national growth rates were estimated using methods that were unique for each source category.[7] Pechan developed State-level growth factors by multiplying the national equation-based factors by ratios representing each State's

[7] Post-2009 growth factors were not projected using the equation-based approach because of concerns that the estimated national post-2009 growth rates appear to be unsustainable.

growth relative to National growth for the REMI indicator used in the regression equation. Section a below provides further details on this projection approach.

The second refinement, which was applied to a few specific States when the State-level equation output appeared reasonable in most cases, was to use the State-level output of the equation only up through either 2007 or 2009. The 2018 growth factors were estimated for these States by extrapolating each State's projected growth over the 2002 to 2007/9 timeframe using an exponential curve fitted to the data for this period. Further details on this refinement are provided in Section ii below.

i. National Equation-Based Growth Factors

For three source categories – Consumer/Commercial Solvents: All Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) Related Products; Surface Coating: Miscellaneous Manufacturing; and Consumer/Commercial Solvents: All Coatings and Related Products, the use of State-level REMI forecasts in the nationally-derived emission activity estimation equations results in numerous anomalous growth rates. For these source categories, Pechan first utilized national REMI projections in the emission activity equations. Because of the dramatically higher growth/decline predicted after 2009, Pechan used the regression equation to directly develop national growth factors only through 2009.

Consumer/Commercial Solvents: All FIFRA Products

The 2009 national growth factor was held constant through 2018 for this category because the emission activity equation first predicted a continuation of the historical decline in activity for this category through 2009, then forecasted an increase in activity that was uncharacteristically large by 2018. Because of the uncertainty of the predicted post-2009 trend, Pechan held the 2018 national growth factor constant at 2009 levels. Pechan developed State-level growth factors for this category by multiplying the national growth factors by State/National growth factor ratios. These ratios were determined using State/National projections for the REMI indicator (population) that was included in the emission activity equation.

Surface Coating: Miscellaneous Manufacturing and Consumer/Commercial Solvents: All Coatings

To estimate national 2018 growth factors for each of these two categories, Pechan reduced each national post-2009 annual growth rate, as estimated by each emission estimation equation, by one-half. This adjustment factor was used because it resulted in post-2009 growth rates that approximated those predicted over the 2002-2009 period. Pechan developed State-level growth factors by multiplying the national growth factors by State/National growth factor ratios. These ratios were determined using State/National projections for the REMI indicators that were included in each regression equation (value added in Miscellaneous Manufacturing Industries sector and value added in Chemicals and Allied Products sector).

ii. State Equation-Based Growth Factor Changes

Sulfite Pulping

The use of State-level REMI forecasts in the nationally-derived Sulfite Pulping emission activity equation resulted in uncharacteristically large post-2009 growth rate changes in the District of Columbia. For DC, Pechan used the output of the regression equations up through 2009; 2018 growth factors were developed by extrapolation using an exponential curve fitted to the 2002-2009 growth factor projections.

Electronic and Other Electrical Surface Coating

For Iowa, the use of State-level REMI forecasts in the nationally-derived Electronic and Other Electrical emission activity equation resulted in unusually large post-2007 growth rate changes. For this State, Pechan utilized the State-level equation output to develop growth factors through 2007. The 2018 growth factor was developed for Iowa via extrapolation using an exponential curve fitted to the projected 2002-2007 Iowa growth factors.

c. Non-EGAS Data Sources

Because EGAS provides a *default* set of emission activity growth indicators, Pechan reviewed the availability of better projections sources where time and resources permitted. The following two sections describe specific areas where EGAS default information was replaced with projections from alternative data sources.

i. Population

EGAS is geographically defined by State, and so differences in growth within a State are not reflected in the EGAS default growth factors. Therefore, to account for differences in population projections within a State, Pechan obtained county-level population projections from each State in the CENRAP region and replaced the State-level EGAS population projections with these county-level population projections (Kansas, 2004; LPDC, 2003; MNPLAN, 2002; MO, 1999; ODOC, 2002; SLI, 2004; TXCDS, 2004; UALR, 2003; and UNE, 2002). Appendix Table C-1 presents the population projections complied for this effort.

ii. Other Data

Because of resource constraints, Pechan's research into potential alternative data sources focused on the EGAS growth surrogates that are applied to the highest-emitting point, nonpoint, and nonroad SCCs in the base year inventory for the CENRAP States.[8] Tables III-1 through III-5 in an earlier Pechan report present the top 10 SCCs responsible for the highest 2002 emissions in the CENRAP States for each of the following pollutants: NO_x, PM25-PRI, NH_3, SO_2, and VOC (Pechan, 2005). Based on this review, Pechan was able to identify alternative data sources that

[8]Note that this discussion only applies to nonroad SCCs that not included in the NONROAD model. Refinements to the NONROAD model default growth information are addressed in Section D.1.

were deemed to provide better emission activity surrogates for many of these SCCs. These surrogates are summarized in Table II-4. The following sections describe the rationale for the use of these non-EGAS growth surrogates for projecting emissions in the CENRAP States.

Oil and Gas Production Forecasts

Pechan used DOE's *Annual Energy Outlook* 2004 regional forecasts of onshore and offshore oil and gasoline production (DOE, 2004). From maps of the regions, the production values were allocated to the lower 48 continental States. New Mexico and Texas were the only States to belong to multiple onshore production regions. For these States, Pechan calculated the total production from all regions associated with each State. For SCC 2310000000, on and offshore drilling, the offshore area of the Pacific was added the onshore West Coast region and the offshore area of the Gulf was added to the on-shore region the Gulf Coast to develop growth factors for the States within the overlapping regions.

Historical Average Acres Prescribed Burned

Historical prescribed burning acreage data indicate that 2002 represented a year with uncharacteristically high levels of burning activity. Therefore, Pechan computed the average acreage burned in each State from data available over the period 1996 through 2003 (EPA, 2005). The 2018 growth factors were then developed for each State by computing the ratio of 2002 acreage to the average acreage over the 1996 to 2003 period.

Planted Crop Acreage Forecasts

Pechan obtained 2002 through 2013 national planted acreage projections for major crops from the USDA (ERS, 2004). Pechan then developed an estimated national 2018 planted acreage value via linear extrapolation of the 2002 through 2013 trend.

USDA Livestock Projections

Pechan obtained national livestock projections from USDA's "February 2004 Agricultural Baseline, Projection Tables to 2013" for beef cows, cattle, young chickens and turkeys (ERS, 2004). The USDA's 2002 to 2013 estimates were projected to 2018 using linear extrapolation. The USDA data for young chickens and turkey data were combined for use in projecting poultry SCC emissions activity.

Table II-4. Summary of Non-EGAS Growth Indicators Used For Highest-Emitting SCCs in CENRAP Region

SCC	SCC Description	Growth Indicator	
		EGAS5	This Study
2294000000	Mobile Sources; Paved Roads; All Paved Roads; Total: Fugitives	Population	Onroad VMT
2296000000	Mobile Sources; Unpaved Roads; All Unpaved Roads; Total: Fugitives	Population	Extrapolation of regional historical trend
2310000000	Industrial Processes; Oil and Gas Production: SIC 13; All Processes; Total: All Processes	SIC 13 constant $ output	AEO regional production forecast
2310001000	Industrial Processes; Oil and Gas Production: SIC 13; All Processes; On-shore; Total: All Processes	SIC 13 constant $ output	AEO regional production forecast
2310002000	Industrial Processes; Oil and Gas Production: SIC 13; All Processes; Off-shore; Total: All Processes	SIC 13 constant $ output	AEO regional production forecast
2801000003	Miscellaneous Area Sources; Agriculture Production - Crops; Agriculture - Crops; Tilling	Farm sector constant $ value added	USDA national crop projections
2810015000	Miscellaneous Area Sources; Other Combustion; Prescribed Burning for Forest Management; Total	No growth	Historical average (2002 levels were greater than average)
2805020002	Miscellaneous Area Sources; Agriculture Production - Livestock; Cattle and Calves Waste Emissions; Beef Cows	Farm sector constant $ value added	USDA national beef cow inventory projection
2805020004	Miscellaneous Area Sources; Agriculture Production - Livestock; Cattle and Calves Waste Emissions; Steers, Steer Calves, Bulls, and Bull Calves	Farm sector constant $ value added	USDA national cattle inventory projection
2805025000	Miscellaneous Area Sources; Agriculture Production - Livestock; Swine production composite; Not Elsewhere Classified (see also 28-05-039, -047, -053)	Farm sector constant $ value added	USDA national hog inventory projection
2805030000	Miscellaneous Area Sources; Agriculture Production - Livestock; Poultry Waste Emissions; Not Elsewhere Classified (see also 28-05-007, -008, -009)	Farm sector constant $ value added	USDA national turkey plus young chicken inventory projection
2805047100	Miscellaneous Area Sources; Agriculture Production - Livestock; Swine production - deep-pit house operations (unspecified animal age); Confinement	Farm sector constant $ value added	USDA national hog inventory projection
30202001	Industrial Processes; Food and Agriculture; Beef Cattle Feedlots; Feedlots: General	Farm sector constant $ value added	USDA national beef cow inventory projection

Onroad Vehicle Miles Traveled Projections

Pechan used onroad VMT projections to forecast paved road fugitive dust emissions activity. The VMT projections are discussed in Section E.1 of this report.

Extrapolation of Historical Unpaved Road VMT Trend

Unpaved road VMT for 1990 to 2002 were compiled for each of the CENRAP States, based on data used in EPA's National Emission Inventory. A review of the data indicated a disconnect between the 1995 and 1996 values and questionable State-level unpaved road VMT trends. In addition, data for Arkansas and Minnesota appeared questionable for multiple years. Therefore, Pechan concluded that the most reasonable approach would be to develop a single regional growth factor based on post-1995 unpaved road VMT data excluding data for Arkansas and Minnesota. First, Pechan summed the VMT estimates for each year across CENRAP States (excluding Arkansas, and Minnesota). Next, Pechan identified a best fit linear function from the 1996 to 2002 regional data and used that function to estimate 2018 unpaved road VMT in the CENRAP region. The 2002 to 2018 regional growth factor (0.813) was then applied to all of the CENRAP States.

Point Source NOx Cap in Texas Ozone Nonattainment Areas

To account for a point source NO_x emissions cap in certain Texas ozone nonattainment area counties, Pechan applied a no growth assumption (growth factor of 1.0) to all NO_x point sources in the following Texas counties: Brazoria, Chambers, Collin, Dallas, Denton, Fort Bend, Galveston, Hardin, Harris, Jefferson, Liberty, Montgomery, Orange, Tarrant, and Waller.

Integrated Planning Model

Pechan compiled a comprehensive set of growth factors for all base year EGU SCC records using EGAS 5.0. The EGAS 5.0 defaults are based on DOE's *Annual Energy Outlook* electric generation sector energy forecasts (DOE, 2004). For the final CENRAP modeling, it is anticipated that some, but not all, base year EGU SCC records will be projected using forecast information from IPM runs.

B. DEVELOPMENT OF CONTROL FACTORS FOR NON-EGU POINT SOURCES

This section describes control factor development for non-EGU point sources. This analysis focused on Federal, State, and local rules and regulations that are expected to reduce emissions or emission rates for criteria pollutants in the CENRAP States post-2002. After the control factor development is described, some examples of resulting emissions are provided as a point of reference.

1. State Controls

a. Texas

For developing control factors (expected emission reductions) for the non-EGU point source categories in Texas, it was recommended by Texas Commission on Environmental Quality (TCEQ) staff that the most recent Houston/Galveston Area (HGA) ozone episode modeling files be reviewed. Appropriate data are those listed in Chapter 3: Photochemical Modeling 2007 Future Base Case Summary of Controls Applied found on the TCEQ website (TCEQ, 2004). Separate files are posted according to the geographic area covered, and the applicable control programs. The non-EGU portion of this table is summarized below:

Geographic Area	Base Inventory	Controls Applied	File Name
Beaumont/Port Arthur	NEGU	Ch. 117 controls via Emission Factor Survey; assuming no VOC controls	control.2007.BPA.NEGU
Houston/Galveston	NEGU HRVOC Cap	2007 NO_x Cap Revised Speciation and Cap Cutoff Levels	control.HG_07NO$_x$Cap_NEGU control.new_hga_hrvoc_cap.to2n2_negu and then apply control.new_hga_hrvoc_cap.less20inharris
Dallas/Ft. Worth	NEGU	Ch. 117 controls via Emission Factor Survey; assuming no VOC controls	control.2007.dfw.negu
East Texas	Cement Kiln NO_x	Permit modifications	Already applied permit modifications to afs.MidloKilns._v5 via ellis_kilns.TIPI.00-07
	Agreed Orders and Consent Decree for East Texas	Specific reductions at ALCOA and Eastman	AgreedOrdersControlFactors00to07
West Texas	NEGU	None	None

i. Beaumont/Port Arthur (BPA)

The Beaumont/Port Arthur ozone nonattainment area includes Hardin, Jefferson, and Orange counties. TCEQ (2000a) expects that Tier 1 reductions in NO_x emissions from these three counties will be enough for Beaumont/Port Arthur to attain the 1-hour ozone standard.

The BPA.NEGU file lists the point sources in the Beaumont-Port Arthur ozone nonattainment area that have control factors applied for NO_x. Control factors were developed by facility and unit by the TCEQ by comparing survey results that established base year NO_x emission factors with Chapter 117 NO_x emission limits (which are by source category). The survey included all BPA NO_x sources with 25 tons per year or more of NO_x. Source-specific NO_x control factors range from 0.16 to 1.00 for affected sources.

ii. Houston/Galveston (HGA)

The Houston/Galveston ozone nonattainment area includes Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller counties. On December 6, 2000, the TCEQ adopted a program for the trading of NO_x allowances in the HGA nonattainment area. The trading of these allowances takes place under an area-wide cap. The program requires incremental reductions beginning in 2003 and continuing through 2007, when the full reductions of the program are to be achieved. The trading program is expected to provide as much flexibility in meeting these limits as possible.

The most recent HGA SIP revision is based on analysis to date showing that limiting emissions of ethylene, propylene, 1,3-butadiene, and butanes in conjunction with an 80 percent reduction in NO_x is equivalent in terms of air quality benefit to that resulting from a 90 percent point source NO_x reduction requirement.

The Control.HG_NOxCap_NEGU files for 2007 and 2010, when applied to estimate a control factor for 2018, yield a control factor of 0.45 (a 55 percent reduction). The control factor affects all non-EGU point source NO_x emissions in this nonattainment area.

There are also requirements for additional fugitive VOC emission reductions in Houston-Galveston. These include new rules to reduce emissions of highly reactive VOCs from four key industrial sources: fugitives, flares, process vents, and cooling towers. The highly reactive VOC rules are performance-based, emphasizing monitoring, record keeping, reporting, and enforcement, rather than establishing individual unit emission rates. After evaluation of how these rules were applied in the Houston SIP analysis, which involved adding highly reactive VOCs to the 2000 emission inventory and removing those HRVOC emissions in the future case, it was decided to not apply any VOC control factors to the 2002 VOC emissions in the 2018 emission projections.

iii. Dallas/Fort Worth

Appendix F of the Dallas/Fort Worth ozone nonattainment demonstration (TNRCC, 1999a) identifies NO_x control factors proposed for specific industrial boilers and engines and EGUs in that area. These unit-specific reductions will be applied to estimate 2018 NO_x emissions.

30 TAC 117, Subchapter 13 limits NO_x emissions from cement kilns in the Dallas/Fort Worth area. This rule establishes emission limits on the basis of pounds of NO_x per ton of clinker produced. These limits are based on the NO_x emissions averaged over each 30 consecutive day period (later changed to a 365 day period), and vary depending on the type of cement kiln. These NO_x emission limits by kiln type are as follows:

1. For each long wet kiln:
   a. In Bexar, Comal, Hays, and McLennan Counties, 6.0 lbs/ton of clinker produced
   b. In Ellis County, 4.0 lbs/ton
2. For each long dry kiln, 5.1 lbs/ton
3. For each preheater kiln, 3.8 lbs/ton
4. For each preheater-precalciner or precalciner kiln, 2.8 lbs/ton

These emission limits are expected to achieve a 30 percent reduction in cement kiln NO_x emissions.

Appendix F of the Dallas/Fort Worth ozone nonattainment demonstration (TNRCC, 1999a) identifies eleven cement kilns modeled as part of the proposed Dallas/Fort Worth NO_x emission reduction strategy. The level of NO_x controls required by TNRCC ranged by unit from 6 percent to 66 percent. These controls were applied on a unit-by-unit basis.

The DFW.NEGU file lists the point sources in the Dallas-Ft. Worth area that have control factors applied for NO_x. Control factors were developed by facility and unit by the TCEQ using the same emission factor survey and comparison with NO_x emission limit technique that was described above for Beaumont-Port Arthur. The survey included all DFW NO_x sources that reported 2 tons per year or more of NO_x. Source-specific control factors range from 0.13 to 1.00 for affected sources.

Agreed order control factors from the TCEQ were applied to simulate the effects of such orders on two facilities. A control factor of zero is applied to the Eastman plant (482030019), simulating the shutdown of this facility. NO_x control factors are applied to three boilers at the Alcoa (483310001) aluminum production facility.

Another TCEQ control factor file contains information about the future year criteria pollutant emissions for the cement kilns in Ellis County. These emission estimates were used to estimate appropriate growth and control factors for the 2018 emission forecasts for this area/source category.

b. Missouri

The fine grid counties in eastern Missouri are affected by EPA NO_x SIP Call requirements. The State of Missouri supplied information about unit-specific NO_x emission reductions for affected facilities. For non-EGUs, this included an 8 ton per ozone season NO_x emission limit applied to Anheuser Busch-Unit 6, a 9 ton per ozone season limit applied to Trigen-Unit 5, and a 36 ton per ozone season limit applied to Trigen-Unit 6.

c. Kansas

Rule 28-19-717 requires control of VOC emissions from commercial bakery ovens in Johnson and Wyandotte counties. This rule applies to bakery ovens with a potential to emit VOCs equal to or greater than 100 tons per year. Each commercial bakery oven subject to this regulation shall install and operate VOC emissions control devices for each bakery oven to achieve at least an 80 percent total removal efficiency on the combined VOC emissions of all baking ovens, calculated as the capture efficiency times the control device efficiency. Each bakery oven (Keebler Company) in these two counties with more than 100 tons per year of VOC emissions in 2002 had an 80 percent VOC control efficiency applied in the 2018 projections.

d. Louisiana

Point sources in the Baton Rouge nonattainment area and the nearby region of influence are affected by Chapter 22 NO_x control provisions. The provisions of this chapter apply to any affected facility in the Baton Rouge nonattainment area (the entire parishes of Ascension, East Baton Rouge, Iberville, Livingston, and West Baton Rouge) and the Region of Influence (affected facilities in the attainment parishes of East Feliciana, Pointe Coupee, St. Helena, and West Feliciana). The provisions of this chapter apply during the ozone season (May 1 to September 30) of each year. Compliance is expected to occur as expeditiously as possible, but no later than May 1, 2005.

The effects of this NO_x regulation were included in the analysis by applying a 34 percent NO_x emission reduction to the 2002 non-EGU point source emissions in the greater Baton Rouge area. This control factor application is consistent with what was included in the most recent Houston-Galveston area modeling domain assessments by the TCEQ.

2. Federal Maximum Achievable Control Technology (MACT) Standards

Numerous MACT standards have been promulgated pursuant to Section 112 of Title I of the Clean Air Act, and are controlling emissions of hazardous air pollutants (HAPs) from stationary sources of air pollution. Many of the MACT standards are expected to produce associated VOC reductions, since many HAPs are also VOCs, so the emission projections need to capture the expected effects of post-2002 MACT standards.

Pechan performed the following steps to determine the MACT standards expected to have the greatest impact of VOC, NO_x, and PM emissions for the forecast year:

1. Identified the source categories and associated SCCs for each MACT standard having a post-2002 compliance date for existing sources.
2. Eliminated MACT categories that do not achieve significant VOC emission reductions.
3. VOC emission reduction estimates for the reciprocating internal combustion engine MACT category are based on information from EPA's Clean Air Interstate Rule technical support document (Alpine, 2004).
4. VOC emission reduction estimates for all other MACT categories are based on information found in the preamble to the final rule of each MACT Subpart as published in the *Federal Register*. Table II-5 lists those MACT categories for which VOC, NO_x, and/or PM emission reduction percentages could be estimated based on emission reduction information found in the preamble to each respective final rule.

3. Non-EGU Point Source Analysis Results

a. Houston Galveston Area (HGA)

Pechan's modeling of the NO_x emissions cap in the 8-county HGA applies a 55 percent NO_x emission reduction to the 2002 NO_x point source emissions. NO_x emissions in the HGA are expressed in annual tons. These annual tons and the equivalent ozone season daily (OSD) tons are listed below. Then, the right-most column below shows the comparable values from the TCEQ analysis for HGA.

Table II-5. Post-2002 MACT Standards and Expected VOC, NO_x, and PM Reductions

MACT Standard - Source Category	Code of Federal Regulations Subpart	Compliance Date (existing sources)	VOC (% Reduction)	NO_x (% Reduction)	Total PM (% Reduction)	Affected SCCs
Asphalt		5/1/2006	85			305001XX, 305002XX, 305050XX, 306011XX
Auto and Light Duty Trucks	IIII	4/26/2007	40			40201601 to 40201632; 40201699
Coke Ovens: Pushing, Quenching and Battery Stacks	CCCCC	4/14/2006	43			30300304; 30300303
Fabric Printing, Coating & Dyeing	OOOO	5/29/2006	60			40201101 to 40201199; 40201201; 40201210
Friction Products Manufacturing	QQQQQ	10/18/2005	44			30111103; 30111199; 31401001; 31401002
Integrated Iron and Steel	FFFFF	5/20/2006	20		20	30301501 to 30301596
Large Appliances	NNNN	7/23/2005	45			40201401 to 40201499
Leather Finishing Operations	TTTT	2/27/2005	51			32099997; 32099998; 32099999
Lime Manufacturing	AAAAA	1/5/2007			23	305016XX
Manufacturing Nutritional Yeast	CCCC	5/21/2004	10			30203404 to 30203424; 30203504 to 30203540
Metal Can	KKKK	6/10/2005	70			40201702; 40201703 to 40201799
Metal Coil	SSSS	6/10/2005	53			402018XX
Metal Furniture	RRRR	5/23/2006	73			402020XX
Misc. Coating Manufacturing	HHHHH	12/11/2006	64			402026XX
Misc. Metal Parts and Products	MMMM	1/2/2007	48			402025XX
Misc. Organic Chemical Production and Processes (MON)	FFFF	11/10/2006	66			645200XX; 30113001 to 30113007; 684300XX; 30101005 to 30101099; 68445001; 68445010; 68445013; 68445020; 68445022; 68445101; 68445201; 30110002 to 30110099; 64820001; 64820010; 64821001; 64821010; 64822001; 64822010; 64823001; 64823010; 64823001; 64823010; 64880001; 64882001; 64882002; 64882599; 30105001; 30105101 to 30105130; 30801001; 31604001; 31604002; 31600403; 68510001; 68510010; 68510011; 68580001; 68582001; 68582002; 68582599; 30101837; 64610301 to 64610350; 64610001 to 64610050; 64610101 to 64610150; 64610201 to 64610250; 64615001 to 64615030; 64620001 to 64620038; 64630001 to 64630083; 64631001 to 64631083; 64632001 to 64632083; 64680001; 64682001; 64682002; 64682501; 64682502; 64682599; 64130001 to 64130025; 64130101 to 64130125; 64130201 to 64130225; 64131010 to 64131030; 64132001 to 64132030; 64133001 to 64133030; 64180001; 64182001; 64182002; 64182599; 64615001; 64620001; 65135001

Table II-5 (continued)

MACT Standard - Source Category	Code of Federal Regulations Subpart	Compliance Date (existing sources)	VOC (% Reduction)	NO_x (% Reduction)	Total PM (% Reduction)	Affected SCCs
Paper and Other Web	JJJJ	12/4/2005	80			30701199; 402013XX
Pesticide Active Ingredient Production	MMM	12//23/2003	65			30103301
Petroleum Refineries	UUU	4/11/2005	55			Catalytic cracking: 30600201; 30600202; 30600301 Catalytic reforming: 30601601; 30601602; 30601603; 30601604
Plastic Parts	PPPP	4/19/2007	80			402022XX
Plywood and Composite Wood Products	DDDD	9/28/2007	54			307007XX; 30700921 to 30700971; 30701001 to 30701057; 30700602 to 30700661
Polymers and Resins III	OOO	1/20/2003	51			Phenolic resins: 30101805; “polyamide” resins: 30101827
Reciprocating Internal Combustion Engines (RICE)	ZZZZ	6/15/2007	13	17		20100102; 20100202; 20100702; 20100802; 20100902; 20200102; 20200104; 20200202; 20200204; 20200301; 20201001; 20201002; 20201012, 20201014; 20201602; 20201702, 20200501; 20200702; 20200706; 20200902; 20300101; 20300201; 20300301
Rubber Tire Manufacturing	XXXX	7/11/2005	52			308001XX
Secondary Aluminum Production	RRR	3/24/2003			61	30400101 to 30400199
Site Remediation	GGGGG	10/8/2006	50			504001XX; 50400201, 50400202; 504002XX; 504100XX; 504101XX; 504102XX; 504103XX; 504102XX; 504103XX; 504104XX; 504105XX; 504106XX; 504107XX; 50480001; 50482001; 50482002; 50482599; 50480004
Solvent Extraction for Vegetable Oil Production	GGGG	4/12/2004	25			302019XX
Stationary Combustion Turbines	YYYY	3/5/2007	90			20100101, 20100201, 20200101, 20200103, 20200201, 20200203, 20200901, 20300102, 20300202, 20300203
Taconite Iron Ore Processing	RRRRR	10/30/2006			62	32302371 to 32302399
Wet Formed Fiberglass Mat Production	HHHH	4/11/2005	74			30501201 to 30501299
Wood Building Products	QQQQ	5/28/2006	63			40202101 to 40202199

NOTE: **Based on organic HAP emission reductions

	HGA Non-EGU NO_x Emissions		
	Annual Tons	**Daily Tons**	**TCEQ Analysis OSD Tons**
2002 Point Source NO_x	113,109	309.9	283
Post-cap NO_x	50,899	139.4	135

The TCEQ analysis OSD NO_x cap summary values above are for non-EGU 2000 NO_x and 2007 modeled NO_x (see Table 3.5-16 in their report). The above comparison indicates that the CENRAP NO_x modeling for HGA will be consistent with prior analyses by TCEQ for this area.

b. Beaumont-Port Arthur (BPA)

Pechan's modeling of the NO_x emissions cap in the 3-county BPA area applies NO_x control efficiencies based on an emission factor survey for the area. These results are summarized below.

	BPA Area Non-EGU NO_x Emissions		
	Annual Tons	**Daily Tons**	**TCEQ Analysis Daily Tons**
2002 Point Source NO_x	35,441	97.0	96.6
Post-cap NO_x	28,254	77.4	81.9

The TCEQ analysis OSD NO_x cap summary values above are for non-EGU 2000 NO_x OSD and 2007 modeled NO_x with growth and controls. The CENRAP non-EGU NO_x emissions in the 2002 point source file are about the same as the 2000 estimates on an OSD basis. However, the expected emission benefit of the non-EGU NO_x controls is greater than that modeled by TCEQ on both a percentage and an absolute tonnage basis.

c. Dallas Fort Worth (DFW)

Pechan's modeling of the NO_x emissions cap in the 4-county DFW area applies NO_x control efficiencies to certain sources based on an emission factor survey for the area. These results are summarized below.

	DFW Area Non-EGU NO_x Emissions		
	Annual Tons	**Daily Tons**	**TCEQ Analysis Daily Tons**
2002 Point Source NO_x	846	2.3	6.9
Post-cap NO_x	647	1.8	13.1

The TCEQ analysis OSD NO_x ton values listed above are for non-EGU 2000 NO_x OSD and 2007 modeled NO_x with growth and controls. The 2002 and post-cap NO_x tons listed for the DFW area only include sources affected by the NO_x control program, so these values are much lower than the TCEQ emissions, which include all non-EGU point source emissions in the area.

d. Baton Rouge

Pechan's modeling of the NO_x emissions cap in the greater Baton Rouge area applies a 34 percent NO_x emissions reduction to the 2002 NO_x point source emissions. These results are summarized below.

	Baton Rouge 9-Parish Area Non-EGU NO_x Emissions		
	Annual Tons	Daily Tons	TCEQ Analysis Daily Tons
2002 Point Source NO_x	74,847	205	630.9
Post-cap NO_x	49,399	135	586.2

The TCEQ analysis daily tons summary values above are for the entire State of Louisiana, and are for non-EGU 2000 NO_x and 2007 NO_x with growth and LDEQ SIP controls. Because the TCEQ summaries are for the entire State, the values are necessarily higher than those for the 9-parish area. Pechan estimates a 70 tpd NO_x reduction for the 9-parish NO_x control program. TCEQ estimates that the Statewide emission benefit of the LDEQ SIP controls is a 45 tpd reduction from 2000 levels, or a 61 tpd reduction from what the 2007 NO_x emissions would be expected to be without the Baton Rouge SIP controls.

C. DEVELOPMENT OF CONTROL FACTORS FOR AREA SOURCES

1. State Controls

Table II-6 summarizes regulations in the CENRAP States for which more stringent State requirements relative to Federal rules are in place for the mobile equipment repair and refinishing (MERR), architectural and industrial maintenance (AIM) coatings, consumer products and solvent cleaning area source VOC emission categories. For categories where more stringent rules for these categories are not found in the State regulations, "National Rule" is stated to refer to the applicable Federal requirements. The sections below describe how the information from these rules were used to develop control efficiencies. Table II-7 summarizes the final control efficiencies that were used to model these rules, and the counties and SCCs where these rules were applied.

Stage II, or at-the-pump, refueling control programs are in place in three States in the CENRAP region—Louisiana, Missouri, and Texas. Although these programs may have been in place prior to 2002, these controls are included here because the phase-in of the onboard vapor recovery systems controls changes the overall refueling control efficiency of Stage II programs.

Table II-6. VOC Solvent Rule Summary

SCCs	2465000000	2401001000	2415360000, 2415300000, 2415230000, 2415200000	2401005000	
State	**Consumer Products**	**AIM Coating**	**Solvent Cleaning Operations**	**Mobile Equipment Repair and Refinishing**	**State Contact, e-mail**
Arkansas	National Rule	National Rule	National Rule	National Rule	
Iowa	National Rule	National Rule	National Rule	National Rule	Marnie Stein Marnie.stein@dnr.state.ia.us
Kansas	National Rule	National Rule	28-19-714 The provisions of this regulation apply to cold cleaning, open-top vapor degreasing, and conveyorized degreasing operations located in Johnson and Wyandotte counties, and to the sale of cold cleaner solvents for use within either county. These requirements apply after August 31, 2002. Only cold cleaning solvents with a vapor pressure less than 1.0 mm Hg at 68F shall be used. Only cold cleaning solvents with a vapor pressure less than 5.0 mm Hg at 68F shall be used for each cold cleaning operation that is used for cleaning carburetors. Each cold solvent cleaner shall be equipped with a cover. Open-top vapor degreasers shall be equipped with a cover. Conveyorized degreasers shall have a processing system with an overall VOC control efficiency of 65 percent or greater.	National Rule	
Louisiana	National Rule	National Rule	Title 33, Part III Subchapter C, Section 2125 (Vapor Degreasers) These requirements were last amended April 2004. Open-top vapor degreasers shall achieve an overall VOC control efficiency of 85 percent or greater.	National Rule	
Minnesota	National Rule	National Rule	National Rule	National Rule	Paul Kim Paul.kim@state.mn.us
Missouri - Statewide (metro and outstate areas)	National Rule	National Rule	National Rule	National Rule	
Missouri - St. Louis metro area only (city of St. Louis, and St. Louis, St. Charles, Jefferson & Franklin counties)	National Rule	National Rule	- 10 CSR 10-5.300 (degreasing operations) - 10 CSR 10-5.455 (solvent cleanup operations not subject to degreasing operations) - Effective 2001 - Rule covers entire areas of counties specified - Cold cleaners, open-top vapor degreasers and conveyorized cleaner requirements modeled after 1977 CTG - Restrictions on cold cleaning more stringent than CTG in some cases - EPA NESHAP Subpart T requirements override some solvent cleaning requirements - Degreasers meeting certain size/solvent criteria required to meet minimum 65% VOC reduction efficiency	National Rule	

Table II-6 (continued)

SCCs	2465000000	2401001000	2415360000, 2415300000, 2415230000, 2415200000	2401005000	
State	**Consumer Products**	**AIM Coating**	**Solvent Cleaning Operations**	**Mobile Equipment Repair and Refinishing**	**State Contact, e-mail**
Missouri - Kansas City metro area only (Clay, Jackson, Platte counties)	National Rule	National Rule	- 10 CSR 10-2.210 (degreasing operations) - 10 CSR 10-2.215 (solvent cleanup operations not subject to degreasing operations) - Effective 2001 - Rule covers entire areas of counties specified - Cold cleaners, open-top vapor degreasers and conveyorized cleaner requirements modeled after 1977 CTG - Restrictions on cold cleaning more stringent than CTG in some cases - EPA NESHAP Subpart T requirements override some solvent cleaning requirements - Degreasers meeting certain size/solvent criteria required to meet minimum 65% VOC reduction efficiency	National Rule	
Nebraska	National Rule	National Rule	National Rule	National Rule	David Brown David.brown@ndeq.state.ne.us
Oklahoma	National Rule	National Rule	National Rule	National Rule	Ray Bishop Ray.bishop@deq.state.ok.us
Texas	Chapter 115.612 establishes control requirements effective in February 2004 for automotive windshield washer fluid. No person shall sell, supply, offer for sale, distribute, or manufacture for use in Texas any automotive windshield washer fluid containing VOCs in excess of 23.5% by weight.	Rule 115.420 applies to surface coating processes.	Degreasing processes in the Beaumont/Port Arthur, Dallas/Ft. Worth, and Houston/Galveston areas and in Gregg, Nueces, Victoria, Bexar, Comal, Guadalupe, Wilson, Bastrop, Caldwell, Hays, Travis, and Williamson counties have VOC control requirements via Chapter 115.412 for cold solvent cleaning and open-top vapor or conveyorized degreasers. The cold solvent cleaner requirement is equivalent to a VOC reduction efficiency of 65 percent or greater. The open-top vapor or conveyorized degreaser requirement is equivalent to a VOC reduction efficiency of 85 percent or greater.	Rule 115.422 control requirements apply in Beaumont/Port Arthur, Dallas/Fort Worth, El Paso, and Houston/Galveston. Vehicle refinishing operations shall minimize VOC emissions during equipment cleanup via enclosed containers for washing, rinsing, and draining, keeping wash solvents in an enclosed reservoir, and waste solvents and other cleaning materials in closed containers. Coating application equipment shall have a transfer efficiency of at least 65 percent.	

Table II-7. VOC Solvent Controls As Modeled

Counties	Pollutant	Control Efficiency* (%)	SCC	Description
KS: Johnson, Wyandotte	VOC	66	2415000000	Solvent Utilization: Degreasing: All Processes/All Industries
TX: Dallas, El Paso, Galveston, Hardin, Harris, Jefferson, Tarrant	VOC	35	2401005000	Auto Refinishing: SIC 7532
TX: Bastrop, Bexar, Caldwell, Comal, Gregg, Guadalupe, Hays, Nueces, Travis, Victoria, Williamson, Wilson	VOC	83	2415105000	Furniture and Fixtures (SIC 25): Open Top Degreasing
			2415110000	Primary Metal Industries (SIC 33): Open Top Degreasing
			2415120000	Fabricated Metal Products (SIC 34): Open Top Degreasing
			2415125000	Industrial Machinery and Equipment (SIC 35): Open Top Degreasing
			2415130000	Electronic and Other Elec. (SIC 36): Open Top Degreasing
			2415135000	Transportation Equipment (SIC 37): Open Top Degreasing
			2415140000	Instruments and Related Products (SIC 38): Open Top Degreasing
			2415145000	Miscellaneous Manufacturing (SIC 39): Open Top Degreasing
TX: Statewide	VOC	17	2460400000	Solvent Utilization: Miscellaneous Non-industrial: Consumer and Commercial: All Automotive Aftermarket Products

*These control efficiencies are all applied with a rule penetration of 100 percent and a rule effectiveness of 100 percent.

a. Kansas

i. Solvent Cleaning Operations

Kansas Rule 28-19-714 contains a 1.0 mm Hg maximum vapor pressure requirement for solvent cleaning operations, effective September 2002. Based on an evaluation of the Ozone Transport Commission (OTC) model rule for this source category, a 1.0 mm Hg at 68°F maximum VOC vapor pressure requirement leads to an estimated 66 percent reduction in VOC emissions relative to the national rule for cold cleaners and vapor degreasers (Pechan, 2001). The Kansas rule also includes a higher (5.0 mm Hg at 68°F) maximum vapor pressure requirement for the cleaning of carburetors, but this difference may not be significant relative to the OTC rule. Conveyorized degreasers are required to achieve an overall VOC control efficiency of 65 percent or greater; however, the Kansas rule does not appear to include any additional requirements relative to the national rule (other than the maximum vapor pressure requirements). Therefore, a 66 percent post-2002 VOC control efficiency was applied in Johnson and Wyandotte Counties, based on data from the OTC model rule.

b. Missouri

i. Solvent Cleaning Operations

Based on Pechan's review of Missouri's regulations, solvent cleaning regulations applicable to the Kansas City and St. Louis metropolitan areas appear to be more stringent than the national rule; however, these rules became effective before 2002. Therefore, no additional solvent controls were applied in Missouri.

ii. Stage II Refueling Controls

Stage II controls are required in the city of St. Louis and the following St. Louis area counties: Franklin County, Jefferson County, St. Charles County, and St. Louis County. This is required under 10 CSR 10-5.220 "Control of Petroleum Liquid Storage, Loading and Transfer." This regulation requires that gasoline stations with a minimum monthly throughput of 10,000 gallons of gasoline are required to maintain a 95 percent efficiency of total capture and emission reduction. These gasoline station owners are required to comply with the Missouri Performance Evaluation Test Procedures beginning in 1998.

c. Louisiana

i. Solvent Cleaning Operations

Title 33, Part III, Section 2125 specifies additional operational requirements for open top vapor degreasers not found in EPA's 1977 control techniques guideline (CTG). One requirement of the Louisiana Code specifies a minimum 85 percent VOC reduction efficiency for open top vapor degreasers not found in the CTG. Section 2125 was last amended in April 2004.

ii. Stage II Refueling Controls

A Stage II control program is in place in the following parishes in Louisiana: Ascension, East Baton Rouge, Iberville, Livingston, Pointe Coupee, and West Baton Rouge. The Stage II controls are required to attain a minimum of 95 percent gasoline vapor control efficiency at stations with a minimum throughput of 10,000 gallons of gasoline per month. This rule is under Title 33, Part III, Section 2132 "Stage II Vapor Recovery Systems for Control of Vehicle Refueling Emissions at Gasoline Dispensing Facilities." Compliance with these regulations was first required in 1993.

d. Texas

i. Cold Cleaners

The 1977 CTG for cold solvent cleaners is estimated to achieve VOC emission reductions of between 55 and 69 percent relative to 1977 baseline (uncontrolled) levels (Pechan, 2002). Texas rule 115.412 is equivalent to VOC emission reductions of at least 65 percent relative to uncontrolled levels. There do not appear to be any significant differences between the Texas rule and the CTG, and therefore no additional VOC reductions were applied to the 2002 Texas inventory for cold cleaners.

ii. Open-top Vapor or Conveyorized Degreasers

The national rule for vapor degreasing is estimated to achieve VOC emission reductions of between 10 and 15 percent (Pechan, 2002). The Texas rule 115.412 requires VOC emission reductions of at least 85 percent from these sources for the following counties: Bastrop, Bexar, Caldwell, Comal, Gregg, Guadalupe, Hays, Nueces, Travis, Victoria, Williamson, and Wilson. Assuming that the baseline 2002 vapor degreasing emissions include a 10 percent reduction from the national rule and that a total control of 85 percent would be applied to comply with the Texas rule, the incremental reduction from the Texas rule, relative to the 2002 emissions, would be 83 percent. This rule became effective in December 2004.

iii. Mobile Equipment Repair and Refinishing

Texas rule 115.422 requires that coating application equipment shall have a transfer efficiency of at least 65 percent and requires the use of high volume low pressure (HVLP) spray guns. This rule applies in the following counties: Dallas, El Paso, Galveston, Hardin, Harris, Jefferson, and Tarrant. Based on an evaluation of the OTC model rule for this source category, the use of “high transfer efficiency” HVLP guns is estimated to achieve a 35 percent VOC emission reduction relative to the national rule (Pechan, 2001). Spray gun controls are estimated to contribute an additional 3 percent VOC emission reduction. However, the Texas rule contains a less stringent requirement for the enclosure of spray guns and related parts. Therefore, a 35 percent post-2002 VOC control efficiency incremental to the national rule was applied in the counties listed above to account for this rule. This rule became effective in May 2002.

iv. Consumer Products

The national rule limits the VOC content of windshield wiper fluid to 35 percent by weight (effective December 1998). The Texas rule 115.612 limits the VOC content to 23.5 percent by weight. This represents a 33 percent reduction in the VOC content (and as a result, emissions) from the 2002 baseline. A single SCC includes all “auto aftermarket products”. Therefore, an assumption must be made as to what fraction of emissions from auto aftermarket products can be attributed to auto wiper fluid. An engineering estimate of 50 percent was applied, based on the assumption that the other major VOC-emitting auto aftermarket products (waxes, polishes and cleaning products) are likely consumed in lesser quantities by volume than windshield wiper fluid. Thus, the reduction applied to VOC emissions from the SCC representing auto aftermarket products was 17 percent. This rule became effective in February 2004.

v. Portable Fuel Containers

Texas has a portable fuel container rule (Statewide). In TCEQ analyses, this has been modeled as a reduction in evaporative VOC emissions using lawn and garden equipment SCCs within EPA’s NONROAD model. See the Nonroad section of this chapter for information about how the rule effects were incorporated in the analysis.

vi. Stage II Refueling Controls

Stage II refueling controls are required in the following Texas counties: Brazoria, Chambers, Collin, Dallas, Denton, El Paso, Fort Bend, Galveston, Hardin, Harris, Jefferson, Liberty, Montgomery, Orange, Tarrant, and Waller. This is regulated by the TCEQ Chapter 115, Sections 240 through 249 "Control of Vehicle Refueling Emissions (Stage II) at Motor Vehicle Fuel Dispensing Facilities." This regulation requires that gasoline stations with a minimum monthly throughput of 10,000 gallons of gasoline are required to have installed an approved Stage II vapor recovery system which is certified to reduce VOC emissions to the atmosphere by at least 95 percent. Annual inspections are required and the program began in 1992.

vii. Gas-fired Water Heaters, Small Boilers, and Process Heaters

A Statewide rule, adopted as part of the April 2000 Dallas/Forth Worth SIP revision, reduces NO_x emissions from new natural gas-fired water heaters, small boilers, and process heaters sold and installed in Texas beginning in 2002. The rule applies to each new water heater, boiler, or process heater with a maximum rated capacity of up to 2.0 million British thermal units per hour. This is Rule 117.461. It should be noted that this control on natural gas-fired water heaters may be overturned by the SB 473 prohibition on regulating water heater emissions.

To simulate the effects of this rule in 2018, the following factors were applied Statewide in Texas.

SCC	NO_x Control Efficiency	Rule Penetration	Rule Effectiveness
2103006000	75%	80%	100%
2104006000	75%	80%	100%

2. Federal Controls

a. Residential Wood Combustion

For this analysis, a 20 year estimated lifetime for woodstoves and fireplace inserts was used along with the SCC-specific growth factors, and emission factor ratios by SCC, to account for the replacement of retired woodstoves that emit at pre-new source performance standard (NSPS) levels, with new catalyst-equipped wood burning equipment. This was done using an equation to estimate equipment turnover for a situation with a 4 percent per year retirement rate, and the SCC-specific growth factors. Emission factor ratios are pollutant-specific. The growth and retirement equation was used to estimate the relationship between base year (2002) emissions and 2018 emissions by SCC and pollutant.

Then, this relationship was used to estimate the control efficiency that would have to be applied along with the growth factor to yield the appropriate future year emission value. SCCs for controlled woodstoves and fireplace inserts have no control efficiency applied. Their 2018 emissions will change in proportion to the growth rate. Table II-8 displays the various residential woodstove and fireplace area source SCCs that are used in the CENRAP State emission inventories and the associated 2018 control factors used in this analysis.

Table II-8. Residential Wood Combustion Control Factors for CENRAP States

SCC	Description	Growth Factor 2002 to 2018	Pollutant	CF*	2018 Ratio of Controlled/ Uncontrolled Emissions	2018 Control Factor (Emission Reduc. %)
States: AR, LA, OK, TX						
2104008000	Total Woodstoves and Fireplaces	1.034	VOC	0.28	0.664	35.8
		1.034	CO	0.45	0.751	27.3
		1.034	NOx	0.71	0.885	14.4
		1.034	PM	0.67	0.864	16.4
2104008002	Fireplace inserts	1.034	VOC	0.28	0.664	35.8
		1.034	CO	0.45	0.751	27.3
		1.034	NOx	0.71	0.885	14.4
		1.034	PM	0.67	0.864	16.4
2104008010	Woodstoves-general	1.034	VOC	0.28	0.654	34.6
		1.034	CO	0.45	0.736	26.4
		1.034	NOx	0.71	0.861	13.9
		1.034	PM	0.67	0.842	15.8
2104008001	Fireplaces	1.034			1.034	0
2104008003	Fireplace inserts-certified-non-catalytic	1.034			1.034	0
2104008004	Fireplace inserts-certified-catalytic	1.034			1.034	0
2104008030	Woodstoves-certified-catalytic	1.034			1.034	0
2104008050	Woodstoves-certified-non-catalytic	1.034			1.034	0
States: IA, KS, NE, MO, MN						
2104008000	Total Woodstoves and Fireplaces	0.986	VOC	0.28	0.65	34
		0.986	CO	0.45	0.73	26
		0.986	NOx	0.71	0.851	13.7
		0.986	PM	0.67	0.832	15.6
2104008002	Fireplace inserts	0.986	VOC	0.28	0.65	34
		0.986	CO	0.45	0.73	26
		0.986	NOx	0.71	0.851	13.7
		0.986	PM	0.67	0.832	15.6
2104008010	Woodstoves-general	0.986	VOC	0.28	0.654	34.6
		0.986	CO	0.45	0.736	26.4
		0.986	NOx	0.71	0.861	13.9
		0.986	PM	0.67	0.842	15.8
2104008001	Fireplaces	0.986			0.986	0
2104008003	Fireplace inserts-certified-non-catalytic	0.986			0.986	0
2104008004	Fireplace inserts-certified-catalytic	0.986			0.986	0
2104008030	Woodstoves-certified-catalytic	0.986			0.986	0
2104008050	Woodstoves-certified-non-catalytic	0.986			0.986	0

NOTE: *The ratio between the emission factor for a certified-catalyst equipped woodstove/fireplace insert and for an uncontrolled unit.

b. Onboard Vapor Recovery Systems

The control efficiency from refueling onroad vehicles will be greater in 2018 than in 2002 due to vehicle turnover and the Federal requirement for onboard vapor recovery systems in onroad vehicles. Percentage reductions in VOC emissions from this control measure in 2018, relative to 2002, were calculated using a sampling of MOBILE6 runs, including the effect of Stage II programs where they are in place. These resulting reduction factors were included in the area source sector control files.

D. DEVELOPMENT OF NONROAD 2018 EMISSION INVENTORY

Pechan estimated NONROAD model mass emissions for 2018 for all CENRAP States using EPA's NONROAD2004 model (EPA, 2004a). Pechan developed nonroad option files to reflect season-specific inputs that applied to an entire State or group of counties. These runs also incorporated revised activity, seasonal allocation, and county allocation files developed by Sonoma Technology, Inc. (STI) to improve the recreational marine component of the 2002 base year NONROAD inventory (STI, 2004).

Pechan ran NONROAD for four scenarios: 1) typical January weekday (JanWD); 2) typical January weekend day (JanWE); 3) typical July weekday (JulWD); and 4) typical July weekend day (JulWE). The January runs represented average daily emissions for the time period October 1 through April 30, and the July runs represented average daily emissions for the time period May 1 through September 30. Annual emissions were estimated using these daily results as input to the formula below:

(JanWD x 152 days) + (JanWE x 60 days) + (JulWD x 109 days) + (JulWE x 44 days) = Annual Average Emissions

In Table II-9, the default Statewide temperatures and Reid vapor pressure (RVP) values used are listed for each model scenario. Pechan also accounted for local fuel-related programs that would affect NONROAD model engine emissions. A listing of the areas with county-specific fuel programs are presented in Tables II-10 through II-13. In addition, the characteristics or input values needed to model these programs in NONROAD are presented. Table II-10 provides a list of those areas that have year-round Stage II programs in place. Tables II-11 and II-12 show the summer season RVP values assumed for areas with reformulated gasoline and low RVP programs, as well as year-round oxygenated fuel programs that are part of RFG programs. Table II-13 presents the weight percent oxygen (O_2) levels used for the 2018 runs. Iowa, Minnesota, and El Paso County, Texas are the only areas with official oxygenated fuel programs. For the remaining areas, it was established that some blending of ethanol into their fuel is occurring, even though no regulatory requirement is in effect (STI, 2004). The 2018 diesel fuel sulfur values reflect the requirements of the Clean Air Diesel Rule that all nonroad diesel fuel meet 15 parts per million sulfur content by the year 2015. Per the requirements of the Tier 2 and gasoline sulfur rulemaking, the gasoline sulfur levels were also revised to 30 parts per million.

Table II-9. Statewide Temperature and RVP Inputs for 2018 NONROAD Model Runs

State FIPS	State	Typical Day	Minimum Temperature, ºF	Maximum Temperature, ºF	Average Temperature, ºF	RVP, psi
5	Arkansas	July	72	93	82	9
		January	31	50	40	13
19	Iowa	July	66	86	76	8.3
		January	12	29	20	13.2
20	Kansas	July	68	89	78	8.2
		January	17	37	27	13.2
22	Louisiana	July	73	91	82	9
		January	40	60	50	13
27	Minnesota	July	63	83	73	8.7
		January	4	22	13	13.4
29	Missouri	July	67	90	78	8.4
		January	22	42	32	13.2
31	Nebraska	July	66	88	77	8.3
		January	13	33	23	13.2
40	Oklahoma	July	71	93	82	9
		January	26	47	36	13
48	Texas	July	77	96	86	9
		January	36	55	45	13

Table II-10. CENRAP Stage II Refueling Programs

FIPS State Code	State Name	FIPS County Code	County Name	Effectiveness
22	LOUISIANA	5	Ascension Parish	95
22	LOUISIANA	33	East Baton Rouge Parish	95
22	LOUISIANA	47	Iberville Parish	95
22	LOUISIANA	63	Livingston Parish	95
22	LOUISIANA	77	Pointe Coupee Parish	95
22	LOUISIANA	121	West Baton Rouge Parish	95
29	MISSOURI	71	Franklin County	95
29	MISSOURI	99	Jefferson County	95
29	MISSOURI	183	St. Charles County	95
29	MISSOURI	189	St. Louis County	95
29	MISSOURI	510	St. Louis city	95
48	TEXAS	39	Brazoria County	95
48	TEXAS	71	Chambers County	95
48	TEXAS	85	Collin County	95
48	TEXAS	113	Dallas County	95
48	TEXAS	121	Denton County	95
48	TEXAS	141	El Paso County	95
48	TEXAS	157	Fort Bend County	95
48	TEXAS	167	Galveston County	95
48	TEXAS	199	Hardin County	95
48	TEXAS	201	Harris County	95
48	TEXAS	245	Jefferson County	95
48	TEXAS	291	Liberty County	95
48	TEXAS	339	Montgomery County	95
48	TEXAS	361	Orange County	95
48	TEXAS	439	Tarrant County	95
48	TEXAS	473	Waller County	95

Table II-11. CENRAP Reformulated Gasoline Programs

FIPS State Code	State Name	FIPS County Code	County Name	RVP	O2, wt %
29	MISSOURI	71	Franklin County	6.8	2.1
29	MISSOURI	99	Jefferson County	6.8	2.1
29	MISSOURI	183	St. Charles County	6.8	2.1
29	MISSOURI	189	St. Louis County	6.8	2.1
29	MISSOURI	510	St. Louis city	6.8	2.1
48	TEXAS	39	Brazoria County	6.7	2.1
48	TEXAS	71	Chambers County	6.7	2.1
48	TEXAS	85	Collin County	6.7	2.1
48	TEXAS	113	Dallas County	6.7	2.1
48	TEXAS	121	Denton County	6.7	2.1
48	TEXAS	157	Fort Bend County	6.7	2.1
48	TEXAS	167	Galveston County	6.7	2.1
48	TEXAS	201	Harris County	6.7	2.1
48	TEXAS	291	Liberty County	6.7	2.1
48	TEXAS	339	Montgomery County	6.7	2.1
48	TEXAS	439	Tarrant County	6.7	2.1
48	TEXAS	473	Waller County	6.7	2.1

Table II-12. CENRAP Low RVP Programs

FIPS State Code	State Name	FIPS County Code	County Name	RVP
20	KANSAS	091	JOHNSON	7.0
20	KANSAS	209	WYANDOTTE	7.0
22	LOUISIANA	005	ASCENSION PARISH	7.8
22	LOUISIANA	033	EAST BATON ROUGE PARISH	7.8
22	LOUISIANA	047	IBERVILLE PARISH	7.8
22	LOUISIANA	063	LIVINGSTON PARISH	7.8
22	LOUISIANA	077	POINTE COUPEE PARISH	7.8
22	LOUISIANA	121	WEST BATON ROUGE PARISH	7.8
29	MISSOURI	047	CLAY	7.0
29	MISSOURI	095	JACKSON	7.0
29	MISSOURI	165	PLATTE	7.0
48	TEXAS	001	ANDERSON	7.5
48	TEXAS	005	ANGELINA	7.5
48	TEXAS	007	ARANSAS	7.5
48	TEXAS	013	ATASCOSA	7.5
48	TEXAS	015	AUSTIN	7.5
48	TEXAS	021	BASTROP	7.5
48	TEXAS	025	BEE	7.5
48	TEXAS	027	BELL	7.5
48	TEXAS	029	BEXAR	7.5
48	TEXAS	035	BOSQUE	7.5
48	TEXAS	037	BOWIE	7.5
48	TEXAS	041	BRAZOS	7.5
48	TEXAS	051	BURLESON	7.5
48	TEXAS	055	CALDWELL	7.5
48	TEXAS	057	CALHOUN	7.5
48	TEXAS	063	CAMP	7.5
48	TEXAS	067	CASS	7.5
48	TEXAS	073	CHEROKEE	7.5
48	TEXAS	089	COLORADO	7.5
48	TEXAS	091	COMAL	7.5
48	TEXAS	097	COOKE	7.5
48	TEXAS	099	CORYELL	7.5
48	TEXAS	119	DELTA	7.5
48	TEXAS	123	DEWITT	7.5
48	TEXAS	139	ELLIS	7.5
48	TEXAS	141	EL PASO	7.0
48	TEXAS	145	FALLS	7.5
48	TEXAS	147	FANNIN	7.5
48	TEXAS	149	FAYETTE	7.5
48	TEXAS	159	FRANKLIN	7.5
48	TEXAS	161	FREESTONE	7.5

Table II-12 (continued)

FIPS State Code	State Name	FIPS County Code	County Name	RVP
48	TEXAS	175	GOLIAD	7.5
48	TEXAS	177	GONZALES	7.5
48	TEXAS	181	GRAYSON	7.5
48	TEXAS	183	GREGG	7.5
48	TEXAS	185	GRIMES	7.5
48	TEXAS	187	GUADALUPE	7.5
48	TEXAS	199	HARDIN	7.5
48	TEXAS	203	HARRISON	7.5
48	TEXAS	209	HAYS	7.5
48	TEXAS	213	HENDERSON	7.5
48	TEXAS	217	HILL	7.5
48	TEXAS	221	HOOD	7.5
48	TEXAS	223	HOPKINS	7.5
48	TEXAS	225	HOUSTON	7.5
48	TEXAS	231	HUNT	7.5
48	TEXAS	239	JACKSON	7.5
48	TEXAS	241	JASPER	7.5
48	TEXAS	245	JEFFERSON	7.5
48	TEXAS	251	JOHNSON	7.5
48	TEXAS	255	KARNES	7.5
48	TEXAS	257	KAUFMAN	7.5
48	TEXAS	277	LAMAR	7.5
48	TEXAS	285	LAVACA	7.5
48	TEXAS	287	LEE	7.5
48	TEXAS	289	LEON	7.5
48	TEXAS	293	LIMESTONE	7.5
48	TEXAS	297	LIVE OAK	7.5
48	TEXAS	309	MCLENNAN	7.5
48	TEXAS	313	MADISON	7.5
48	TEXAS	315	MARION	7.5
48	TEXAS	321	MATAGORDA	7.5
48	TEXAS	331	MILAM	7.5
48	TEXAS	343	MORRIS	7.5
48	TEXAS	347	NACOGDOCHES	7.5
48	TEXAS	349	NAVARRO	7.5
48	TEXAS	351	NEWTON	7.5
48	TEXAS	355	NUECES	7.5
48	TEXAS	361	ORANGE	7.5
48	TEXAS	365	PANOLA	7.5
48	TEXAS	367	PARKER	7.5
48	TEXAS	373	POLK	7.5
48	TEXAS	379	RAINS	7.5

Table II-12 (continued)

FIPS State Code	State Name	FIPS County Code	County Name	RVP
48	TEXAS	387	RED RIVER	7.5
48	TEXAS	391	REFUGIO	7.5
48	TEXAS	395	ROBERTSON	7.5
48	TEXAS	397	ROCKWALL	7.5
48	TEXAS	401	RUSK	7.5
48	TEXAS	403	SABINE	7.5
48	TEXAS	405	SAN AUGUSTINE	7.5
48	TEXAS	407	SAN JACINTO	7.5
48	TEXAS	409	SAN PATRICIO	7.5
48	TEXAS	419	SHELBY	7.5
48	TEXAS	423	SMITH	7.5
48	TEXAS	425	SOMERVELL	7.5
48	TEXAS	449	TITUS	7.5
48	TEXAS	453	TRAVIS	7.5
48	TEXAS	455	TRINITY	7.5
48	TEXAS	457	TYLER	7.5
48	TEXAS	459	UPSHUR	7.5
48	TEXAS	467	VAN ZANDT	7.5
48	TEXAS	469	VICTORIA	7.5
48	TEXAS	471	WALKER	7.5
48	TEXAS	477	WASHINGTON	7.5
48	TEXAS	481	WHARTON	7.5
48	TEXAS	491	WILLIAMSON	7.5
48	TEXAS	493	WILSON	7.5
48	TEXAS	497	WISE	7.5
48	TEXAS	499	WOOD	7.5

Table II-13. CENRAP Oxygenated Fuel Inputs

FIPS State Code	State Name	Area/County	O2, wt %
05	ARKANSAS	Statewide	0.30
19	IOWA	Statewide	1.94
20	KANSAS	Statewide	0.14
22	LOUISIANA	Statewide	0.27
27	MINNESOTA	Statewide	3.32
29	MISSOURI	Statewide	0.32
31	NEBRASKA	Statewide	1.47
40	OKLAHOMA	Statewide	0.0
48	TEXAS	El Paso County	2.7

1. Growth

Growth factors in NONROAD2004 are based on national, historical changes in fuel-specific equipment populations. Pechan has concerns about using growth rates that vary significantly from the model growth rates without fully evaluating the impact the revised growth rates may have on other related activity variables such as median life and scrappage rates. Pechan did, however, reflect State differences in growth rates by adjusting the NONROAD model growth rates for several significant nonroad categories, as identified in CENRAP's 2002 base year NONROAD model inventory (STI, 2004). These adjustments were made using State-level growth rates based on surrogate socioeconomic indicators believed to correlate with activity for each category. These data are available from the REMI model, and are incorporated into EGAS (Houyoux, 2004). The proposed methodology for making these adjustments was first documented in a technical memorandum prepared for CENRAP (Pechan, 2005). The NONROAD priority categories, along with the socioeconomic indicator used to adjust the national growth rate for each category, are listed in Table II-14. Note that employment and value added data are available from REMI for the Agricultural Production sector (SIC 01, 02). This is expected to be a suitable surrogate for the growth in farm equipment, but growth rates for these variables were not calculated separately in REMI for each State, and are reported as the same value for all States. As such, Pechan used *Output in Agricultural Services* (SIC 07) as a surrogate indicator for farm equipment growth.

Table II-15 lists the NONROAD national growth factor value for 2018 (relative to 2002 base year) for each of the priority categories. Unlike other nonroad categories, separate growth rates are included in NONROAD for some of the specific recreational equipment applications, such as ATVs and Off-Highway Motorcycles. Table II-16 lists the 2018 growth factors for each chosen REMI surrogate indicator. Values are presented for each CENRAP State, as well as the nation. The general equation used to make this adjustment is shown below, along with an example of this calculation for gasoline lawn and garden equipment:

$$NRDGR_{ST} = NRDGR_{NAT} \times (REMIGR_{ST}/REMIGR_{NAT})$$

Table II-14. NONROAD Model Priority Growth Categories and REMI Data for Adjusting National NONROAD Growth Rates

SCC	SCC Description	NONROAD Model Growth Indicator Code	REMI Code	REMI Code Description
2270002000	Diesel Construction	21	604	Construction Employment - SIC 15, 16, 17
2270005000	Diesel Farm	31	165	Agricultural Services Output - SIC 07
2260004000 2265004000	2-Stroke Gasoline Lawn and Garden 4-Stroke Gasoline Lawn and Garden	52	901	Population (Thousands)
2282005000 2282010000	2-Stroke Gasoline Recreational Marine 4-Stroke Gasoline Recreational Marine	92	903	Real Disposable Personal Income
2260001030 2265001030	2-Stroke Gasoline ATVs 4-Stroke Gasoline ATVs	95 96	903	Real Disposable Personal Income
2260001010 2265001010	2-Stroke Gasoline Off-Highway Motorcycles 4-Stroke Gasoline Off-Highway Motorcycles	97	903	Real Disposable Personal Income
2260001020	2-Stroke Gasoline Snowmobiles	98	903	Real Disposable Personal Income
2282005015	2-Stroke Gasoline Recreational Marine - Personal Watercraft	99	903	Real Disposable Personal Income

Table II-15. NONROAD Model Category Growth Factors for 2018

Category	Indicator Code	Growth Factor[1]
Diesel Construction	21	1.432
Diesel Farm	31	1.389
2 and 4-stroke Gasoline Lawn and Garden	52	1.337
2 and 4-stroke Gasoline Recreational Marine	92	1.146
2-stroke Gasoline ATVs	95	2.756
4-stroke Gasoline ATVs	96	2.105
2 and 4-stroke Gasoline Off-Highway Motorcycles	97	1.925
2-Stroke Gasoline Snowmobiles	98	1.705
2-Stroke Gasoline Recreational Marine - Personal Watercraft	99	1.146

NOTE: [1]Growth factor values calculated relative to base year 2002.

Table II-16. REMI State and National Growth Factors for 2018

REMI CODE	CODEDESC	STFIPS	Geographic Area	Growth Factor[1]
604	Construction - SIC 15, 16, 17	05	Arkansas	1.035
604	Construction - SIC 15, 16, 17	19	Iowa	1.049
604	Construction - SIC 15, 16, 17	20	Kansas	1.016
604	Construction - SIC 15, 16, 17	22	Louisiana	1.120
604	Construction - SIC 15, 16, 17	27	Minnesota	1.005
604	Construction - SIC 15, 16, 17	29	Missouri	1.023
604	Construction - SIC 15, 16, 17	31	Nebraska	1.011
604	Construction - SIC 15, 16, 17	40	Oklahoma	1.098
604	Construction - SIC 15, 16, 17	48	Texas	1.011
604	Construction - SIC 15, 16, 17	NA	National	1.025
165	Agricultural Services	05	Arkansas	1.117
165	Agricultural Services	19	Iowa	1.301
165	Agricultural Services	20	Kansas	1.329
165	Agricultural Services	22	Louisiana	1.330
165	Agricultural Services	27	Minnesota	1.334
165	Agricultural Services	29	Missouri	1.391
165	Agricultural Services	31	Nebraska	1.281
165	Agricultural Services	40	Oklahoma	1.358
165	Agricultural Services	48	Texas	1.400
165	Agricultural Services	NA	National	1.376
901	Population (Thousands)	05	Arkansas	1.173
901	Population (Thousands)	19	Iowa	1.126
901	Population (Thousands)	20	Kansas	1.160
901	Population (Thousands)	22	Louisiana	1.138
901	Population (Thousands)	27	Minnesota	1.171
901	Population (Thousands)	29	Missouri	1.150
901	Population (Thousands)	31	Nebraska	1.144
901	Population (Thousands)	40	Oklahoma	1.253
901	Population (Thousands)	48	Texas	1.299
901	Population (Thousands)	NA	National	1.218
903	Real Disposable Personal Income	05	Arkansas	1.561
903	Real Disposable Personal Income	19	Iowa	1.519
903	Real Disposable Personal Income	20	Kansas	1.550
903	Real Disposable Personal Income	22	Louisiana	1.588
903	Real Disposable Personal Income	27	Minnesota	1.576
903	Real Disposable Personal Income	29	Missouri	1.540
903	Real Disposable Personal Income	31	Nebraska	1.530
903	Real Disposable Personal Income	40	Oklahoma	1.621
903	Real Disposable Personal Income	48	Texas	1.665
903	Real Disposable Personal Income	NA	National	1.596

NOTE: [1]Growth factor values calculated relative to base year 2002.

where:

$NRDGR_{ST}$	=	Revised NONROAD State-level Growth Rate
$NRDGR_{NAT}$	=	Base NONROAD National Growth Rate
$REMIGR_{ST}$	=	State REMI Growth Rate
$REMIGR_{NAT}$	=	National REMI Growth Rate

The revised growth rate for gasoline lawn and garden equipment in Oklahoma is calculated as follows:

$$NRDGR_{ST} = 1.337 \times (1.253 \div 1.218)$$
$$= 1.374$$

Table II-17 shows the adjusted 2018 growth factors calculated for all CENRAP States for all priority equipment categories, and compares these values to the NONROAD model default growth factor values.

Pechan prepared a revised NATION.GRW file for use in the NONROAD model. Once 2002-based growth rates were calculated, Pechan normalized these rates to reflect the 2002 year value in the NATION.GRW file. Since this year was not reported for most category codes, these 2002 data were calculated using linear interpolation of values reported for the most recent prior year and closest future year. Pechan then incorporated 2018 data for each of the appropriate indicator codes for all CENRAP States. State-specific records for historic years prior to 2002 were also added (since base year population values for most equipment types are for 1996 or 1998) using the same values as the national-level indicators.

2. Controls

EPA's NONROAD2004 model incorporates the effects of most final Federal standards, including the Tier 4 diesel engine standards and the exhaust emission standards for large spark-ignition (S-I) engines, diesel marine, and land-based recreational engines. The only remaining federal standards not modeled by NONROAD2004 include permeation and evaporative emission standards for gasoline recreational and large S-I engines, respectively. The evaporative standards for recreational equipment only affect permeation emissions, which are not currently included in NONROAD2004. These standards do not affect any other evaporative emission components in the model (i.e., diurnal or refueling). Therefore, Pechan did not model the recreational equipment permeation emission standards. Pechan developed an estimate of the emission reductions due to the large S-I standard to apply to the affected SCCs as a post-processing adjustment, which is discussed below.

For the large S-I evaporative standards, Pechan obtained overall emission reduction information from the Large S-I Regulatory Support Document (EPA, 2002). Using large S-I evaporative base and control case future year inventories, emission reductions were estimated for 2018. These emission reductions vary by evaporative component, but for this analysis Pechan summed the emissions across all components to estimate emission reductions for all evaporative

Table II-17. Adjusted 2018 Growth Factors for Nonroad Priority Equipment Categories

State FIPS	State Name	NONROAD Growth Factor[1]	Adjusted Growth Factor[1]	Percent Difference
2 and 4-stroke Gasoline Lawn and Garden - Indicator Code 52				
5	Arkansas	1.337	1.287	-3.9
19	Iowa	1.337	1.235	-8.3
20	Kansas	1.337	1.273	-5
22	Louisiana	1.337	1.249	-7
27	Minnesota	1.337	1.284	-4.1
29	Missouri	1.337	1.261	-6
31	Nebraska	1.337	1.255	-6.5
40	Oklahoma	1.337	1.374	2.7
48	Texas	1.337	1.424	6.1
Diesel Construction - Indicator Code 21				
5	Arkansas	1.432	1.446	1
19	Iowa	1.432	1.466	2.3
20	Kansas	1.432	1.419	-0.9
22	Louisiana	1.432	1.565	8.5
27	Minnesota	1.432	1.404	-2
29	Missouri	1.432	1.429	-0.2
31	Nebraska	1.432	1.412	-1.4
40	Oklahoma	1.432	1.534	6.6
48	Texas	1.432	1.412	-1.4
Diesel Farm - Indicator Code 31				
5	Arkansas	1.389	1.127	-23.2
19	Iowa	1.389	1.314	-5.7
20	Kansas	1.389	1.342	-3.5
22	Louisiana	1.389	1.343	-3.4
27	Minnesota	1.389	1.346	-3.2
29	Missouri	1.389	1.404	1.1
31	Nebraska	1.389	1.293	-7.4
40	Oklahoma	1.389	1.37	-1.4
48	Texas	1.389	1.413	1.7
2 and 4-stroke Gasoline Recreational Marine - Indicator Code 92				
5	Arkansas	1.146	1.121	-2.2
19	Iowa	1.146	1.091	-5
20	Kansas	1.146	1.113	-3
22	Louisiana	1.146	1.141	-0.4
27	Minnesota	1.146	1.132	-1.2
29	Missouri	1.146	1.106	-3.6
31	Nebraska	1.146	1.099	-4.3
40	Oklahoma	1.146	1.165	1.6
48	Texas	1.146	1.196	4.2
2-stroke Gasoline ATVs - Indicator Code 95				
5	Arkansas	2.756	2.696	-2.2
19	Iowa	2.756	2.623	-5.1
20	Kansas	2.756	2.677	-3
22	Louisiana	2.756	2.742	-0.5

Table II-17 (continued)

State FIPS	State Name	NONROAD Growth Factor[1]	Adjusted Growth Factor[1]	Percent Difference
27	Minnesota	2.756	2.721	-1.3
29	Missouri	2.756	2.659	-3.6
31	Nebraska	2.756	2.642	-4.3
40	Oklahoma	2.756	2.8	1.6
48	Texas	2.756	2.875	4.1
4-stroke Gasoline ATVs - Indicator Code 96				
5	Arkansas	2.105	2.059	-2.2
19	Iowa	2.105	2.003	-5.1
20	Kansas	2.105	2.045	-2.9
22	Louisiana	2.105	2.095	-0.5
27	Minnesota	2.105	2.078	-1.3
29	Missouri	2.105	2.031	-3.6
31	Nebraska	2.105	2.018	-4.3
40	Oklahoma	2.105	2.139	1.6
48	Texas	2.105	2.196	4.1
2 and 4-stroke Gasoline Off-Highway Motorcycles - Indicator Code 97				
5	Arkansas	1.925	1.884	-2.2
19	Iowa	1.925	1.832	-5.1
20	Kansas	1.925	1.87	-2.9
22	Louisiana	1.925	1.916	-0.5
27	Minnesota	1.925	1.901	-1.3
29	Missouri	1.925	1.858	-3.6
31	Nebraska	1.925	1.846	-4.3
40	Oklahoma	1.925	1.956	1.6
48	Texas	1.925	2.009	4.2
2-Stroke Gasoline Snowmobiles - Indicator Code 98				
5	Arkansas	1.705	1.669	-2.2
19	Iowa	1.705	1.623	-5.1
20	Kansas	1.705	1.657	-2.9
22	Louisiana	1.705	1.697	-0.5
27	Minnesota	1.705	1.684	-1.2
29	Missouri	1.705	1.646	-3.6
31	Nebraska	1.705	1.635	-4.3
40	Oklahoma	1.705	1.733	1.6
48	Texas	1.705	1.779	4.2
2-Stroke Gasoline Recreational Marine - Personal Watercraft - Indicator Code 99				
5	Arkansas	1.146	1.121	-2.2
19	Iowa	1.146	1.091	-5
20	Kansas	1.146	1.113	-3
22	Louisiana	1.146	1.141	-0.4
27	Minnesota	1.146	1.132	-1.2
29	Missouri	1.146	1.106	-3.6
31	Nebraska	1.146	1.099	-4.3
40	Oklahoma	1.146	1.165	1.6
48	Texas	1.146	1.196	4.2

NOTE: [1]Growth factor values calculated relative to base year 2002.

emissions combined, as well as crankcase emissions. Large S-I evaporative emission reductions for 2018 were estimated to be 78.1 percent.

Pechan calculated two rule penetration adjustments to account for the fraction of the SCC-level emissions that are affected by the rule. Since the rule only affects large S-I engines greater than 25 horsepower, the first adjustment was developed to reflect that fraction of the activity associated with these larger engines. This was estimated using 2002 national gasoline consumption results by horsepower and equipment category from NONROAD2004. As a simplifying assumption, we used the 2002 rule penetration value for 2018 and for all applications within a category, though this is likely to vary by year and application. Table II-18 provides a summary of the horsepower-related rule penetration values by equipment category. A second rule penetration adjustment by SCC was also developed to account for that fraction of the SCC-level emissions associated with evaporative VOC relative to the total VOC emissions (i.e., exhaust plus evaporative). Final emission reductions by SCC are presented in Table II-19. These emission reductions were applied directly to the SCC-level output from the NONROAD model as a post-processing step.

The following equation shows an example of how overall adjusted emission reductions were estimated for 4-stroke industrial forklifts in 2018:

$$ER_{ADJ} = RP_{hp} \times RP_{evap} \times ER$$

Table II-18. Horsepower-Related Rule Penetration Values by Category for Large S-I Evaporative Standards

Fuel Type	Classification	Rule Penetration
Gasoline	Agricultural Equipment	0.40
Gasoline	Airport Equipment	0.74
Gasoline	Commercial Equipment	0.05
Gasoline	Construction and Mining Equipment	0.14
Gasoline	Industrial Equipment	0.59
Gasoline	Commercial Lawn and Garden Equipment	0.07
Gasoline	Railroad Equipment	0.04
Gasoline	Recreational Equipment[1]	0.43
CNG	All Classifications	1.0
LPG	All Classifications	1.0

NOTE: [1]Applies to specialty vehicle carts only; other recreational equipment covered by recreational standards.

Table II-19. Control Effectiveness Values by SCC for Large S-I Evaporative Standards in 2018

SCC	Percent Control Effectiveness
2260001060	11.2
2260002006	0.3
2260002009	0.6
2260002021	0.6
2260002027	0.3
2260002039	0.1
2260002054	0.3
2260003030	3.8
2260003040	2.7
2260004016	0.9
2260004021	1
2260004026	1.1
2260004031	0.4
2260004036	0.2
2260004071	0.2
2260005035	3.7
2260005050	1.6
2260006005	0.4
2260006010	0.3
2260006015	0.2
2265001060	7.3
2265002003	1.4
2265002006	1.5
2265002009	1.1
2265002015	1.2
2265002021	1.7
2265002024	1.1
2265002027	1
2265002030	1.2
2265002033	2
2265002039	1
2265002042	2.8
2265002045	4.1
2265002054	1.3
2265002057	5.7
2265002060	6.5
2265002066	1
2265002072	2.7
2265002078	2.9
2265002081	5
2265003010	14.5
2265003020	24.4
2265003030	9
2265003040	5
2265003050	13.1
2265003060	5
2265003070	25.8

Table II-19 (continued)

SCC	Percent Control Effectiveness
2265004011	1.5
2265004016	1.9
2265004026	2.6
2265004031	1.8
2265004036	1.8
2265004041	0.9
2265004046	1.2
2265004051	1.9
2265004056	0.8
2265004066	0.9
2265004071	0.6
2265004076	1.9
2265005010	3.4
2265005015	8.3
2265005020	18.4
2265005025	20.4
2265005030	4.7
2265005035	9.5
2265005040	7.2
2265005045	18.3
2265005050	3.6
2265005055	11.6
2265005060	14.5
2265006005	1
2265006010	0.8
2265006015	0.6
2265006025	0.7
2265006030	0.8
2265008005	11.5
2265010010	3
2267001060	17.5
2267002003	6.6
2267002021	12.6
2267002024	6.1
2267002030	6.3
2267002033	17
2267002045	10.9
2267002054	10.4
2267002057	7.7
2267002060	1
2267002072	11.7
2267002081	13.1
2267003010	13.7
2267003020	0.8
2267003030	0.1
2267003050	9.6
2267005050	8
2267005055	17.6

Table II-19 (continued)

SCC	Percent Control Effectiveness
2267006005	17.2
2267006010	13.8
2267006015	4.7
2267006025	4.3
2267006030	11.5
2268002081	12.9
2268003020	0.9
2268003030	0.3
2268003060	2.7
2268006005	17.6
2268006010	15.3
2268006015	5.8
2285004015	0.6
2285006015	9.8

where:

ER_{ADJ}	=	adjusted emission reduction accounting for rule penetration
RP_{hp}	=	rule penetration for affected horsepower fraction
RP_{evap}	=	rule penetration for evaporative fraction of total VOC emissions
ER	=	evaporative emission reduction for affected engines

$$
\begin{aligned}
ER_{ADJ} &= 0.590 \text{ x } 0.529 \text{ x } 0.781 \\
&= 0.244 \\
&= 24.4 \text{ percent}
\end{aligned}
$$

a. State Controls

In addition to Federal controls, Pechan accounted for regulations in Texas that control nonroad refueling spillage emissions from use of portable fuel containers. Similar to the large S-I evaporative standard modeling discussed above, Pechan calculated two rule penetration adjustments accounting for the appropriate fraction of the SCC-level emissions affected by the rule. The first adjustment was developed to reflect that fraction of the SCC emissions associated with equipment fueled with a portable fuel container. Nonroad equipment refueled by a portable container are generally smaller horsepower engines than those refueled at service stations. A second rule penetration adjustment by SCC was also developed to account for that fraction of the SCC-level emissions associated with evaporative spillage VOC relative to the total VOC emissions (i.e., exhaust plus evaporative). These adjustments were both estimated using 2002 national evaporative VOC emissions data by horsepower, equipment category, and evaporative component, from NONROAD2004. Control efficiency was assumed to be 100 percent, and full equipment turnover of gas cans should be achieved by 2018.

The final emission reductions by SCC are presented in Table II-20. These emission reductions were applied directly to the appropriate SCCs as a post-processing step for all counties in Texas.

3. Non-NONROAD Model

Pechan compiled control information for commercial marine vessels and locomotives. Standards affecting these categories are Federal standards that affect all areas of the nation. No additional local controls were modeled in the CENRAP region for these categories.

In 2003, EPA proposed aircraft engine NO_x emission standards that will bring U.S. aircraft standards into alignment with standards developed by the International Civil Aviation Organization. EPA did not prepare emission reduction estimates for these standards because any such reductions would be modest (e.g., 94 percent of aircraft engines are currently meeting or exceeding these standards). Therefore, Pechan did not account for emission reductions from these standards for this analysis.

Table II-20. 2018 VOC Emission Reductions by SCC for Texas Portable Container Rule

SCC	Percent VOC Reduction
2260001010	0.8%
2260001030	2.7%
2260003030	6.6%
2260003040	4.2%
2260004015	14.3%
2260004016	15.7%
2260004020	39.1%
2260004021	17.7%
2260004025	19.9%
2260004026	19.7%
2260004030	5.5%
2260004031	5.4%
2260004035	3.2%
2260004071	2.1%
2260006005	6.1%
2260006010	5.4%
2260006015	4.0%
2260007005	9.1%
2265001010	5.5%
2265001030	7.0%
2265001060	0.1%
2265003010	0.3%
2265003030	2.3%
2265003040	4.3%
2265003050	0.0%
2265004010	23.5%
2265004011	25.7%
2265004015	29.9%
2265004016	33.0%
2265004025	39.4%
2265004026	46.7%
2265004030	13.0%
2265004031	28.7%
2265004035	15.6%
2265004040	6.3%
2265004041	9.1%
2265004046	8.8%
2265004051	31.8%
2265004055	7.0%
2265004056	8.7%
2265004066	3.1%
2265004071	4.2%
2265004075	3.8%
2265004076	3.8%
2265006005	4.6%
2265006010	9.7%
2265006015	6.4%
2265006025	10.2%
2265006030	9.6%
2265007010	52.4%

a. Locomotives

Emission reduction impacts of the Federal locomotive engine standards are available in an EPA Regulatory Support Document (EPA, 1998). This document contains emission reduction information specific to Class I Operations, Class II/III Operations, Passenger Trains (Amtrak and Commuter Lines), and Switch (Yard) Locomotives. Year-specific percentage reduction estimates for select pollutants are available for each locomotive sector for each year over the 1999-2040 period. These emission reductions reflect the control technology efficiencies, as well as the expected rule penetration for the years of interest. Rule effectiveness was assumed to be 100 percent.

In addition, overall SO_2, PM_{10}, and $PM_{2.5}$ emission reductions associated with decreases in the diesel fuel sulfur content were also included. These were estimated from future base case and control case locomotive emission inventories prepared for EPA's regulatory impact analysis (RIA) for the Clean Air Diesel Rule (EPA, 2004). In the case of PM, since exhaust PM standards already apply to locomotives, a combined emission reduction was calculated for each future year that accounted for both the exhaust standards and reductions in PM sulfate due to the fuel sulfur limits. Table II-21 presents the 2018 emission reductions that apply to locomotive SCC emissions.

b. Commercial Marine Vessels

EPA has promulgated two sets of commercial marine vessel regulations: a regulation setting Category 1 and 2 marine diesel engine standards and a regulation setting Category 3 marine diesel engine standards. Category 1 marine diesel engines are defined as engines of greater than 37 kilowatts but with a per-cylinder displacement of 5 liters/cylinder or less. Category 2 marine diesel engines cover engines of 5 to 30 liters/cylinder, and Category 3 marine diesel engines include the remaining, very large, engines. For this analysis, overall emission reductions were estimated for each projection year of interest using information from the regulatory support documents prepared for these rulemakings (EPA, 1999; EPA, 2003). In addition to the EPA standards, beginning in 2000, marine diesel engines greater than or equal to 130 kilowatts are subject to an international NO_x emissions treaty (MARPOL) developed by the International Maritime Organization. The emission reductions reflect both the MARPOL and EPA standards.

Because the reductions vary by category of vessel, assumptions were made concerning the characterization of engines associated with diesel commercial marine vessel SCCs included in the base year inventory. For SCC 2280002100 (Marine Vessels, Commercial Diesel Port emissions), Category 2 engines were assumed. For SCC 2280002200 (Marine Vessels, Commercial Diesel Underway emissions), Category 3 engines were assumed.

Table II-21. 2018 Emission Reductions and Control Information for Federal Rail Standards[1]

SCC	SCC Description	Pollutant	2018 Emission Reduction, %	2018 Control Efficiency	2018 Rule Effectiveness	2018 Rule Penetration
2285000000	Railroad Equipment All Fuels Total	NOX	47.7	62	100	76.9
2285002000	Railroad Equipment Diesel Total	NOX	47.7	62	100	76.9
2285002006	Railroad Equipment Diesel Line Haul Locomotives: Class I Operations	NOX	52	62	100	83.9
2285002007	Railroad Equipment Diesel Line Haul Locomotives: Class II / III Operations	NOX	13	62	100	21
2285002008	Railroad Equipment Diesel Line Haul Locomotives: Passenger Trains (Amtrak)	NOX	51	62	100	82.3
2285002009	Railroad Equipment Diesel Line Haul Locomotives: Commuter Lines	NOX	51	62	100	82.3
2285002010	Railroad Equipment Diesel Yard Locomotives	NOX	31	58	100	53.4
2285000000	Railroad Equipment All Fuels Total	PM10-PRI	42.31			
2285002000	Railroad Equipment Diesel Total	PM10-PRI	42.31			
2285002006	Railroad Equipment Diesel Line Haul Locomotives: Class I Operations	PM10-PRI	44.8			
2285002007	Railroad Equipment Diesel Line Haul Locomotives: Class II / III Operations	PM10-PRI	22.25	22.3	100	99.8
2285002008	Railroad Equipment Diesel Line Haul Locomotives: Passenger Trains (Amtrak)	PM10-PRI	43.24			
2285002009	Railroad Equipment Diesel Line Haul Locomotives: Commuter Lines	PM10-PRI	43.24			
2285002010	Railroad Equipment Diesel Yard Locomotives	PM10-PRI	30.8			
2285000000	Railroad Equipment All Fuels Total	PM25-PRI	42.31			
2285002000	Railroad Equipment Diesel Total	PM25-PRI	42.31			
2285002006	Railroad Equipment Diesel Line Haul Locomotives: Class I Operations	PM25-PRI	44.8			
2285002007	Railroad Equipment Diesel Line Haul Locomotives: Class II / III Operations	PM25-PRI	22.25	22.3	100	99.8
2285002008	Railroad Equipment Diesel Line Haul Locomotives: Passenger Trains (Amtrak)	PM25-PRI	43.24			
2285002009	Railroad Equipment Diesel Line Haul Locomotives: Commuter Lines	PM25-PRI	43.24			
2285002010	Railroad Equipment Diesel Yard Locomotives	PM25-PRI	30.8			

Table II-21 (continued)

SCC	SCC Description	Pollutant	2018 Emission Reduction, %	2018 Control Efficiency	2018 Rule Effectiveness	2018 Rule Penetration
2285000000	Railroad Equipment All Fuels Total	SO2	97.58	97.6	100	100
2285002000	Railroad Equipment Diesel Total	SO2	97.58	97.6	100	100
2285002006	Railroad Equipment Diesel Line Haul Locomotives: Class I Operations	SO2	97.58	97.6	100	100
2285002007	Railroad Equipment Diesel Line Haul Locomotives: Class II / III Operations	SO2	97.58	97.6	100	100
2285002008	Railroad Equipment Diesel Line Haul Locomotives: Passenger Trains (Amtrak)	SO2	97.58	97.6	100	100
2285002009	Railroad Equipment Diesel Line Haul Locomotives: Commuter Lines	SO2	97.58	97.6	100	100
2285002010	Railroad Equipment Diesel Yard Locomotives	SO2	97.58	97.6	100	100
2285000000	Railroad Equipment All Fuels Total	VOC	23.6	47	100	50.2
2285002000	Railroad Equipment Diesel Total	VOC	23.6	47	100	50.2
2285002006	Railroad Equipment Diesel Line Haul Locomotives: Class I Operations	VOC	27	47	100	57.4
2285002008	Railroad Equipment Diesel Line Haul Locomotives: Passenger Trains (Amtrak)	VOC	26	47	100	55.3
2285002009	Railroad Equipment Diesel Line Haul Locomotives: Commuter Lines	VOC	26	47	100	55.3
2285002010	Railroad Equipment Diesel Yard Locomotives	VOC	10	50	100	20

NOTE: [1]Values for CE, RE, and RP for PM10 and PM25 were not estimated since these values account for PM reductions due to both exhaust and fuel sulfur standards.

Similar to locomotives, overall SO_2, PM_{10} and $PM_{2.5}$ emission reductions associated with decreases in the diesel fuel sulfur content were also included based on information in EPA's RIA for the Clean Air Diesel Rule (EPA, 2004b). See Table II-22 for the 2018 emission reductions that apply to commercial marine vessel SCC emissions.

E. DEVELOPMENT OF ONROAD DATA

For the onroad projections in the CENRAP air quality modeling, Pechan provided a set of VMT growth factors in SMOKE format, along with SMOKE-formatted MOBILE6 input files. The MOBILE6 input files incorporate any Federal, State, or local control program information. Thus, control factors or emission reduction percentages are not explicitly provided for this sector, but rather are incorporated in the MOBILE6 modeling. The development of the VMT growth factors and the MOBILE6 input files are discussed below. Once VMT growth factors were calculated for all of the CENRAP States, the growth factors were multiplied by the CENRAP base year 2002 VMT data to calculate 2018 VMT. The projected 2018 VMT by county and SCC (vehicle type and roadway type) were then provided in a SMOKE-formatted file, along with the corresponding average vehicle speed for that county/SCC combination. These speed inputs are the same as those used in the 2002 CENRAP base case—no updates were made to the modeled speeds.

1. VMT Growth

a. Default VMT Growth Methodology

As indicated in the Methods Document, Pechan's proposed default VMT growth methodology was to use EGAS VMT growth factors when more specific data were not supplied by the State or local agencies. However, when attempting to prepare the EGAS VMT growth factors using the beta version of EGAS 5, Pechan encountered a bug in the EGAS code that prevented data from being output for the onroad mobile SCCs. As an alternative (but similar) methodology, Pechan developed a set of 2002 to 2018 VMT growth factors using the same methodology used by EPA in their CAIR rule analysis that had originally been developed for EPA's draft Section 812 second prospective analysis (Mullen and Neumann, 2004).

The VMT projections account for vehicle class-specific growth factors and population growth factors. The data used for the vehicle class-specific growth factors are vehicle category-specific 2002 VMT and VMT projections to 2018, both at the national level, for the following three vehicle classes: 1) Light-duty vehicles (under 8,500 lbs); 2) Commercial light trucks (between 8,500 and 10,000 lbs); and 3) Freight trucks (greater than 10,000 lbs). These national VMT projections were obtained from the 2005 Annual Energy Outlook (DOE, 2005).

The national 2002 VMT and the 2018 VMT projections were allocated to the MOBILE6 vehicle categories using the default MOBILE6 VMT fractions by vehicle type in 2002 and 2018. Overall vehicle-specific growth factors were then calculated by multiplying the ratio of the 2018 to 2002 VMT at the MOBILE6 vehicle type level.

Table II-22. 2018 Emission Reductions and Control Information for Federal Diesel Commercial Marine Standards

SCC	SCC Description	Pollutant	2018 Emission Reduction, %	2018 Control Efficiency	2018 Rule Effectiveness	2018 Rule Penetration
2280002100	Marine Vessels, Commercial Diesel Port emissions	PM25-PRI	12.14	12.1	100	100
2280002100	Marine Vessels, Commercial Diesel Port emissions	PM10-PRI	12.14	12.1	100	100
2280002100	Marine Vessels, Commercial Diesel Port emissions	SO2	97.58	97.6	100	100
2280002100	Marine Vessels, Commercial Diesel Port emissions	NOX	20.46	43.7	100	46.8
2280002200	Marine Vessels, Commercial Diesel Underway emissions	PM25-PRI	12.14	12.1	100	100
2280002200	Marine Vessels, Commercial Diesel Underway emissions	PM10-PRI	12.14	12.1	100	100
2280002200	Marine Vessels, Commercial Diesel Underway emissions	SO2	97.58	97.6	100	100
2280002200	Marine Vessels, Commercial Diesel Underway emissions	NOX	14.88	43.2	100	34.4

Different levels of population growth throughout the CENRAP States were accounted for by calculating the ratio of county level population growth to national population growth. The population estimates used in these calculations were the EGAS population projections derived from Census population estimates and the REMI demographic/migration module which forecasts regional population change (REMI, 1997).

These resulting growth factors were then multiplied by the CENRAP 2002 VMT data at the county/roadway type/vehicle type level of detail to obtain projected 2018 VMT data. This is illustrated in the following equation:

$$VMT18_{C,V,R} = VMT02_{,C,V,R} * (VMT_{EIA18,V} / VMT_{EIA02,V}) * [(POP_{18,C}/POP02_{,C})/(POP_{18,US}/POP_{02,US})]$$

where:

$VMT18_{C,V,R}$	=	2018 projected VMT for county *C*, vehicle type *V*, road type *R* (million miles)
$VMT02_{C,V,R}$	=	2002 CENRAP VMT for county *C*, vehicle type *V*, road type *R* (million miles)
$VMT_{EIA20,\ \ V}$	=	2020 EIA-based VMT projection for vehicle type *V* (billion miles)
$VMT_{EIA99,V}$	=	1999 EIA-based VMT for vehicle type *V* (billion miles)
$POP_{20,C}$	=	2020 EGAS 4.0 population of county *C*
$POP_{99,C}$	=	1999 EGAS 4.0 population of county *C*
$POP_{20,US}$	=	2020 EGAS 4.0 population of *US*
$POP_{99,US}$	=	1999 EGAS 4.0 population of *US*

It should be noted that this equation does not specifically account for varying growth rates by functional roadway class. Our research in 2003 did not reveal a consistent national basis on which to make roadway-class-specific projections.

b. State or Local VMT Growth Methodology

Several State and local agencies within the CENRAP States provided data to be used in projecting VMT growth for that State or local area. Early in this project, Pechan asked the CENRAP emission inventory contacts for information on appropriate contacts from their State Departments of Transportation and from the major metropolitan planning organizations in their State. Pechan then inquired of these contacts whether they had developed their own VMT growth projections, and if so, the VMT growth data and will request any available documentation on the development of these growth factors and the growth factors themselves so that these growth factors would be applied correctly in the CENRAP projections. Responses to this request were provided by Arkansas, Iowa, Minnesota, Missouri, Nebraksa, and Oklahoma. However, the VMT projection data provided by Arkansas and Missouri were for 2003 only, and the VMT projection data provided by Nebraska were to 2009 only. Neither of these projections were considered sufficient for use in projecting VMT to 2018, so these data were discarded. Within the resources available, Pechan also attempted to locate publicly available projected VMT data for major cities within the CENRAP States that were not included in the State-provided VMT projection data and was able to obtain projected VMT information for several cities in Texas. The non-default VMT projection data used are described below.

i. Iowa

The Des Moines Area Metropolitan Planning Organization (MPO) provided projected VMT data for four counties in the Des Moines area: Dallas, Madison, Polk, and Warren. For each of these counties, daily link-level VMT data were provided for the years 2000, 2005, 2010, 2020, and 2030. For each of these years, Pechan summed the total VMT for each county and then performed a linear interpolation between the 2000 and 2005 county-level VMT totals to estimate county-level 2002 VMT. Similarly, Pechan linearly interpolated the county-level VMT totals from 2010 and 2020 to obtain an estimate of the 2018 county-level VMT totals. Finally, for each of these four counties, Pechan divided the interpolated 2018 county-level VMT by the interpolated 2002 county-level VMT to calculate a 2002 to 2018 VMT growth factor. These county-level VMT growth factors were then applied to all road types and vehicle types within the corresponding county. These growth factors are as follows: 2.09 for Dallas County, 1.64 for Madison County, 1.48 for Polk County, and 1.64 for Warren County. Default VMT growth factors were used in all other Iowa counties.

ii. Minnesota

The Minnesota Department of Transportation (MnDOT) provided a series of historical annual VMT data from 1983 to 2003. From these data, Pechan conducted a set of regression analyses with the Minnesota historical VMT as the dependent variable, and historical Minnesota values (from REMI model incorporated into EGAS 5) for the following potential independent variables: year, driving age population, gasoline and oil expenditures, real disposable per capita income, and total output. Although population came in a close second, the variable with the best statistical fit was year. Pechan solved the resulting equation with values for year of 2002 and 2018 and computed the ratio of the 2018 equation value to the 2002 equation value. This resulted in 2002 to 2018 VMT growth factor of 1.37 that was applied Statewide to all road types and vehicle types.

iii. Oklahoma

The Oklahoma DEQ provided a spreadsheet containing State total VMT from 1983 through 2020. The VMT from 1983 through 2003 were daily Highway Performance Modeling System (HPMS) actual VMT totals. The 2004 through 2020 daily VMT totals were estimated by Oklahoma DEQ using linear regression based on the actual VMT data. From these data, Pechan estimated a 2002 to 2018 State-level VMT growth factor by dividing the projected 2018 daily VMT value by the 2002 Oklahoma HPMS daily VMT value. This resulted in a growth factor of 1.2754 and was applied Statewide to all road types and vehicle types.

iv. Texas

Pechan estimated VMT growth factors for the counties in the Austin and Dallas areas, based on publicly available data.

Pechan obtained VMT for the Austin area from August 2003 TCEQ-sponsored on-road mobile source emission inventories for the Austin/San Marcos Metropolitan Statistical Area. The following counties were included in these inventories: Bastrop, Caldwell, Hays, Travis, and Caldwell. For each of these counties, daily September VMT were provided for 1995, 1999, 2002, 2005, 2007, and 2012, with separate values for Monday through Thursday, Friday, Saturday, and Sunday. Pechan summed the VMT by county in each year to obtain total VMT for a week in September. Using the 2007 and 2012 weekly September VMT data, Pechan performed a linear extrapolation to estimate 2018 weekly September VMT. County-level VMT growth factors from 2002 to 2018 were then calculated by dividing the 2018 weekly September VMT by the 2002 weekly September VMT.

Pechan obtained VMT projection data for the Dallas area from the 2004 update to the Metropolitan Transportation Plan, prepared by the North Central Texas Council of Governments. This document included 1999 and 2025 VMT data for five individual counties (Dallas, Tarrant, Denton, Collin, and Rockwall) plus two additional area groups including two counties each (Ellis and Kaufman in one group and Johnson and Parker in another group). Pechan used linear interpolation to estimate 2002 and 2018 VMT data for each of these counties or county groups and then calculated the 2002 to 2018 VMT growth factors by dividing the estimated 2018 VMT by the estimated 2002 VMT.

Table II-23 summarizes the non-default VMT growth factors applied in the CENRAP States. All of these non-default growth factors were applied to all road types and vehicle types in that county.

Table II-23. 2002 to 2018 Non-Default VMT Growth Factors Applied in CENRAP States

State	County	2002 to 2018 VMT Growth Factor
Iowa	Dallas	2.09
	Madison	1.64
	Polk	1.48
	Warren	1.64
Minnesota	All	1.37
Oklahoma	All	1.28
Texas	Bastrop	1.62
	Caldwell	1.43
	Collin	1.85
	Dallas	1.32
	Denton	1.99
	Ellis	1.79
	Hays	1.44
	Johnson	1.75
	Kaufman	1.79
	Parker	1.75
	Rockwall	1.70
	Tarrant	1.47
	Travis	1.75
	Williamson	2.18

2. SMOKE MOBILE6 Inputs

Each SMOKE-formatted MOBILE6 input file represents a single representative MOBILE6 scenario for a specific county or group of counties. For each county or group of counties modeled, two SMOKE-formatted MOBILE6 files were prepared: one representing July conditions and one representing January conditions. Within SMOKE, the July input files will be used to model the ozone season months (i.e., May through September) and the January input files will be used to represent all other months. For counties with no State or local control programs and no locally-provided inputs, these MOBILE6 inputs primarily contain the calendar year being modeled (2018) and fuel input parameters for the season being modeled. Temperature data are also provided, but these are overridden in SMOKE by temperatures specific to the month being modeled. A simple SMOKE-formatted MOBILE6 input file for a county with no local inputs is shown below:

```
SCENARIO RECORD     : ARKANSAS COUNTY, AR - WINTER
CALENDAR YEAR       : 2018
EVALUATION MONTH    : 1
ALTITUDE            : 1
MIN/MAX TEMPERATURE: 50.0 70.0
FUEL RVP            : 13.0
FUEL PROGRAM        : 1
DIESEL SULFUR       : 15.0
OXYGENATED FUELS    : 0.500  0.001  0.006  0.001  1
PARTICULATE EF      : PMGZML.CSV PMGDR1.CSV PMGDR2.CSV PMDZML.CSV PMDDR1.CSV PMDDR2.CSV
```

Note that no speed information is included in this input file. The speed information is provided in the projected VMT files at the county/roadway type level of detail. In all cases, CALENDAR YEAR was set to 2018, ALTITUDE was set to “1” (i.e., low altitude), MIN/MAX TEMPERATURE was set as shown above (as dummy temperature values), DIESEL SULFUR was set to 15.0 (i.e., 15 ppm sulfur in the diesel fuel), and the PARTICULATE EF command was set using the files listed in the example above. The EVALUATION MONTH command was set to “1” for the January input files and to “2” for the July input files. The remaining commands listed in the example above (FUEL RVP, FUEL PROGRAM, ands OXYGENATED FUELS), as well as any additional commands needed, were set according to the specifics of the county or counties being modeled.

Note that the diesel sulfur input of 15 ppm sulfur in the diesel fuel represents the expected national diesel sulfur content in 2018. This reflects the requirements of the Federal heavy-duty vehicle/low sulfur diesel rulemaking. Other Federal control programs are included in the MOBILE6 defaults, with no additional inputs needed. This includes the emission standards associated with the heavy-duty vehicle rulemaking, the Tier 2 emission standards for light-duty vehicles and trucks, as well as all prior emission standards.

Optional local inputs that were included in the MOBILE6 files that are not related to control programs are the registration distributions and diesel sales fractions. The registration distributions (a distribution of registered vehicles by age for 16 vehicle types) used in the CENRAP 2002 base year modeling were used without change in the 2018 modeling. All CENRAP States except Arkansas has included registration distributions in the 2002 modeling.

The diesel sales fractions (the fraction of vehicles sales by model year that are diesel-fueled for 14 weight categories of vehicles) from 2002 were projected forward to 2018. To do this, the vehicles sales fractions listed for the 2002 model year were carried forward to all model years from 2003 to 2018. The diesel sales fractions values from the 1994 through 2002 model years, as listed in the 2002 diesel sales fractions files, were not changed. The diesel sales fractions from model years 1978 were removed from the files, as these model years are not needed in the 2018 calendar year modeling. Diesel sales fractions were provided in the 2002 CENRAP base year modeling for all CENRAP States except Arkansas and Texas.

A set of January and July SMOKE MOBILE6 input files were created for each group of counties with a unique combination of local inputs, fuels, and control programs. Thus, since Arkansas had supplied no local inputs, and there are no county-specific control programs in the State, a single set of MOBILE6 input files is used to model the entire State of Arkansas. In most of the other States, a single set of input files models a single county since most States provided county-specific registration distributions or diesel sales fraction data.

Area-specific control programs modeled in each State are described below.

a. Inspection and Maintenance and Anti-tampering Programs

Onroad vehicle inspection and maintenance (I/M) programs and/or anti-tampering programs (ATPs) are required in specific counties in Louisiana, Missouri, and Texas. Changes to these programs have occurred or will occur such that the versions needed for the 2002 modeling were updated to best reflect the programs expected to be in place in 2018.

i. Louisiana

The Louisiana I/M program applies to the 5-parish Baton Rouge ozone nonattainment area (Ascension Parish, East Baton Rouge Parish, Iberville Parish, Livingston Parish, and West Baton Rouge Parish). The specifics of this program, in MOBILE6 format, are shown in Figure II-1.

ii. Missouri

Missouri includes a basic I/M program in Franklin County, per State regulation 11 CSR 50-2.400 “Emission Test Procedures” and an enhanced I/M program in the remainder of the St. Louis area (St. Louis City, Jefferson County, St. Charles County, and St. Louis County), per State regulation 10 CSR10-5.380 “Motor Vehicle Emissions Inspection.” The specifics of the Franklin County program, in MOBILE6 format, are shown in Figure II-2. The St. Louis enhanced program is shown in Figure II-3.

Figure II-1. Baton Rouge I/M Program and ATP Characteristics

```
I/M GRACE PERIOD   : 1 2
I/M PROGRAM        : 1 2002 2050 1 TRC OBD I/M
I/M MODEL YEARS    : 1 1996 2050
I/M VEHICLES       : 1 22222 21111111 1
I/M STRINGENCY     : 1 20.0
I/M EFFECTIVENESS  : 0.75 0.75 0.75
I/M COMPLIANCE     : 1 96
I/M WAIVER RATES   : 1 0.0 0.0

I/M PROGRAM        : 2 2000 2001 1 TRC GC
I/M MODEL YEARS    : 2 1980 2001
I/M VEHICLES       : 2 22222 21111111 1
I/M COMPLIANCE     : 2 96.0

I/M PROGRAM        : 3 2002 2006 1 TRC GC
I/M MODEL YEARS    : 3 1980 2006
I/M VEHICLES       : 3 11111 21111111 1
I/M COMPLIANCE     : 3 96.0

I/M PROGRAM        : 4 2002 2050 1 TRC EVAP OBD & GC
I/M MODEL YEARS    : 4 1996 2050
I/M VEHICLES       : 4 22222 21111111 1
I/M STRINGENCY     : 4 20.0
I/M COMPLIANCE     : 4 96.0

I/M PROGRAM        : 5 2007 2050 1 TRC EVAP OBD & GC
I/M MODEL YEARS    : 5 2007 2050
I/M VEHICLES       : 5 11111 21111111 1
I/M STRINGENCY     : 5 20.0
I/M COMPLIANCE     : 5 96.0

ANTI-TAMP PROG     :
00 80 50 22222 21111111 1 11 072. 22212222
```

Figure II-2. Franklin County I/M Program and ATP Characteristics

```
I/M PROGRAM        : 1 2000 2050 2 T/O IDLE
I/M MODEL YEARS    : 1 1971 2050
I/M VEHICLES       : 1 22222 11111111 1
I/M STRINGENCY     : 1 15.2
I/M COMPLIANCE     : 1 96.0
I/M WAIVER RATES   : 1 10.9 9.9
I/M GRACE PERIOD   : 1 2

I/M PROGRAM        : 2 2000 2050 2 T/O GC
I/M MODEL YEARS    : 2 1981 2050
I/M VEHICLES       : 2 22222 11111111 1
I/M COMPLIANCE     : 2 96.0
I/M GRACE PERIOD   : 2 2

ANTI-TAMP PROG     :
00 71 50 22222 11111111 1 12 096. 12212122
```

Figure II-3. St. Louis Enhanced I/M Program Characteristics

```
I/M PROGRAM        : 1 2003 2050 2 T/O OBD I/M
I/M MODEL YEARS    : 1 1996 2050
I/M VEHICLES       : 1 22222 11111111 1
I/M STRINGENCY     : 1 20.0
I/M COMPLIANCE     : 1 96.0
I/M WAIVER RATES   : 1 3.0 3.0
I/M GRACE PERIOD   : 1 2

I/M PROGRAM        : 2 1990 2002 2 T/O IDLE
I/M MODEL YEARS    : 2 1971 1980
I/M VEHICLES       : 2 22222 11111111 1
I/M STRINGENCY     : 2 18.0
I/M COMPLIANCE     : 2 96.0
I/M WAIVER RATES   : 2 25.3 25.3
I/M GRACE PERIOD   : 2 2

I/M PROGRAM        : 3 1990 2002 2 T/O IM240
I/M MODEL YEARS    : 3 1981 2050
I/M VEHICLES       : 3 22222 11111111 1
I/M STRINGENCY     : 3 18.0
I/M COMPLIANCE     : 3 96.0
I/M WAIVER RATES   : 3 25.3 25.3
I/M CUTPOINTS      : 3 MO_IM240.cut
I/M GRACE PERIOD   : 3 2

I/M PROGRAM        : 4 2003 2050 2 T/O OBD & GC
I/M MODEL YEARS    : 4 1996 2050
I/M VEHICLES       : 4 22222 11111111 1
I/M COMPLIANCE     : 4 96.0
I/M GRACE PERIOD   : 4 2

I/M PROGRAM        : 5 2000 2002 2 T/O GC
I/M MODEL YEARS    : 5 1981 2050
I/M VEHICLES       : 5 22222 11111111 1
I/M COMPLIANCE     : 5 96.0
I/M GRACE PERIOD   : 5 2
```

iii. Texas

The Texas I/M program and ATP differ by the start date of the program in various county groups. In addition, the El Paso program is different from that in the other parts of the State. The Texas I/M program is defined in State regulation section 114.50 “Vehicle Emissions Inspection Requirements. The specifics of the Texas program, in MOBILE6 format, are shown in Figure II-4 for Harris, Dallas, and Tarrant Counties. The El Paso program is shown in Figure II-5. I/M inspections began in Collin and Denton Counties in 2002. This program is shown in Figure II-6. Testing began in 2003 for Brazoria, Ellis, Fort Bend, Galveston, Johnson, Kaufman, Montgomery, Parker, and Rockwall Counties. This program is shown in Figure II-7. Finally, testing is scheduled to begin in 2005 for the Austin area counties of Travis and Williamson. The characteristics of this program are shown in Figure II-8.

Figure II-4. Harris, Dallas, and Tarrant Counties I/M Program Characteristics

```
I/M GRACE PERIOD   : 1 2
I/M EXEMPTION AGE  : 1 25
I/M PROGRAM        : 1 1996 2001 1 TRC 2500/IDLE
I/M MODEL YEARS    : 1 1978 2050
I/M VEHICLES       : 1 22222 22222222 2
I/M STRINGENCY     : 1 20
I/M COMPLIANCE     : 1 96
I/M WAIVER RATES   : 1 3.0 3.0

I/M GRACE PERIOD   : 2 2
I/M EXEMPTION AGE  : 2 25
I/M PROGRAM        : 2 2002 2050 1 TRC OBD I/M
I/M MODEL YEARS    : 2 1996 2050
I/M VEHICLES       : 2 22222 11111111 1
I/M STRINGENCY     : 2 20
I/M COMPLIANCE     : 2 96
I/M WAIVER RATES   : 2 3.0 3.0

I/M GRACE PERIOD   : 3 2
I/M EXEMPTION AGE  : 3 25
I/M PROGRAM        : 3 2002 2050 1 TRC ASM 2525/5015 FINAL
I/M MODEL YEARS    : 3 1978 1995
I/M VEHICLES       : 3 22222 22222222 2
I/M STRINGENCY     : 3 20
I/M COMPLIANCE     : 3 96
I/M WAIVER RATES   : 3 3.0 3.0

I/M GRACE PERIOD   : 4 2
I/M EXEMPTION AGE  : 4 25
I/M PROGRAM        : 4 2002 2050 1 TRC ASM 2525/5015 FINAL
I/M MODEL YEARS    : 4 1996 2050
I/M VEHICLES       : 4 11111 22222222 2
I/M STRINGENCY     : 3 20
I/M COMPLIANCE     : 4 96
I/M WAIVER RATES   : 4 3.0 3.0

I/M GRACE PERIOD   : 5 2
I/M EXEMPTION AGE  : 5 25
I/M PROGRAM        : 5 2002 2050 1 TRC EVAP OBD & GC
I/M MODEL YEARS    : 5 1996 2050
I/M VEHICLES       : 5 22222 11111111 1
I/M COMPLIANCE     : 4 96

I/M GRACE PERIOD   : 6 2
I/M EXEMPTION AGE  : 625
I/M PROGRAM        : 6 2002 2050 1 TRC GC
I/M MODEL YEARS    : 6 1978 1995
I/M VEHICLES       : 6 22222 22222222 2
I/M COMPLIANCE     : 6 96
```

Figure II-4 (continued)

```
I/M GRACE PERIOD   : 7 2
I/M EXEMPTION AGE  : 7 25
I/M PROGRAM        : 7 2002 2050 1 TRC GC
I/M MODEL YEARS    : 7 1996 2050
I/M VEHICLES       : 7 11111 22222222 2
I/M COMPLIANCE     : 7 96

ANTI-TAMP PROG     :
84 78 16 22222 22222222 2 11 096. 22112222
```

Figure II-5. El Paso County I/M Program Characteristics

```
I/M GRACE PERIOD   : 1 2
I/M EXEMPTION AGE  : 1 25
I/M PROGRAM        : 1 1996 2050 1 TRC 2500/IDLE
I/M MODEL YEARS    : 1 1978 2050
I/M VEHICLES       : 1 22222 22222222 2
I/M STRINGENCY     : 1 20
I/M COMPLIANCE     : 1 96
I/M WAIVER RATES   : 1 3.0 3.0

I/M GRACE PERIOD   : 2 2
I/M EXEMPTION AGE  : 2 25
I/M PROGRAM        : 2 1996 2050 1 TRC GC
I/M MODEL YEARS    : 2 1978 2050
I/M VEHICLES       : 2 22222 22222222 2
I/M COMPLIANCE     : 2 96

ANTI-TAMP PROG     :
86 78 16 22222 22222222 2 11 096. 22112222
```

Figure II-6. Collin and Denton Counties I/M Program Characteristics

```
I/M GRACE PERIOD   : 1 2
I/M EXEMPTION AGE  : 1 25
I/M PROGRAM        : 1 2002 2050 1 TRC OBD I/M
I/M MODEL YEARS    : 1 1996 2050
I/M VEHICLES       : 1 22222 11111111 1
I/M STRINGENCY     : 1 20
I/M COMPLIANCE     : 1 96
I/M WAIVER RATES   : 1 3.0 3.0

I/M GRACE PERIOD   : 2 2
I/M EXEMPTION AGE  : 2 25
I/M PROGRAM        : 2 2002 2050 1 TRC ASM 2525/5015 FINAL
I/M MODEL YEARS    : 2 1978 1995
I/M VEHICLES       : 2 22222 22222222 2
I/M STRINGENCY     : 2 20
I/M COMPLIANCE     : 2 96
I/M WAIVER RATES   : 2 3.0 3.0

I/M GRACE PERIOD   : 3 2
I/M EXEMPTION AGE  : 3 25
I/M PROGRAM        : 3 2002 2050 1 TRC ASM 2525/5015 FINAL
I/M MODEL YEARS    : 3 1996 2050
I/M VEHICLES       : 3 11111 22222222 2
I/M STRINGENCY     : 3 20
I/M COMPLIANCE     : 3 96
I/M WAIVER RATES   : 3 3.0 3.0

I/M GRACE PERIOD   : 4 2
I/M EXEMPTION AGE  : 4 25
I/M PROGRAM        : 4 2002 2050 1 TRC EVAP OBD & GC
I/M MODEL YEARS    : 4 1996 2050
I/M VEHICLES       : 4 22222 11111111 1
I/M COMPLIANCE     : 4 96

I/M GRACE PERIOD   : 5 2
I/M EXEMPTION AGE  : 5 25
I/M PROGRAM        : 5 2002 2050 1 TRC GC
I/M MODEL YEARS    : 5 1978 1995
I/M VEHICLES       : 5 22222 22222222 2
I/M COMPLIANCE     : 5 96

I/M GRACE PERIOD   : 5 2
I/M EXEMPTION AGE  : 5 25
I/M PROGRAM        : 5 2002 2050 1 TRC GC
I/M MODEL YEARS    : 5 1996 2050
I/M VEHICLES       : 5 11111 22222222 2
I/M COMPLIANCE     : 5 96

ANTI-TAMP PROG     :
84 78 16 22222 22222222 2 11 096. 22112222
```

Figure II-7. 9-County Texas, 2003 Start Year, I/M Program Characteristics

```
I/M GRACE PERIOD   : 1 2
I/M EXEMPTION AGE  : 1 25
I/M PROGRAM        : 1 2003 2050 1 TRC OBD I/M
I/M MODEL YEARS    : 1 1996 2050
I/M VEHICLES       : 1 22222 11111111 1
I/M STRINGENCY     : 1 20
I/M COMPLIANCE     : 1 96
I/M WAIVER RATES   : 1 3.0 3.0

I/M GRACE PERIOD   : 2 2
I/M EXEMPTION AGE  : 2 25
I/M PROGRAM        : 2 2003 2050 1 TRC ASM 2525/5015 FINAL
I/M MODEL YEARS    : 2 1978 1995
I/M VEHICLES       : 2 22222 22222222 2
I/M STRINGENCY     : 2 20
I/M COMPLIANCE     : 2 96
I/M WAIVER RATES   : 2 3.0 3.0

I/M GRACE PERIOD   : 3 2
I/M EXEMPTION AGE  : 3 25
I/M PROGRAM        : 3 2003 2050 1 TRC ASM 2525/5015 FINAL
I/M MODEL YEARS    : 3 1996 2050
I/M VEHICLES       : 3 11111 22222222 2
I/M STRINGENCY     : 3 20
I/M COMPLIANCE     : 3 96
I/M WAIVER RATES   : 3 3.0 3.0

I/M GRACE PERIOD   : 4 2
I/M EXEMPTION AGE  : 4 25
I/M PROGRAM        : 4 2003 2050 1 TRC EVAP OBD & GC
I/M MODEL YEARS    : 4 1996 2050
I/M VEHICLES       : 4 22222 11111111 1
I/M COMPLIANCE     : 4 96

I/M GRACE PERIOD   : 5 2
I/M EXEMPTION AGE  : 5 25
I/M PROGRAM        : 5 2003 2050 1 TRC GC
I/M MODEL YEARS    : 5 1978 1995
I/M VEHICLES       : 5 22222 22222222 2
I/M COMPLIANCE     : 5 96

I/M GRACE PERIOD   : 6 2
I/M EXEMPTION AGE  : 6 25
I/M PROGRAM        : 6 2003 2050 1 TRC GC
I/M MODEL YEARS    : 6 1996 2050
I/M VEHICLES       : 6 11111 22222222 2
I/M COMPLIANCE     : 6 96

ANTI-TAMP PROG     :
84 78 16 22222 22222222 2 11 096. 22112222
```

Figure II-8. Austin Area I/M Program Characteristics

```
I/M GRACE PERIOD   : 1 2
I/M EXEMPTION AGE  : 1 25
I/M PROGRAM        : 1 2005 2050 1 TRC OBD I/M
I/M MODEL YEARS    : 1 1996 2050
I/M VEHICLES       : 1 22222 11111111 1
I/M STRINGENCY     : 1 20
I/M COMPLIANCE     : 1 96
I/M WAIVER RATES   : 1 3.0 3.0

I/M GRACE PERIOD   : 2 2
I/M EXEMPTION AGE  : 2 25
I/M PROGRAM        : 2 2005 2050 1 TRC 2500/IDLE
I/M MODEL YEARS    : 2 1978 1995
I/M VEHICLES       : 2 22222 22222222 2
I/M STRINGENCY     : 2 20
I/M COMPLIANCE     : 2 96
I/M WAIVER RATES   : 2 3.0 3.0

I/M GRACE PERIOD   : 3 2
I/M EXEMPTION AGE  : 3 25
I/M PROGRAM        : 3 2005 2050 1 TRC 2500/IDLE
I/M MODEL YEARS    : 3 1996 2050
I/M VEHICLES       : 3 11111 22222222 2
I/M STRINGENCY     : 3 20
I/M COMPLIANCE     : 3 96
I/M WAIVER RATES   : 3 3.0 3.0

I/M GRACE PERIOD   : 4 2
I/M EXEMPTION AGE  : 4 25
I/M PROGRAM        : 4 2005 2050 1 TRC EVAP OBD & GC
I/M MODEL YEARS    : 4 1996 2050
I/M VEHICLES       : 4 22222 11111111 1
I/M COMPLIANCE     : 4 96

I/M GRACE PERIOD   : 5 2
I/M EXEMPTION AGE  : 5 25
I/M PROGRAM        : 5 2005 2050 1 TRC GC
I/M MODEL YEARS    : 5 1978 1995
I/M VEHICLES       : 5 22222 22222222 2
I/M COMPLIANCE     : 5 96

I/M GRACE PERIOD   : 6 2
I/M EXEMPTION AGE  : 6 25
I/M PROGRAM        : 6 2005 2050 1 TRC GC
I/M MODEL YEARS    : 6 1996 2050
I/M VEHICLES       : 6 11111 22222222 2
I/M COMPLIANCE     : 6 96

ANTI-TAMP PROG     :
84 78 16 22222 22222222 2 11 096. 22112222
```

b. Gasoline Programs

The control programs modeled in the SMOKE MOBILE6 input files included the effects of several gasoline programs. Reformulated gasoline was modeled in the St. Louis, Missouri; Houston, Texas; and Dallas, Texas ozone nonattainment areas. The specific counties modeled with Federal reformulated gasoline are the same as those modeled with this program in the NONROAD model runs, as shown in Table II-11. No changes were expected in oxygenated fuel programs or inputs. Therefore, the MOBILE6 oxygenated fuel input parameters did not change from the 2002 base year modeling.

State-run low RVP gasoline control programs are in place in three of the CENRAP States: Kansas, Missouri, and Texas. These low RVP programs are not statewide, but are in specific counties. The Kansas and Missouri programs are in 1-hour ozone maintenance areas. The Texas program covers a broader area of the State. In addition to these State low RVP programs, the six-parish Baton Rouge ozone nonattainment area is subject to a 7.8 psi RVP maximum during the ozone season months, as regulated by the Federal RVP program for southern ozone nonattainment areas. Descriptions of the individual State low RVP programs are given below. Note that these RVP limits were applied to the nonroad gasoline engines covered in the NONROAD model, as well as onroad vehicles, for the counties and months discussed below, and this information was summarized in Table II-12.

i. Kansas

The Kansas low RVP program is specified under Section 28-19-719 “Fuel Volatility” of the Kansas Air Quality Regulations and applies in Johnson and Wyandotte Counties. These two counties are part of the Kansas City ozone maintenance area. This regulation specifies that gasoline dispensed for use in motor vehicles in Johnson and Wyandotte Counties not exceed an RVP of 7.0 pounds per square inch (psi). Gasoline containing between 9 and 10 percent ethanol by volume is limited to an RVP of 8.0 psi. These regulations are in effect from June 1 through September 15 of each year, starting in 2001. To account for the time needed for individual gasoline stations to comply with these limits, the low RVP program is modeled from May through September in the MOBILE6 SMOKE input files.

ii. Missouri

The Missouri low RVP program is specified under Section 10-2.330 “Control of Gasoline Reid Vapor Pressure” of the Missouri Code of State Regulations for the Air Conservation Commission and applies in Clay, Platte, and Jackson Counties. These counties are part of the Kansas City ozone maintenance area. This regulation specifies that gasoline dispensed for use in motor vehicles in Clay, Platte, and Jackson Counties not exceed an RVP of 7.0 psi. Gasoline containing between 9 and 10 percent ethanol by volume is limited to an RVP of 8.0 psi. These regulations are in effect from June 1 through September 15 of each year, starting in 2001. To account for the time needed for individual gasoline stations to comply with these limits, the low RVP program is modeled from May through September in the MOBILE6 SMOKE input files.

iii. Texas

The Texas low RVP program is specified under Section 114.301 through 114.309 "Low Emission Fuels, Division 1: Gasoline Volatility" of the Texas Natural Resource Conservation Commission regulations and applies in a 95-county area of eastern Texas. This area excludes the eastern Texas counties in the Dallas and Houston area that are included in the Federal reformulated gasoline program. This regulation specifies that gasoline dispensed for use in the 95 affected counties not exceed an RVP of 7.8 psi. These regulations are in effect at gasoline dispensing facilities from June 1 through October 1 of each year, beginning in 2001. To account for the time needed for individual gasoline stations to comply with these limits, the low RVP program is modeled from May through September in the MOBILE6 SMOKE input files.

A separate low RVP program is in place in El Paso County. Under this program, gasoline dispensed in El Paso County is limited to an RVP of 7.0 psi from June 1 through September 16. This program began in 1996. To account for the time needed for individual gasoline stations to comply with these limits, the low RVP program is modeled from May through September in the MOBILE6 SMOKE input files.

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CHAPTER III. DEVELOPMENT OF DATA FOR AREAS OUTSIDE OF THE CENRAP STATES

A. WRAP

The Western Regional Air Partnership (WRAP) includes all of the States west of the CENRAP region. WRAP's current schedule for preparing new emission projections for its States did not include any new information by March 2005, so the previous WRAP 2018 emission forecasts will be used as the basis for CENRAP's projection year emissions modeling. The existing WRAP 2018 emission forecasts are made from a 1996 base year. The CENRAP emission modelers already have access to these WRAP emission inventory projection files, so Pechan did not expend any further effort in preparing or modifying the WRAP emission projection data.

B. VISTAS

The Visibility Improvement State and Tribal Association of the Southeast (VISTAS) includes the States of Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia. VISTAS had recently completed 2018 emission projections for its States in March 2005. VISTAS agreed that CENRAP may use the 2018 SMOKE-ready emission modeling files that VISTAS developed for its States once all QA has been completed on these files. Because the CENRAP emission modelers are the same as those performing the emission modeling for VISTAS, Pechan did not expend any further effort in preparing or modifying the VISTAS emission inventory.

For the EGU sector, CENRAP determined that it would be best to use a consistent IPM data set for all of the non-WRAP States. Therefore, for the EGU sector, the VISTAS EGU data will be replaced by the EGU data from the summer 2005 IPM projections.

C. MRPO

The Midwest Regional Planning Organization (MRPO) includes the States of Illinois, Indiana, Michigan, Ohio, and Wisconsin. Pechan developed growth factors for the point and area source emissions for the MRPO States as discussed in section II.A of this document. Pechan obtained the mobile source inputs for the MRPO States from 2018 modeling prepared by VISTAS, with the permission of both VISTAS and MRPO. These are the inputs that were used in VISTAS 2018 modeling for these States, with inputs provided by MRPO States. Pechan prepared point and area source control factors, based on projection year modeling we had prepared earlier for MRPO. The emission inventory file for 2018 for the NONROAD model categories was based on interpolating the 2015 and 2020 nonroad emission inventories prepared by EPA in support of the Clean Air Interstate Rule in 2004 (EPA, 2004c). Emissions from the MRPO States for the EGU sector will be obtained by CENRAP from the summer 2005 IPM runs.

D. MANE-VU

The Mid-Atlantic/Northeast Visibility Union (MANE-VU) MRPO includes the States of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont, and the District of Columbia. For the MANE-VU States, Pechan used the point and area source growth factors developed for the MRPO States as discussed in section II.A of this document. Pechan obtained the mobile source inputs for the MANE-VU States from the 2018 modeling prepared by VISTAS, as discussed above for MRPO. These are the inputs that were used in VISTAS 2018 modeling for the MANE-VU States. Pechan prepared point and area source control factors, based on projection year modeling we had prepared earlier for MRPO that include the MANE-VU States. The emission inventory file for 2018 for the NONROAD model categories was based on interpolating the 2015 and 2020 nonroad emission inventories prepared by EPA in support of the Clean Air Interstate Rule in 2004 (EPA, 2004c). Emissions from the MRPO States for the EGU sector will be obtained by CENRAP from the summer 2005 IPM runs.

E. CANADA

Available emission data sets for Canada are currently limited to historical emission years--1995 and 2000. EPA and LADCO/MRPO are using these inventories to estimate current and future year emissions for these provinces. It is our understanding that LADCO is using/planning to use 1995 point source emission estimates and 2000 onroad/off-road/area source emission estimates to estimate Canadian emissions for their modeling domain. (The 2000 point source emissions data are not being used because of confidentiality limitations.) The 2000 Canadian emission data sets for the three nonproprietary sectors (non-point/area, nonroad mobile, and onroad mobile) are available at: http://www.epa.gov/ttn/chief/net/canada.html#data. This file contains information in both dBaseIV and SMOKE IDA format.

While we know that Environment Canada compiles emission projections on a regular basis to support the development of Federal and provincial emission control strategies, it is not expected that Environment Canada would be able to provide growth and control factors on a timely basis for this CENRAP project. Pechan recommended that CENRAP use the base year 1995 and 2000 Canadian emissions data without adjustments for all future year model simulations. The CENRAP emission modelers already have access to these Canadian emission inventory files, so Pechan did not expend any further effort in preparing or modifying the Canadian emission inventory.

F. MEXICO

The emissions inventory base year for Mexico is for 1999, from the BRAVO study. Inventories for the years 2002 and 2012 were also estimated in order to understand how growth and existing control strategies may impact future emissions. Currently, the 1999 emission inventory is available, but the emission databases for the other years are not. Moreover, the point source database will most likely be proprietary, and could require signing a non-disclosure agreement for access. Pechan has recommended, and CENRAP has agreed, that the 1999 Mexican emission database be used as is for the CENRAP 2018 modeling, due to the uncertainty inherent in applying growth and control factors to this inventory. The CENRAP emission modelers already have access to these Mexican emission inventory files, so Pechan did not expend any further effort in preparing or modifying the 1999 Mexican emission inventory.

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CHAPTER IV. ISSUES OF CONCERN

Due to the timing of the growth and control factor development under this project, some adjustments may need to be made in the future to the factors developed under this project. As the CENRAP 2002 emission inventory continues to be revised, as well as the base year inventories for the other RPOs, issues may arise related to matching the growth and control factors to a revised base year inventory. In cases where SCCs are changed, added to, or deleted from the base year inventory, the growth and control factors may no longer match correctly to the base year inventory. In these cases, the projection year inventories will be incorrect.

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APPENDIX A
METHODS FOR DEVELOPMENT OF GROWTH AND CONTROL INPUTS FOR 2018 EMISSIONS (SCHEDULES 3 AND 9)

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CHAPTER I. INTRODUCTION

The purpose of this project is to prepare emission growth and control factors that can be applied to the Central Regional Air Planning Association (CENRAP) 2002 base year emission inventory to obtain a 2018 emissions inventory for the CENRAP region. The CENRAP region includes the States and Tribal areas of Arkansas, Iowa, Kansas, Louisiana, Minnesota, Missouri, Nebraska, Oklahoma, and Texas. In addition to the CENRAP States, additional factors will be compiled under this project to include the entire CENRAP modeling domain. This will include projected emissions data or projection year growth and control factor data from the other Regional Planning Organizations (RPOs), Canada, and Mexico. All data products will be prepared in SMOKE-compatible format.

These projection year growth and control factor data will be used to support air quality modeling and State Implementation Plan (SIP) development and implementation activities for the regional haze rule and fine particulate matter (PM) and ozone National Ambient Air Quality Standards (NAAQS). The data will be applicable to all source categories and pollutants included in the CENRAP 2002 emission inventory. This includes the following pollutants: sulfur oxides (SO_x), oxides of nitrogen (NO_x), volatile organic compounds (VOC), carbon monoxide (CO), ammonia (NH_3), and particles with an aerodynamic diameter less than or equal to a nominal 10 and 2.5 micrometers (i.e., primary PM_{10} and $PM_{2.5}$).

This Methods Document explains the data sources that E.H. Pechan & Associates, Inc. (Pechan) plans to use and the procedures Pechan will follow in developing the necessary growth and control data for this project. Chapter II of this document presents Pechan's planned methods for developing control factors and growth factors for the CENRAP States. The methods are presented separately for each of the major source categories. Chapter III of this document presents the data sources and methods that Pechan will use for developing the data for areas outside of the CENRAP States, including other RPOs and Canada and Mexico. References are included in Chapter IV.

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CHAPTER II. METHODS FOR THE CENRAP REGION

A. CONTROL FACTOR DEVELOPMENT METHODS AND DATA SOURCES

1. Non-EGU Point Sources

a. Federal Controls

For non-electricity generating unit (EGU) point sources, the analysis of Federal controls will focus on maximum achievable control technology (MACT) standards. Numerous MACT emission standards have been promulgated since 1990, and are designed to control emissions of hazardous air pollutants (HAPs) from stationary sources. Many of the MACT standards are expected to produce associated VOC emission reductions, so the 2018 control factors need to capture the expected effects of post-2002 MACT standards.

Pechan prepared criteria pollutant-specific emission control factors for various projection years (including 2018) for the Lake Michigan Air Directors Consortium (LADCO) during late 2004. The procedure for developing the MACT standard-associated control factors included identifying source categories and associated Source Classification Codes (SCCs) for each MACT standard having a post-2002 compliance date for existing sources. The control factors for most MACT categories are based on information found in the preamble to the final rule of each MACT subpart as published in the *Federal Register*. Pechan plans to circulate this table of control factors to the CENRAP States for review before using this table to develop non-EGU point source control factors for the CENRAP States.

b. State/Local Controls

CENRAP States will be surveyed to gather information on control programs for the 2018 inventory. The general approach is to use State contacts and information for 1-hour ozone and PM_{10} SIPs to determine where post-2002 emission reductions are expected. Two States where we expect there to be post-2002 non-EGU point source emission reductions include Texas and Missouri. For Texas, it is expected that control factors will be based on the control factor file developed by Pechan during 2001 for the prior Western Regional Air Partnership (WRAP) emission forecast to 2018, with updates to a 2002 base year and to reflect recent SIP updates (Houston-Galveston area). Another possible way to approach this is to obtain the most recent Texas control factor file from the Texas Commission on Environmental Quality (CEQ) and incorporate it into the CENRAP State control factor database. Key issues in determining whether using any new Texas CEQ control factor files in this analysis is advisable include whether this file is for a 2002 base year inventory, and how the reductions in highly reactive VOCs that are required in the Houston-Galveston area SIP are treated in 2002 and any forecast years.

The portion of eastern Missouri that is within the fine grid is affected by the NO_x SIP Call, so controls would be expected to be added in those counties to reduce point source NO_x emissions between 2002 and 2018. It appears to us that the associated Missouri rule affects NO_x emissions from EGUs but not some of the non-EGU source categories like industrial boilers/turbines, stationary internal combustion engines, and cement kilns that are regulated in other NO_x SIP Call affected States. Rules that potentially affect the non-EGU source categories appear to be under development. Pechan plans to inquire with the Missouri Department of Natural Resources to determine whether control factors for these non-EGU categories should be included in the 2018 control factor file. The number of affected sources appears to be small enough that source-specific control factors can be developed.

We can also survey the other CENRAP States (besides Texas and Missouri) to determine whether these are State/local regulations that would be expected to provide post-2002 emissions reductions. If there are, pollutant-specific control factors will be developed for those geographic areas by SCC.

2. Area Sources

For the CENRAP States, Pechan will contact each State to obtain information for any on-the-books controls affecting non-EGU point and area sources from 2002 to 2018. Pechan will also compile information for national controls affecting these sources from EPA regulatory support documents. Based on the analyses performed by Pechan for other RPOs, the Federal controls for which area source control factors are expected to be developed is limited to residential wood combustion. For this analysis, a 20-year estimated lifetime for woodstoves and fireplace inserts will be used along with the SCC-specific growth factors, and emission factor ratios by SCC, to account for the replacement of retired woodstoves that emit at pre-new source performance standard levels, with new wood burning equipment, that would be catalyst-equipped. Emission factor ratios will be pollutant-specific.

Federal rules affecting VOC solvent emissions such as those from consumer products and architectural and industrial maintenance coatings are expected to be incorporated in the 2002 emission databases, so no post-2002 emission rate reductions are expected for these categories.

3. EGU Point Sources

Data sources to be used for developing EGU control factors include CENRAP's 2002 nine State point source National Emissions Inventory (NEI) input format (NIF) data files (prepared by Pechan and Carolina Environmental Program and delivered on December 10, 2004), the Workgroup-selected growth factors, and the U.S. Environmental Protection Agency's (EPA's) 2020 Integrated Planning Model (IPM) Base and Clean Air Interstate Rule (CAIR) Control post-processed scenario data files (developed by Pechan for EPA from IPM parsed output files). Because 2018 IPM data from two RPOs are unavailable, 2020 data will be used as a surrogate (with CENRAP's agreement). This should pose no significant problem since no known pollutant regulations are in effect in 2020 and not 2018. The 2020 Base and Control (CAIR) post-processed IPM scenario data files include annual emission values for seven pollutants – sulfur dioxide (SO_2), NO_x, CO, VOC, NH_3, primary PM_{10}, and primary $PM_{2.5}$ – as well as annual heat input; only SO_2, NO_x, and heat input are provided in the initial IPM files; the other emissions, along with throughput, were developed during the post-processing phase. Because EPA required that Pechan use an older emission factor file from 2003, and new NH_3 emissions factors for EGUs were developed in Spring 2004, the post-processed files delivered to EPA included ammonia emissions developed using the old emission factors; as agreed to in a January 10th conference call, Pechan will recalculate these emissions using the new NH_3 emissions factors.

For EGUs in the CENRAP States and in the 2020 IPM Base Case and CAIR post-processed data files, Pechan will provide growth and control factors in SMOKE format. The control factors will be provided in SMOKE CONTROL (Table 8.66 in the SMOKE v2.1 User's Manual) formatted files.

Each EGU record in both the 2020 Base and Control Cases will be ORISPL-BLRID matched into the EGU extract of the CENRAP NIF files (if at all possible) to obtain the FIPS State and county, plant ID, and point ID (where a point is generally equivalent to a boiler) as needed. Since the IPM scenarios only have one SCC per boiler, the emissions for all SCCs at a given point in CENRAP will be assigned to the SCC with the largest emissions.

The control factor (cf) for each 2020 Base and Control Case EGU unit will be calculated as follows for each of the seven pollutant emissions:

2020 EGU pollutant's emissions cf = (2020 pollutant's emissions) / (2002 EGU's State-SCC gf ∗ 2002 CENRAP pollutant's emissions summed to the point-level and assigned to the SCC with the largest emissions).

The IPM units that operate in 2020 but either are not in the 2002 CENRAP data (i.e., generic or committed/planned units) or could not be matched, will not be included in the SMOKE CONTROL formatted files because no control factors can be calculated. Yet, they have emissions that need to be accounted for. Based on a conversation with EPA's Marc Houyoux, a principal developer of SMOKE, it would be best for Pechan to provide the projected emissions for those units in either an Excel file or a SMOKE IDA (Table 8.45 in the SMOKE v2.1 User's Manual) point source formatted file.

4. Nonroad Sources

Pechan will contact CENRAP States to determine whether each State has specific nonroad equipment regulations beyond the Federal engine standards that are expected to be in place by 2018. In cases where State regulations do exist, Pechan will determine the affected SCCs and pollutants, and will compile or develop estimates of the percent emission reduction of the rule in 2018. To date, Pechan has determined that the States of Iowa, Kansas, Minnesota, Nebraska, and Oklahoma do not have additional air requirements for nonroad sources.

Pechan has compiled estimates of control effectiveness for 2018 for Federal regulations affecting diesel locomotives and commercial marine engines. This information is available from the relevant Regulatory Support Documents prepared by EPA (EPA, 1998; EPA, 1999; EPA, 2003). These regulations include engine exhaust standards, as well as diesel fuel sulfur limits that will reduce SO_2 and PM emissions. For their 2003 aircraft engine NO_x emission standards, EPA did not prepare emission reduction estimates because any such reductions were believed to be modest (e.g., 94 percent of aircraft engines are currently meeting or exceeding these standards). Therefore, Pechan does not propose to account for aircraft emission reductions from these standards for this analysis.

In running the NONROAD2004 model, all Federal engine standards are accounted for, with the exception of evaporative emission standards for large spark-ignition and land-based recreational gasoline equipment. The evaporative standards for recreational equipment only affect permeation emissions, which are not currently included in NONROAD2004. As such, baseline emissions and reductions will not be modeled. The large spark ignition standards affect a subset of evaporative emissions for engines of a specified horsepower (EPA, 2002). Under contract to LADCO, Pechan has developed estimates of SCC-specific emission reductions for this standard, which can be applied to the NONROAD model output as a post-processing step.

5. Onroad Sources

For the onroad sources, control measures are defined in terms of inputs to the SMOKE MOBILE6 files rather than a control factors file. These input files will incorporate all promulgated Federal control programs, including the heavy-duty diesel (2007) engine standard and low sulfur diesel fuel as well as the Tier 2 emission standards and low sulfur gasoline program. Federal control programs are generally modeled through the MOBILE6 defaults, with no specific user input commands necessary. Reformulated gasoline will be modeled in the following nonattainment areas: St. Louis (4 Missouri counties plus St. Louis City), Dallas-Fort Worth (4 counties), and Houston-Galveston (8 counties).

Pechan will contact each of the CENRAP State contacts to determine whether any changes in fuel programs or inspection and maintenance (I/M) programs, from those modeled in the CENRAP 2002 emission inventory, are expected to take place by 2018. Pechan will also determine from these contacts whether any other area-specific control programs are planned. If any programs are planned that cannot be modeled with MOBILE6 (e.g., transportation control measures), Pechan either will develop control factors that can be applied by the emission modelers to the resulting onroad emissions or will adjust the vehicle miles traveled (VMT) growth factors to account for the control measure, depending upon which approach is appropriate for the specific measure.

B. GROWTH FACTOR DEVELOPMENT METHODS AND DATA SOURCES

1. Non-EGU Point Sources and Area Sources (EGAS)

Pechan will develop emission activity growth data for the CENRAP States using a combination of approaches/data sources. For the most part, Pechan will rely on growth factors that are produced by EPA's Economic Growth Analysis System (EGAS). Under Task 5, Pechan prepared a Technical Memorandum comparing EGAS Versions 4.0 and 5.0 (Pechan, 2005).

In preparing the Task 5 memorandum, Pechan reviewed the indicators selected as default emission activity growth surrogates in EGAS 4.0 and 5.0 for the highest-emitting point and nonpoint SCCs in the CENRAP base year inventory. Pechan then reviewed alternative data sources for the availability of better growth surrogates. Based on this review, Pechan identified alternative growth indicator recommendations for a number of important CENRAP source categories (e.g., use of *Annual Energy Outlook* projections for oil and gas production SCCs). In addition, Pechan identified alternatives to the State-level population projections from EGAS (i.e., county-level population projections prepared by government agencies/universities in each CENRAP State).

Chapter III of the Task 5 memorandum details Pechan's recommendations for the methods and data sources to use in developing stationary point and nonpoint (area) source growth factors for the CENRAP States. Pechan will prepare emission activity growth data for the stationary source emission sources in the CENRAP States that reflects CENRAP feedback on the recommended methods and data sources that are outlined in this chapter.

2. EGU Point Sources

a. Data Sources/Quality Assurance Issues

Data sources to be used to calculate EGU growth factors include EPA's 2020 IPM Base post-processed scenario data file (developed by Pechan for EPA from IPM parsed output files), EPA's 2002 EGU inventory, and EGAS 5 EGU 2020 growth factors. Reasons for these choices are explained below.

Pechan will compare the CENRAP nine State-SCC level (2002 to 2020) EGAS 5 growth factors with growth factors calculated as throughput (fuel consumption) ratios derived from EPA's 2020 Base Case Scenario and the 2002 EGU inventory developed for EPA (and based on the Department of Energy's Energy Information Administration (EIA) Form EIA-767 and EPA's Clean Air Markets Division (CAMD)'s Emission Tracking System/ Continuous Emissions Monitoring (ETS/CEM) reported data).

For the IPM-based growth factor development, Pechan originally planned to use the EGUs extracted from the CENRAP data files for the 2002 throughput, but found that several States did not report throughput. We tried to fill in missing values by back calculating throughput using CENRAP reported CO emissions (which would be uncontrolled, unlike SO_2 and NO_x; and larger in magnitude than VOC) and its emissions factor (or the SCC-based EPA-approved uncontrolled emission factor for CO if no emission factor was included in the CENRAP files). However, from a check of some CENRAP records with both throughput and CO reported, it was found that the back-calculated throughput was frequently different from the reported throughput (i.e., had a greater than ten percent difference).

An additional issue with using the CENRAP data files is that we first broadly defined EGUs as those records with a positive ORISPL or SIC=4911, 4932, or 4939, and SCCs beginning with 101 or 201. However, we found several plants "missing" from the CENRAP EGU data that were in either the EIA-767 or ETS/CEM data files; these plants may be in the CENRAP data files, but not in our EGU extract. Also, some sets of records with ORISPLs and SCCs beginning with 101 or 201 did not have any boiler IDs included in the data files and/or some had some boiler IDs identified and some not (and some seemingly duplicated). Additionally, we found some discrepant ORISPLs.

Pechan also compared total SO_2, NO_x, and CO emissions for each of the nine CENRAP States from the 2002 Inventory and the all inclusive CENRAP EGU extract. In most cases, the 2002 EGU inventory emission totals were greater. All three pollutant emissions are within a 10 percent difference for three States (Kansas, Missouri, and Nebraska); NO_x is within a 10 percent difference for five more States (Iowa, Louisiana, Minnesota, Oklahoma, and Texas); and SO_2 is within an 11 percent difference for three more States (Minnesota, Oklahoma, and Texas); Arkansas' emissions for all three pollutants were not close, perhaps because some plant data in the CENRAP files were missing, some emissions may be reversed, etc.

Pechan had not anticipated nor allotted hours for performing quality assurance (QA) on the CENRAP data, but found it necessary to do so to some extent to determine whether the data could be used for throughput. To avoid further expenditure of hours, we determined that it would be best to use the 2002 EPA EGU Inventory for the 2002 throughput data, rather than the CENRAP data files. Please note that we are not stating that all nine of the CENRAP States have all or any of the issues addressed above, but that enough of them did that we were not able to either use the reported throughput or calculated throughput at the State-SCC level with a high degree of confidence.

b. Growth Factor Calculation

The growth factor (gf) for each State-SCC will be calculated as follows:

gf = (2020 IPM Base Case throughput aggregate) / (2002 EGU inventory throughput aggregate),

where:

the 2020 IPM Base Case throughput is derived from the given heat input and a default fuel heat content; and

the 2002 EGU inventory throughput is reported data if the boiler is included in the EIA-767, and is derived from the given heat input and a default fuel heat content if it is not in the EIA-767 but is in the ETS/CEM data file.

Pechan will provide an Excel data file which will include the nine State-SCC level records and their EGAS 5 and IPM-based growth factors for 2020 as well as a Technical Memorandum that includes a recommendation and rationale for the proposed growth factor methodology.

A summary report of the changes in 2018 IPM inputs requested by the Visibility Improvement – State and Tribal Association of the Southeast (VISTAS) and the Midwest Regional Planning Organization (MRPO) was provided to Pechan, along with a response to a follow-up question. If VISTAS and MRPO approve the release of this information, with CENRAP's agreement, it will be included in the final report and will serve as the part of the deliverable Technical Memorandum that presents a summary of the changes made to IPM inputs by the other RPOs.

The growth factors (whose methodology will be determined by the CENRAP Workgroup) from Task 6 will be provided in SMOKE PROJECTION format (Table 8.70 in the SMOKE v2.1 User's Manual).

3. Nonroad Sources

For the aircraft, commercial marine vessel and locomotive categories, Pechan will develop emission activity growth data for the CENRAP States using EGAS. Pechan's recommendations for developing growth factors for these categories were outlined in a Task 5 Technical Memorandum, and the final methods will reflect any additional feedback from CENRAP.

Also as part of Task 5, Pechan will prepare a separate Technical Memorandum to describe the proposed adjustments to the NONROAD model national growth rates to reflect State data for significant categories. The data to regionalize the NONROAD model growth factors will be obtained from REMI, as incorporated into EGAS (Houyoux, 2004).

4. VMT for Onroad Sources

To estimate growth in onroad VMT, Pechan will first ask CENRAP for appropriate contacts from their State Departments of Transportation and from the major metropolitan planning organizations (MPOs) in their State. Pechan will then inquire of these contacts whether they have developed their own growth projections, and if so, will request any available documentation on the development of these growth factors and the growth factors themselves. The documentation will be important in understanding the geographic area covered by the growth factors, the base and projection years of the growth factors, and the sources of data driving the projections. The documentation should also provide information on the level of detail at which the growth factors were developed (e.g., do the factors vary by interstates vs. arterials, by rural area vs. urban area, by vehicle type, etc.). Any growth factor data will need to be provided electronically in database (Access, DBF, or MySQL), spreadsheet (Excel), or text file format for processing under this project. When VMT growth factors are provided for a different base and projection year, Pechan will consult with the agency supplying the data to determine the best method for converting the growth factors to a 2002 to 2018 projection. For areas with no local VMT growth factor information available, or those for which growth factors cannot be appropriately calculated within the time and resources available under this contract, Pechan will use EGAS VMT growth factors.

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CHAPTER III. METHODS FOR AREAS OUTSIDE OF THE CENRAP REGION

A. CANADIAN EMISSION ESTIMATES

Pechan expects to provide emission estimates for Canada to CENRAP using data and methods that are consistent with those being used by LADCO/MRPO and EPA to estimate current and future year emissions for these provinces. These data sets are currently limited to historical emission years (1995 and 2000). It is our understanding that LADCO is using/planning to use 1995 point source emission estimates and 2000 onroad/off-road/area source emission estimates to estimate Canadian emissions for their modeling domain. (The 2000 point source emissions data is not being used because of confidentiality limitations.) The 2000 Canadian emission data sets for the three sectors (non-point/area, nonroad mobile, and onroad mobile) are available at: http://www.epa.gov/ttn/chief/net/canada.html#data. This file contains information in both dBaseIV and SMOKE IDA format.

While we know that Environment Canada compiles emission projections on a regular basis to support the development of Federal and provincial emission control strategies, it is not clear whether Environment Canada would be able to provide growth and control factors on a timely basis for this CENRAP project. Pechan will contact Marc Deslauriers of Environment Canada on this issue. In short, though, Pechan expects that its recommendation will be that CENRAP use the base year Canadian emissions data without adjustments for all future year model simulations. If we want to pursue the course of developing our own growth and control factors to apply to Canadian base year emissions to estimate 2018 emissions, some information on the forecasting methods that Environment Canada uses is available from a draft NARSTO report. However, the description in the NARSTO report is less detailed than is needed to develop source category-specific growth and control factors. This alternative is probably best pursued by our contacting Marc Deslauriers to determine that organization’s willingness/ability to provide us with either the data or the methods that they have developed to prepare emission forecasts to a year close to 2018.

B. MEXICAN EMISSION ESTIMATES

The baseline emissions inventory base year for Mexico is for 1999. Inventories for the years 2002 and 2012 were also estimated in order to understand how growth and existing control strategies may impact future emissions. Currently, the 1999 emission inventory is available, but the emission databases for the other years are not. Moreover, the point source database will most likely be proprietary, and could require signing a non-disclosure agreement for access. Therefore, the three alternatives for estimating 2018 emissions for Mexico for this CENRAP project appear to be:

1. Use the available 1999 emission databases as is.
2. Pursue obtaining the 2012 Mexican emissions database via Leonora Rojas to see if it might be available on a timely basis.

3. Develop growth and control factors to apply to the 1999 emissions data to better estimate 2018 emissions. We have a summary description of how Mexico performs its own projections to use as a guide for doing this. In general, growth factors are applied to all sectors, but control factors are only applied for onroad vehicles.

C. WRAP EMISSION ESTIMATES

WRAP's current schedule for preparing any new emission projections for its States will not provide any new information by March 2005, so Pechan expects to use the previous WRAP 2018 emission forecasts as the basis for what it provides to CENRAP. The existing WRAP 2018 emission forecasts are made from a 1996 base year. One potential update to the previous non-EGU point and area source forecasts is adapting the previous projections (which were prepared by Pechan) to incorporate updated growth factors, and to use the 2002 emissions data set as the new base year. However, these updates may be difficult to accomplish within the project constraints.

D. VISTAS EMISSION ESTIMATES

Pechan has contacted the VISTAS Technical Coordinator, Pat Brewer, to determine the availability of emission projection data for this project. VISTAS has recently completed 2018 emission projections for its States. These projection data are now being reviewed by the States. VISTAS will need to get permission from the States in order to release the data to CENRAP. It is expected that this would occur during February. SMOKE-ready modeling files for VISTAS are expected to be completed in January. Pechan will have further conversations with VISTAS to determine whether the mass emissions files or SMOKE files are more appropriate for CENRAP's purposes. It may be preferable to obtain the annual mass emission files, as the SMOKE modeling files were set up to model specific episodes that may not be consistent with the modeling that CENRAP will do. If CENRAP determines that it is preferable to use the emissions, Pechan will format the emissions in SMOKE/IDA format.

E. MRPO PROJECTIONS

For these five States, Pechan has developed 2018 (and other year) growth and control factors for LADCO for all man-made emission sectors, except on-road vehicles. Therefore, we expect that these same growth and control factors will be delivered to CENRAP. Because LADCO is performing the emissions processing of these files, Pechan plans to check with Mark Janssen to determine whether LADCO made any revisions to these files during its processing steps. If so, the revised files will be obtained from LADCO. We will also check with LADCO about the status and availability of their on-road vehicle emission files.

CHAPTER IV. REFERENCES

EPA, 1998: U.S. Environmental Protection Agency, "Locomotive Emission Standards, Regulatory Support Document," Office of Mobile Sources, Ann Arbor, MI, April 1998.

EPA, 1999: U.S. Environmental Protection Agency, "Final Regulatory Impact Analysis: Control of Emissions from Marine Diesel Engines," EPA420-R-99-026, Office of Mobile Sources, Ann Arbor, MI, November 1999.

EPA, 2002: U.S. Environmental Protection Agency, "Final Regulatory Support Document: Control of Emissions from Unregulated Nonroad Engines," EPA420-R-02-022, Office of Mobile Sources, Ann Arbor, MI, September 2002.

EPA, 2003: U.S. Environmental Protection Agency, "Final Regulatory Support Document: Control of Emissions from New Marine Compression-Ignition Engines at or Above 30 Liters per Cylinder," EPA420-R-03-004, Office of Mobile Sources, Ann Arbor, MI, January 2003.

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NARSTO, 2005: "Improving Emission Inventories for Effective Air Quality Management Across North America: A NARSTO Assessment," January 2005.

Pechan, 2005: E.H. Pechan & Associates, Inc. "Background Information on Versions 4.0 and 5.0 of The Economic Growth Analysis System (EGAS), Technical Memorandum," prepared for Central Regional Air Planning Association (CENRAP), January 3, 2005.

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APPENDIX B
QUALITY ASSURANCE PROJECT PLAN FOR DEVELOPMENT OF GROWTH AND CONTROL INPUTS FOR 2018 EMISSIONS MODELING (SCHEDULES 3 AND 9)

DRAFT

Prepared by

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January 6, 2005

for the

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______________________________________ Date ____________________
Ms. Kathy Pendleton, CENRAP Project Manager

______________________________________ Date ____________________
Ms. Lisa Brenneman, CENRAP Project Manager

______________________________________ Date ____________________
Ms. Annette Sharp, CENRAP Quality Assurance Officer

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INTRODUCTION

The purpose of this project is to prepare emission growth and control factors that can be applied to the Central Regional Air Planning Association (CENRAP) 2002 base year emission inventory to obtain a 2018 emission inventory for the CENRAP region. The CENRAP region includes the States and Tribal areas of Arkansas, Iowa, Kansas, Louisiana, Minnesota, Missouri, Nebraska, Oklahoma, and Texas. In addition to the CENRAP States, additional factors will be compiled under this project to include the entire CENRAP modeling domain. This will include projected emissions data or projection year growth and control factor data from the other Regional Planning Organizations (RPOs), Canada, and Mexico. All data products will be prepared in SMOKE-compatible format.

These projection year growth and control factor data will be used to support air quality modeling and State Implementation Plan (SIP) development and implementation activities for the regional haze rule and fine PM and ozone National Ambient Air Quality Standards (NAAQS). The data will be applicable to all source categories and pollutants included in the CENRAP 2002 emission inventory. This includes the following pollutants: sulfur oxides (SO_x), oxides of nitrogen (NO_x), volatile organic compounds (VOC), carbon monoxide (CO), ammonia (NH_3), and particles with an aerodynamic diameter less than or equal to a nominal 10 and 2.5 micrometers (i.e., primary PM_{10} and $PM_{2.5}$).

This Quality Assurance Project Plan (QAPP) specifies how data quality objectives of accuracy, completeness, and representativeness will be met in compiling the growth and control factor data to be used as inputs to 2018 projection year regional emissions modeling for the CENRAP region for air quality modeling purposes.

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

II. QA PLAN FOR CONSOLIDATION OF EMISSIONS INVENTORIES

A. Project Management

Specific project management elements are discussed below.

1. Distribution List

Ms. Kathy Pendleton, CENRAP Project Manager
Ms. Lisa Brenneman, CENRAP Project Manager
Ms. Annette Sharp, CENRAP Technical Director and Quality Assurance Officer
Mr. James H. Wilson, E.H. Pechan & Associates, Inc. (Pechan) Corporate QA/QC Coordinator
Ms. Maureen Mullen, Pechan Project Manager

Mr. Steve Roe, Pechan QA Reviewer

2. Project / Task Organization

Ms. Kathy Pendleton of CENRAP will be the primary technical contact and Project Manager. She will be assisted by Ms. Lisa Brenneman. Ms. Annette Sharp, will be the Technical Director and Quality Assurance Manager (QAM). Ms. Sharp will be involved in all quality assurance/quality control (QA/QC) activities.

Pechan's QA/QC policy requires that all work be documented, defensible, of known and acceptable quality, and consistent with all contract requirements. This policy is implemented through an integrated three-tiered approach that includes corporate, department, and program elements. At the corporate level, Pechan management provides oversight of the QA/QC program and approves and enforces the overall program. To assist in implementing these functions, Pechan maintains a corporate QA/QC unit that monitors the program, prepares guidelines, and conducts independent program audits.

The Pechan Corporate QA/QC Program is implemented through the Corporate QA/QC Plan and corporate guidelines. The Corporate Plan is an internal document that states the corporate policy and the requirements for department and project plans. The plan is supplemented by guidelines that are used to develop or update department plans and standard operating procedures (SOPs). Department management ensures the technical and fiscal quality of work through management oversight of projects assigned to the department and work performed by department staff; establishes and enforces department plans; approves project plans, budgets and schedules; and ensures a thorough technical and department management review of work.

The Pechan Corporate QA/QC Coordinator, Mr. James H. Wilson, is responsible for QA/QC functions throughout the firm, and has the necessary authority and independence to identify, report, and correct any existing quality problems. The Pechan QA reviewer for this project will be Mr. Steve Roe. Mr. Roe will conduct QA review on each of the SMOKE files developed under this project, on the data and methods used to develop growth and control factors in the SMOKE files, and on the final documentation.

Pechan's Project Manager, Ms. Maureen Mullen, will direct all work to be completed for this project. Ms. Mullen will ensure that all support staff are familiar with and understand the data quality objectives, and the procedures to be followed for meeting the objectives, as well as the requirements of the QA plan (e.g., completion of QA/QC forms).

3. Problem Definition / Background

SIPs for regional haze mitigation must contain emission inventories. Related emission inventories are needed for air quality modeling of regional haze. Inventories prepared for the SIP submittal and for use in modeling are prepared in different formats, but both should be derived from the same or comparable input data. Furthermore, regional modeling will encompass States outside the CENRAP region, so inventory methods should be coordinated with other regions to the extent possible. The eastern RPOs (including CENRAP) have selected 2002 as the baseline year for regional haze modeling. Also, in order to demonstrate progress in improving visibility, it will be necessary to forecast emissions for future years. This project will result in a set of growth and control factors that can be used in SMOKE emissions modeling to project the CENRAP 2002 base year emission inventory to 2018.

4. Project / Task Description

The description of this project by task can be found in Pechan's response (dated November 18, 2004) to the Request for Quotes (RFQ) for "Schedules 3 and 9 - Development of Growth and Control Inputs for 2018 Emissions Modeling" and the "Award of Work and Notice to Proceed" that CENRAP issued to Pechan (Contract Number 04-0628-RPO-018) on December 1, 2004.

5. Data Quality Objectives

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

- Accuracy – Pechan's QA Reviewer will ensure that 100 percent of the procedures/calculations that a Pechan staff member develops and applies to develop growth or control factors will be checked for accuracy and completeness. The procedures/calculations will first be tested on a data sample and the results will be reviewed to ensure that the procedures/calculations are applied as intended and that the results make sense. Adjustments to the procedures/calculations will be made if the results indicate flaws in the initial procedures/calculations. The procedures/calculations will be applied to the entire data set after the procedures/calculations have been tested for accuracy. Sample calculations will be documented covering all procedures.

- Completeness – As part of the quality control (QC) process, review by Pechan, as well as State/local/Tribal (S/L/T) agencies, may indicate missing growth or control factors for certain sources and/or pollutants for a particular county or jurisdiction. Pechan will compare the growth and control factor files to the CENRAP 2002 base year emission inventory to identify source category/county combinations that may be missing growth factors and source category/county/pollutant combinations that should be controlled but that have no control factors in the control factor database.

- Representativeness –Representative growth and control factors will be compiled that can be used by CENRAP to develop a representative 2018 emission inventory. The QA checks on data content discussed in section D of this QAP will be used to identify missing data or data that exceed typical ranges for review with CENRAP and the S/L/T agencies. These factors will be corrected or revised as approved by CENRAP.

- Comparability – The CENRAP 2018 growth and control factors will be compared to those used by the U.S. Environmental Protection Agency (EPA) in its Clean Air Interstate Rule (CAIR) modeling as well as those used by other RPOs for similar projection year emission inventories. Significant differences between these growth and control factor data will be evaluated and any necessary corrections to the data will be made.

6. Documents and Records

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

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

- Determining all deliverables under a project, including work plans, progress reports, and all technical products;
- Determining the time lines for various stages of the document (that is, outline, draft, and final);
- Determining the appropriate review cycle (internal versus external review);
- Determining the appropriate reviewers; and
- Ensuring that all documents and records are incorporated into Pechan's filing system and are distributed to the appropriate recipients.

B. Data Generation and Acquisition

The following explains how data will be acquired or generated for each task of the project:

Task 1. Develop a Quality Assurance Project Plan (QAPP) and Work Plan

This QAPP is being prepared under this task. The following discussion explains the data sources that will be acquired and data that will be generated during preparation of the draft and final deliverables for Tasks 2 through 10. Section D of this QAPP explains the data review and validation procedures that will be applied during preparation of the draft and final deliverables for Tasks 2 through 10.

Pechan has also prepared a draft work plan for the project. The work plan includes the tasks, budgets, and schedules specified in Pechan's response (dated November 18, 2004) to the RFQ for "Schedules 3 and 9 - Development of Growth and Control Inputs for 2018 Emissions Modeling" and the "Award of Work and Notice to Proceed" that CENRAP issued to Pechan (Contract Number 04-0628-RPO-018) on December 1, 2004.

Task 2. Develop a Methods Document

In the Methods Document, Pechan will explain the data sources to be used and the procedures to be followed for developing the necessary growth and control data for this project. Through this task, Pechan will determine the appropriate contacts and data sources to be used to obtain and develop the growth and control data for the CENRAP States, control data sources for Federal control measures, and vehicle miles traveled (VMT) projection data and sources. Pechan will also determine the available sources for obtaining projection year inventory data for other RPOs, Canada, and Mexico. The methods document will also explain the procedures to be followed when data are not available for a specific source category or geographic area.

Task 3. Identify State Controls

Pechan will query the CENRAP State contacts on State control programs expected to be in place in 2018. In addition, Pechan will use information from 1-hour ozone and PM_{10} SIPs to determine where post-2002 emission reductions are expected. For Texas, Pechan will base the control factors on the control factor file developed by Pechan during 2001 for the prior Western Regional Air Partnership (WRAP) emission forecast to 2018, and update this information to a 2002 base year and to reflect recent SIP updates (Houston-Galveston area). Pechan will account for NO_x emission changes for Missouri counties affected by the NO_x SIP Call. This may include using future year NO_x allowances by unit to estimate unit-specific control factors. Where necessary, Pechan will convert the emission reductions to the control efficiency, rule effectiveness, and rule penetration rates needed for the SMOKE modeling. All rule citations will be fully documented.

For the onroad sources, Pechan will start with the 2002 SMOKE-formatted MOBILE6 files developed for the 2002 CENRAP emission inventory. Pechan will query the State contacts provided by CENRAP for expected changes in emission control programs, such as inspection and maintenance programs, and fuel properties or programs between 2002 and 2018. Local data on fleet information, such as vehicle age distributions, will be kept the same as in 2002. Federal control programs, such as the Tier 2 emission standards, will be accounted for by using the MOBILE6 defaults for such programs.

Task 4. Identify Federal Controls

Pechan will compile information on Federal control measures that will be in place in 2018. Pechan's initial source of information will be the work conducted by Pechan to develop

2018 emission inventory control factors for the Midwest RPO (MRPO). Pechan will review documentation from other RPOs (e.g., VISTAS) and the analysis performed by EPA for the CAIR (this had a 2001 base year), as well as any new information on Federal rules. Pechan will focus its primary efforts for this task on maximum achievable control technology (MACT) standards with post-2002 effects. Where necessary, Pechan will convert the emission reductions from the identified Federal control measures to the control efficiency, rule effectiveness, and rule penetration rates needed for the SMOKE modeling. All rule citations will be fully documented.

Task 5. Compare and Provide a Written Summary of Differences Between the Economic Growth Analysis System (EGAS) 4 and EGAS 5 Models

Pechan will use EPA's EGAS 4 and EGAS 5 data and models to compile 2002 to 2018 State- Standard Industrial Classification (SIC) growth factors for the CENRAP States. These data are available in internal Pechan databases which house the Regional Economic Models, Inc. (REMI) data used in EGAS 4 and EGAS 5. Within each State, the comparisons will be developed at the 3-digit SIC code level with a crosswalk between REMI sectors and SCCs.

For the NONROAD model source categories, Pechan will compile data to develop regional growth factors to reflect relative growth rates in the CENRAP States. These will be used to regionalize the default growth factors in NONROAD that use national historic trends by fuel type to project equipment populations and emissions nationwide.

Task 6. Isolate and Examine Emission Growth Factors for CENRAP Electricity Generating Units (EGUs) using the Integrated Planning Model (IPM) and the EGAS 5 Model

Pechan will obtain the EGU EGAS growth factors from the Task 5 output. Pechan has obtained the IPM 2018 Base Case and IPM 2018 CAIR Case outputs from VISTAS/MRPO. Pechan has also obtained generalized information about the changes made by VISTAS/MRPO to the IPM inputs for this data set. However, MRPO has requested that Pechan not use any of these data until they have been reviewed and approved by the MRPO/VISTAS States. If approval of these files does not come in the timeframe needed for completion of this task, Pechan will use the Base Case and CAIR Case outputs from IPM prepared for EPA during August through November 2004. Pechan has these data in-house for projection years of 2010, 2015, and 2020. Pechan developed the final CENRAP 2002 base year emissions inventory for CENRAP that will be used in this task. Pechan will generate State-SCC growth factors for the EGU sector in the CENRAP States from the heat input or throughput data in the 2002 CENRAP emissions inventory and the IPM outputs.

Task 7. Develop Onroad Growth Factors and Nonroad Emissions Inventory for the Future Case CENRAP Emissions Inventory

To prepare the 2018 NONROAD2004 model inputs, Pechan will first acquire from CENRAP the activity inputs that were used to develop the 2002 base year nonroad emissions inventory. Pechan will adjust the growth rates and fuel program inputs with data obtained or generated under Task 5. These data will then be input to EPA's NONROAD2004 model to generate a 2018 nonroad emission inventory for the CENRAP States, for all nonroad categories except locomotives, aircraft, and commercial marine vessels. Growth and control factors for these three nonroad categories will be developed under Tasks 3, 4, and 5 with other area sources.

To develop VMT growth rates, Pechan will first develop a list of contacts in the following priority order: (1) major Metropolitan Planning Organizations, (2) State Departments of Transportation, and (3) State air agencies. Pechan will then contact these agencies to obtain available data for projecting VMT from 2002 to 2018. If the data from these agencies are for a different base or projection year, Pechan will inquire as to whether the average annual growth rate over the period projected by that agency can be applied to the period from 2002 to 2018. If it cannot, Pechan will not use that data source (in these instances, data from the next contact based on the above priority will be used). For QA and tracking purposes, Pechan will log the contact information, data file names and date, geographic coverage of data, level of detail of data (e.g., by vehicle type or road type), and base and projection years of data. Pechan will provide this information to the CENRAP QAM before proceeding to incorporate VMT projection data. For counties or States with no VMT projection data available, Pechan will use EGAS VMT growth factors as the defaults.

Task 8. Develop Future Case Inventory of Areas Outside the CENRAP Region

This task will involve gathering and consolidating projection year emissions data or growth and control data for areas outside the CENRAP region. The sources of data include emissions inventories compiled by the other RPOs, the EPA, and the most currently available Mexican and Canadian emissions inventories.

Pechan will generate a list of organizations (e.g., EPA, RPOs, Environment Canada) and contact information for each organization that potentially has data that can be used to develop a 2018 emissions inventory for CENRAP air quality applications. This list will then be provided to the Workgroup for any feedback.

Once the data acquisition contact list has been finalized, Pechan will contact each organization to identify the projection year emissions data or growth and control data available, determine the quality and format of each available data set, and help facilitate the best mode of data transfer of the desired data sets for use in this task.

Modeling inventory databases or growth and control files acquired during this task will be summarized in tabular form so that CENRAP will know the date acquired, the sources used to assemble the data, the contractor(s) and/or organizations that assembled the data, possible deficiencies of the data, time period of the data (e.g., base year and projection year), and other necessary information needed to enable CENRAP to best understand the databases that are available.

Task 9. Prepare Future Case Growth and Control Summary

Pechan will develop the EGU growth factors at the point level of detail based on either IPM or EGAS model outputs, as determined by the Workgroups in Task 6. This will involve matching the EGU identifiers from the CENRAP 2002 emission inventory to the IPM data. IPM uses unique plant codes (ORISPL) and boiler IDs while the CENRAP inventory uses Federal Information Processing Standard State and county identifiers, plant IDs, and point IDs. From the matched data set, Pechan will develop EGU-specific control factors for all relevant pollutants, based on 2018 IPM emissions data and the 2002 CENRAP EGU data.

For all source sectors covered by this contract, Pechan will develop Excel summary workbooks for each CENRAP State and Tribal area at the SCC level for all relevant source categories and pollutants. The data used in these summaries will be obtained from data generated in Tasks 3 through 7.

Task 10. Prepare a Technical Support Document (TSD)

The Task 2 Methods Document will be used as the starting point for the TSD. Information from the technical memoranda developed under Tasks 5, 6, and 8 and the State and Federal control measure lists from Tasks 3 and 4 will also be included in the TSD. The TSD will document the methods and data sources used in preparing the SMOKE-ready growth and control factors, the nonroad emissions inventory, and the MOBILE6 SMOKE inputs. The Excel workbooks summarizing the growth and control factors for the CENRAP States will be either included in or referenced in the TSD.

C. Assessment and Oversight

Pechan uses assessments to evaluate and improve the quality of environmental data operations. The assessments are an independent process of evaluating the project to ensure that specified requirements of the project are being fulfilled. Pechan will perform periodic audits of data quality and will coordinate with CENRAP's QAM to allow for ongoing oversight of project quality. For this project, QA Summary Reports will be prepared in Excel spreadsheets under Task 9, along with the growth and control factor summaries, to document any QA issues in the growth and control factors. The reports will be sent to each S/L/T agency to review. Each agency will be asked to provide corrections for the QA issues in the spreadsheets, or provide Pechan and CENRAP with directions in supplemental files or by e-mail. Each agency will then return the QA Summary Reports to Pechan. Pechan will then use directions provided in the reports to revise the appropriate growth and control factor files, and will update the reports to log directions that S/L/T agencies provide via e-mail and data provided in supplemental files. A Pechan staff member will then note the date on which revisions are made to the growth and control factor files as specified in the QA reports. Mr. Steve Roe will manage the audit function, which will involve comparing the directions provided in the QA reports to the revised growth and control factor files to ensure that the directions are interpreted correctly, and the files are revised correctly. The auditor will then note in the QA report when corrections have been completed. If corrections are not implemented correctly, the auditor will note this in the QA Summary Report file and will provide follow-up to ensure that the Pechan staff member corrects the issue. Thus, each QA Summary Report file will be used as a chain-of-custody form to document QA issues, S/L/T agency approval for resolution of the issues, and corrections to growth and control factor files.

D. Data Review and Validation

Task 1. Develop a QAPP and Work Plan

Pechan will prepare a draft QAPP and work plan that will undergo review by Pechan internally, and then be submitted to the CENRAP's Workgroups for review and comment. Pechan will revise the QAPP and work plan to address comments provided by the Workgroups. The final QAPP and work plan will be submitted to CENRAP for final approval and signature. The draft and final QAPP and work plan will be submitted in Microsoft Word format.

Task 2. Develop a Methods Document

Pechan will prepare a draft Methods Document that will undergo review by Pechan internally, and then will be submitted to the CENRAP's Workgroups for review and comment. Pechan will revise the Methods Document to address comments provided by CENRAP. The final Methods Document will be submitted to CENRAP for final approval. The draft and final Methods Document will be submitted in Microsoft Word format.

Task 3. Identify State Controls

Pechan will conduct a QA review of the SMOKE control factor files. Range checks will be performed on all values including control efficiency, rule effectiveness, and rule penetration to make sure that all values are valid and reasonable. Comparisons of the control efficiencies will be made with the 2002 CENRAP emissions inventory files to ensure that controls included in the 2002 emission inventory are not double-counted for the projection year. Any point-specific control information will be matched to the 2002 CENRAP emissions inventory to ensure that the correct point identifiers have been used. A QA summary will be developed listing State/SCC combinations in the 2002 CENRAP base year emissions inventory with no control efficiency listed in the State controls file to ensure that all source categories that should have controls applied contain the necessary information in the SMOKE control factor file. Pechan will ensure that the format of the control factor databases are correct based on the SMOKE2.1 User's Guide documentation.

Pechan has developed programs to review MOBILE6 input files. These programs will be modified to perform QA on the SMOKE-formatted MOBILE6 input files to insure that all appropriate control measure commands and input data are included in the appropriate MOBILE6 input files.

Each database in text or database format, as well as each set of MOBILE6 input files, developed during this task will be assigned a version control ID, so that any future modifications of these data sets can be tracked. The version control ID will contain the date that the file was revised, as well as a version number, if more than one revision occurred on the same date (e.g. mobilexxx 2-15-05v2).

Task 4. Identify Federal Controls

Pechan will conduct a QA review of the SMOKE control factor files for the Federal controls as listed above for the State controls. Range checks will be performed on all values including control efficiency, rule effectiveness, and rule penetration to make sure that all values are valid and reasonable. Comparisons of the control efficiencies will be made with the 2002 CENRAP emission inventory files to ensure that controls included in the 2002 emission inventory are not double-counted for the projection year. In addition, checks will be made to verify that source categories with both State and Federal control measures have been given the appropriate controls and that sources are not inappropriately over-controlled. Any point-specific control information will be matched to the 2002 CENRAP emission inventory to ensure that the correct point identifiers have been used. A QA summary will be developed listing State/SCC combinations in the 2002 CENRAP base year emission inventory with no control efficiency listed in either the State controls file or the Federal controls file to ensure that all source categories that should have controls applied contain the necessary information in the SMOKE control factor file. Pechan will ensure that the format of the control factor databases are correct based on documentation in the SMOKE2.1 User's Guide. Each database developed during this task will be assigned a version control ID as described under Task 4, so that any future modifications of these data sets can be tracked.

Task 5. Compare and Provide a Written Summary of Differences Between the Economic Growth Analysis System (EGAS) 4 and EGAS 5 Models

Pechan will conduct a QA review of the SMOKE growth factor files prepared under this task. This will include range checks on all growth factors. Any growth factors above or below the expected range of growth factors will be reviewed for reasonableness. Significant variations in growth factors for the same source categories across States will also be reviewed for reasonableness. The growth factor data will be cross-checked with the CENRAP 2002 emissions inventory to ensure that all State/SCC combinations present in the 2002 inventory have corresponding growth factors (with the exception of onroad and NONROAD model source categories which will be handled in Task 7). Pechan will ensure that the format of the growth factor databases are correct based on the SMOKE2.1 User's Guide. Each database developed during this task will be assigned a version control ID as described under Task 4, so that any future modifications of these data sets can be tracked.

Task 6. Isolate and Examine Emission Growth Factors for CENRAP Electricity Generating Units (EGUs) using the Integrated Planning Model (IPM) and the EGAS 5 Model

The EGAS EGU growth factors to be used in this task will have undergone QA review under Task 5. In developing the IPM EGU growth factors, Pechan will review State/SCC combinations that are present either in the base year or projection year data, but not both. These cases, and Pechan's proposed approach for dealing with these cases for the development of growth factors, will be documented in the Technical Memorandum to be prepared under this task for CENRAP's review. In addition, cases with insufficient data in the CENRAP base year inventory to calculate growth factors will be documented for CENRAP review. The remaining

IPM EGU growth factors by State/SCC will be carefully reviewed. Growth factors that are outside of the expected range of factors will be reviewed for reasonableness and accuracy. If all calculations have been performed correctly, but the data seem unreasonable, these factors will be documented for CENRAP to review and provide corrections or comments on.

Task 7. Develop Onroad Growth Factors and Nonroad Emissions Inventory for the Future Case CENRAP Emissions Inventory

Pechan will use EPA's NIF Format and Content Check QA tool to perform initial QA on the NONROAD2004 NIF output file. Any errors flagged by this tool will be reviewed and corrected as necessary. After the nonroad inventory data are converted into SMOKE format, QA checks will be performed to ensure that the SMOKE-formatted emissions are the same as the emissions in the NIF files. Cross-checks will be performed to ensure that all State/SCC combinations included in the 2002 emission inventory for the source categories included in the NONROAD2004 model are also included in the SMOKE emission files.

Pechan will QA the VMT growth factors prepared in SMOKE format. Range checks will be performed on all VMT growth factors to make sure that all values are valid and reasonable. Any growth factors above or below the expected range of growth factors will be reviewed for reasonableness. Significant variations in growth factors for the same source categories across States will also be reviewed for reasonableness. The growth factor data will be cross-checked with the CENRAP 2002 onroad VMT data to ensure that all onroad State/SCC combinations present in the 2002 inventory have corresponding VMT growth factors. Pechan will ensure that the format of the VMT growth factor databases are correct based on the SMOKE2.1 User's Guide.

Each database developed during this task will be assigned a version control ID as described under Task 4, so that any future modifications of these data sets can be tracked.

Task 8. Develop Future Case Inventory of Areas Outside the CENRAP Region

Each projection year emission inventory or set of growth and control factors for the areas outside the CENRAP region will be assigned a version control ID as described under Task 4 and tracked accordingly. Pechan will ensure the data acquired are formatted correctly for use in SMOKE modeling based on the SMOKE2.1 User's Guide and will document any deficiencies for each inventory database. Pechan will prepare draft summaries for each database indicating the source of the data, base and projection years of the original data, and any data conversions needed from the original base and projection years to the CENRAP base and projection years of 2002 and 2018 for review by CENRAP. Final revisions to the data will be made based on the feedback received.

Task 9. Prepare Future Case Growth and Control Summary

Growth and control factors developed in tasks 3 through 7, as well as the EGU control factors to be developed under this task, will be summarized in Excel spreadsheets by State or Tribal area and SCC. These reports will provide the States and Tribal agencies with an opportunity to review the growth and control data developed under this project and to provide corrections or comments where the data do not correspond with the agencies' expectations. As discussed in Section C, above, Pechan will also provide QA Summary Reports that show concerns that Pechan or the States might have with some of the growth or control factors that should be given additional review by the agency. These QA Summary Reports will be used to track revisions that need to be made to the draft SMOKE growth and control factor files.

Once the State and Tribal agencies have documented the need for any revisions to the growth and control factors, Pechan will prepare final growth and control factor files in SMOKE format. These files will undergo the same QA checks described in the tasks above, along with the final QA audit ensuring that the requested revisions to the growth and control factors have been appropriately implemented in the final SMOKE-formatted files. Each database revised or developed during this task will be assigned a version control ID as described under Task 4, so that any future modifications of these data sets can be tracked.

Task 10. Prepare a TSD

The TSD will undergo QA review to ensure that all methods and data sources are accurately documented and data are reported correctly. Pechan will revise the TSD to incorporate comments provided by the CENRAP Workgroups.

APPENDIX C
CENRAP STATE POPULATION PROJECTIONS

Table C-1. CENRAP State Population Projections

FIPS Code	County	2002	2018	2018GF
		ARKANSAS		
05001	Arkansas	20,355	17,110	0.841
05003	Ashley	23,875	22,294	0.934
05005	Baxter	38,672	42,580	1.101
05007	Benton	165,500	257,479	1.556
05009	Boone	34,713	39,145	1.128
05011	Bradley	12,531	12,357	0.986
05013	Calhoun	5,681	5,430	0.956
05015	Carroll	26,166	32,181	1.23
05017	Chicot	13,623	10,529	0.773
05019	Clark	23,535	23,535	1
05021	Clay	17,127	14,968	0.874
05023	Cleburne	24,570	28,788	1.172
05025	Cleveland	8,541	8,541	1
05027	Columbia	25,343	25,343	1
05029	Conway	20,411	20,411	1
05031	Craighead	84,074	97,527	1.16
05033	Crawford	54,973	67,511	1.228
05035	Crittenden	51,291	51,291	1
05037	Cross	19,343	17,697	0.915
05039	Dallas	8,785	5,322	0.606
05041	Desha	14,805	10,730	0.725
05043	Drew	18,639	18,639	1
05045	Faulkner	89,590	110,979	1.239
05047	Franklin	17,868	18,213	1.019
05049	Fulton	11,527	10,893	0.945
05051	Garland	90,059	104,079	1.156
05053	Grant	16,848	19,377	1.15
05055	Greene	38,038	41,968	1.103
05057	Hempstead	23,492	23,492	1
05059	Hot Spring	30,558	31,999	1.047
05061	Howard	14,251	14,251	1
05063	Independence	34,431	37,350	1.085
05065	Izard	13,192	12,567	0.953
05067	Jackson	17,802	15,475	0.869
05069	Jefferson	83,374	78,668	0.944
05071	Johnson	23,148	26,711	1.154
05073	Lafayette	8,382	6,755	0.806
05075	Lawrence	17,587	17,597	1.001
05077	Lee	12,217	9,790	0.801
05079	Lincoln	14,247	14,247	1
05081	Little River	13,474	13,472	1
05083	Logan	22,394	23,965	1.07
05085	Lonoke	55,302	73,873	1.336

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
05087	Madison	14,345	15,785	1.1
05089	Marion	16,259	16,202	0.996
05091	Miller	41,133	43,426	1.056
05093	Mississippi	50,380	44,719	0.888
05095	Monroe	9,689	5,310	0.548
05097	Montgomery	9,243	9,699	1.049
05099	Nevada	9,742	8,052	0.827
05101	Newton	8,506	8,506	1
05103	Ouachita	27,868	22,234	0.798
05105	Perry	10,436	12,221	1.171
05107	Phillips	25,001	14,105	0.564
05109	Pike	11,137	10,278	0.923
05111	Poinsett	25,401	24,555	0.967
05113	Polk	20,200	20,785	1.029
05115	Pope	55,223	66,020	1.196
05117	Prairie	9,440	8,499	0.9
05119	Pulaski	364,381	379,945	1.043
05121	Randolph	18,102	17,701	0.978
05123	St. Francis	28,773	26,036	0.905
05125	Saline	86,290	107,280	1.243
05127	Scott	11,004	11,787	1.071
05129	Searcy	8,039	5,953	0.741
05131	Sebastian	117,220	136,374	1.163
05133	Sevier	15,811	16,804	1.063
05135	Sharp	17,270	18,451	1.068
05137	Stone	11,518	12,558	1.09
05139	Union	45,279	43,122	0.952
05141	Van Buren	16,314	16,865	1.034
05143	Washington	166,511	219,999	1.321
05145	White	69,354	83,925	1.21
05147	Woodruff	8,466	6,644	0.785
05149	Yell	21,410	24,162	1.129
		IOWA		
19001	Adair	8	8	0.962
19003	Adams	4	4	0.919
19005	Allamakee	15	15	1.046
19007	Appanoose	14	13	0.969
19009	Audubon	7	6	0.943
19011	Benton	26	30	1.153
19013	Black Hawk	128	131	1.022
19015	Boone	26	27	1.013
19017	Bremer	23	24	1.021
19019	Buchanan	21	21	1.005
19021	Buena Vista	20	21	1.031
19023	Butler	15	15	0.975
19025	Calhoun	11	10	0.927
19027	Carroll	21	21	0.983
19029	Cass	14	14	0.958

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
19031	Cedar	18	19	1.048
19033	Cerro Gordo	46	45	0.977
19035	Cherokee	13	12	0.962
19037	Chickasaw	13	13	0.972
19039	Clarke	9	10	1.085
19041	Clay	17	17	0.981
19043	Clayton	18	18	0.978
19045	Clinton	50	49	0.979
19047	Crawford	17	17	0.981
19049	Dallas	43	56	1.291
19051	Davis	9	9	1.029
19053	Decatur	9	9	1.007
19055	Delaware	18	19	1.053
19057	Des Moines	42	41	0.968
19059	Dickinson	17	18	1.097
19061	Dubuque	90	95	1.055
19063	Emmet	11	10	0.937
19065	Fayette	22	22	0.992
19067	Floyd	17	16	0.966
19069	Franklin	11	10	0.963
19071	Fremont	8	7	0.944
19073	Greene	10	10	0.987
19075	Grundy	12	13	1.016
19077	Guthrie	11	12	1.05
19079	Hamilton	16	16	0.99
19081	Hancock	12	12	0.978
19083	Hardin	19	18	0.955
19085	Harrison	16	16	1.038
19087	Henry	20	22	1.061
19089	Howard	10	10	0.975
19091	Humboldt	10	10	0.95
19093	Ida	8	8	0.987
19095	Iowa	16	17	1.058
19097	Jackson	20	21	1.041
19099	Jasper	37	39	1.047
19101	Jefferson	16	16	1.011
19103	Johnson	115	143	1.248
19105	Jones	20	21	1.011
19107	Keokuk	11	11	0.958
19109	Kossuth	17	16	0.922
19111	Lee	37	36	0.959
19113	Linn	196	229	1.17
19115	Louisa	12	13	1.066
19117	Lucas	9	10	1.045
19119	Lyon	12	11	0.966
19121	Madison	14	16	1.112
19123	Mahaska	22	23	1.012
19125	Marion	33	35	1.086

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
19127	Marshall	39	40	1.022
19129	Mills	15	16	1.115
19131	Mitchell	11	10	0.95
19133	Monona	10	10	0.98
19135	Monroe	8	8	0.959
19137	Montgomery	12	11	0.961
19139	Muscatine	42	45	1.062
19141	O'Brien	15	15	0.989
19143	Osceola	7	6	0.931
19145	Page	17	17	0.992
19147	Palo Alto	10	9	0.929
19149	Plymouth	25	26	1.038
19151	Pocahontas	8	8	0.899
19153	Polk	384	443	1.154
19155	Pottawattamie	88	92	1.04
19157	Poweshiek	19	19	1.016
19159	Ringgold	5	5	0.942
19161	Sac	11	10	0.916
19163	Scott	160	172	1.078
19165	Shelby	13	12	0.962
19167	Sioux	32	34	1.073
19169	Story	81	89	1.105
19171	Tama	18	18	1.023
19173	Taylor	7	7	0.942
19175	Union	12	12	0.974
19177	Van Buren	8	8	1.031
19179	Wapello	36	36	1.006
19181	Warren	42	49	1.183
19183	Washington	21	23	1.087
19185	Wayne	7	6	0.946
19187	Webster	40	38	0.961
19189	Winnebago	12	11	0.971
19191	Winneshiek	21	22	1.024
19193	Woodbury	104	108	1.038
19195	Worth	8	8	0.969
19197	Wright	14	13	0.946
KANSAS				
20001	Allen	14,229	13,001	0.914
20003	Anderson	8,142	8,071	0.991
20005	Atchison	16,679	15,072	0.904
20007	Barber	5,084	4,563	0.898
20009	Barton	27,736	24,532	0.884
20011	Bourbon	15,167	15,043	0.992
20013	Brown	10,499	11,492	1.095
20015	Butler	60,536	82,104	1.356
20017	Chase	2,929	2,751	0.939
20019	Chautauqua	4,210	3,994	0.949

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
20021	Cherokee	21,947	20,693	0.943
20023	Cheyenne	3,122	3,084	0.988
20025	Clark	2,382	2,480	1.041
20027	Clay	8,702	7,681	0.883
20029	Cloud	9,931	8,625	0.868
20031	Coffey	8,899	8,832	0.992
20033	Comanche	1,984	1,711	0.862
20035	Cowley	36,416	34,277	0.941
20037	Crawford	38,041	38,870	1.022
20039	Decatur	3,406	2,952	0.867
20041	Dickinson	19,139	21,077	1.101
20043	Doniphan	8,211	7,982	0.972
20045	Douglas	102,290	112,566	1.1
20047	Edwards	3,339	2,406	0.721
20049	Elk	3,137	3,041	0.969
20051	Ellis	27,266	26,864	0.985
20053	Ellsworth	6,417	5,784	0.901
20055	Finney	39,720	42,589	1.072
20057	Ford	32,652	33,945	1.04
20059	Franklin	25,314	24,041	0.95
20061	Geary	26,403	25,905	0.981
20063	Gove	2,991	2,807	0.938
20065	Graham	2,845	2,479	0.871
20067	Grant	7,892	7,078	0.897
20069	Gray	6,044	7,510	1.243
20071	Greeley	1,472	1,338	0.909
20073	Greenwood	7,651	7,681	1.004
20075	Hamilton	2,656	2,423	0.912
20077	Harper	6,274	5,471	0.872
20079	Harvey	33,423	35,899	1.074
20081	Haskell	4,292	4,624	1.077
20083	Hodgeman	2,148	2,467	1.149
20085	Jackson	12,738	20,837	1.636
20087	Jefferson	18,659	17,896	0.959
20089	Jewell	3,495	3,125	0.894
20091	Johnson	476,642	604,251	1.268
20093	Kearny	4,543	4,367	0.961
20095	Kingman	8,424	8,187	0.972
20097	Kiowa	3,106	3,146	1.013
20099	Labette	22,273	21,940	0.985
20101	Lane	2,000	1,907	0.954
20103	Leavenworth	70,805	78,196	1.104
20105	Lincoln	3,542	3,458	0.976
20107	Linn	9,672	9,204	0.952
20109	Logan	2,997	2,918	0.974
20111	Lyon	35,893	34,835	0.971
20113	McPherson	29,404	29,217	0.994

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
20115	Marion	13,244	12,953	0.978
20117	Marshall	10,580	11,483	1.085
20119	Meade	4,619	4,423	0.958
20121	Miami	28,910	35,458	1.226
20123	Mitchell	6,691	6,096	0.911
20125	Montgomery	35,296	31,308	0.887
20127	Morris	6,082	6,213	1.022
20129	Morton	3,359	3,151	0.938
20131	Nemaha	10,459	10,064	0.962
20133	Neosho	16,634	15,009	0.902
20135	Ness	3,316	3,011	0.908
20137	Norton	5,877	5,860	0.997
20139	Osage	16,924	21,237	1.255
20141	Osborne	4,237	3,731	0.881
20143	Ottawa	6,287	6,183	0.983
20145	Pawnee	6,944	6,715	0.967
20147	Phillips	5,869	6,096	1.039
20149	Pottawatomie	18,485	19,005	1.028
20151	Pratt	9,540	8,741	0.916
20153	Rawlins	2,887	2,885	0.999
20155	Reno	63,771	55,264	0.867
20157	Republic	5,468	4,928	0.901
20159	Rice	10,500	10,053	0.957
20161	Riley	61,463	62,795	1.022
20163	Rooks	5,489	5,602	1.021
20165	Rush	3,492	3,252	0.931
20167	Russell	7,053	6,436	0.913
20169	Saline	53,897	54,778	1.016
20171	Scott	4,921	4,772	0.97
20173	Sedgwick	461,943	508,467	1.101
20175	Seward	23,065	22,499	0.975
20177	Shawnee	170,703	170,471	0.999
20179	Sheridan	2,641	2,405	0.911
20181	Sherman	6,396	7,428	1.161
20183	Smith	4,363	3,942	0.904
20185	Stafford	4,662	4,474	0.96
20187	Stanton	2,409	2,396	0.995
20189	Stevens	5,331	5,062	0.95
20191	Sumner	25,526	24,678	0.967
20193	Thomas	8,090	8,008	0.99
20195	Trego	3,141	2,940	0.936
20197	Wabaunsee	6,713	7,171	1.068
20199	Wallace	1,691	1,583	0.936
20201	Washington	6,268	5,917	0.944
20203	Wichita	2,502	2,743	1.096
20205	Wilson	10,141	10,612	1.046
20207	Woodson	3,668	3,261	0.889
20209	Wyandotte	158,366	153,806	0.971

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
LOUISIANA				
22001	Acadia	59,246	64,410	1.087
22003	Allen	26,248	31,234	1.19
22005	Ascension	71,326	83,180	1.166
22007	Assumption	22,740	24,412	1.074
22009	Avoyelles	40,928	45,028	1.1
22011	Beauregard	33,124	36,678	1.107
22013	Bienville	16,368	18,256	1.115
22015	Bossier	93,962	103,806	1.105
22017	Caddo	247,834	268,132	1.082
22019	Calcasieu	180,196	197,882	1.098
22021	Caldwell	11,058	12,550	1.135
22023	Cameron	8,506	8,580	1.009
22025	Catahoula	11,572	12,702	1.098
22027	Claiborne	17,600	19,458	1.106
22029	Concordia	20,996	22,658	1.079
22031	De Soto	24,966	26,984	1.081
22033	East Baton Rouge	419,394	471,404	1.124
22035	East Carroll	9,340	10,110	1.082
22037	East Feliciana	22,278	25,978	1.166
22039	Evangeline	34,952	38,332	1.097
22041	Franklin	22,580	24,498	1.085
22043	Grant	18,108	19,564	1.08
22045	Iberia	74,270	82,838	1.115
22047	Iberville	31,382	34,130	1.088
22049	Jackson	15,740	17,088	1.086
22051	Jefferson	468,032	505,370	1.08
22053	Jefferson Davis	32,264	35,156	1.09
22055	Lafayette	191,976	219,210	1.142
22057	Lafourche	88,170	94,076	1.067
22059	La Salle	13,978	15,048	1.077
22061	Lincoln	45,514	51,604	1.134
22063	Livingston	86,918	100,042	1.151
22065	Madison	12,642	13,980	1.106
22067	Morehouse	32,456	35,486	1.093
22069	Natchitoches	38,372	42,554	1.109
22071	Orleans	478,430	517,570	1.082
22073	Ouachita	152,474	168,980	1.108
22075	Plaquemines	25,464	26,914	1.057
22077	Pointe Coupee	23,848	26,562	1.114
22079	Rapides	121,182	124,696	1.029
22081	Red River	9,354	10,186	1.089
22083	Richland	20,694	22,542	1.089
22085	Sabine	24,762	27,930	1.128
22087	St. Bernard	67,156	70,540	1.05
22089	St. Charles	50,146	57,400	1.145
22091	St. Helena	9,978	10,912	1.094

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
22093	St. James	21,418	23,470	1.096
22095	St. John the Baptist	44,126	49,278	1.117
22097	St. Landry	85,284	94,860	1.112
22099	St. Martin	48,066	53,584	1.115
22101	St. Mary	56,430	59,374	1.052
22103	St. Tammany	198,430	242,360	1.221
22105	Tangipahoa	98,780	113,228	1.146
22107	Tensas	6,784	7,332	1.081
22109	Terrebonne	104,530	114,252	1.093
22111	Union	22,490	25,262	1.123
22113	Vermilion	51,776	55,980	1.081
22115	Vernon	51,726	50,504	0.976
22117	Washington	42,826	45,868	1.071
22119	Webster	42,862	46,920	1.095
22121	West Baton Rouge	21,034	23,428	1.114
22123	West Carroll	11,920	12,612	1.058
22125	West Feliciana	13,792	15,426	1.118
22127	Winn	18,032	20,514	1.138
MINNESOTA				
27001	Aitkin	15,937	21,444	1.346
27003	Anoka	308,230	372,816	1.21
27005	Becker	30,520	34,878	1.143
27007	Beltrami	40,790	48,980	1.201
27009	Benton	35,228	41,944	1.191
27011	Big Stone	5,752	5,484	0.953
27013	Blue Earth	56,601	59,804	1.057
27015	Brown	26,939	28,232	1.048
27017	Carlton	32,291	37,004	1.146
27019	Carver	74,807	108,532	1.451
27021	Cass	28,450	38,826	1.365
27023	Chippewa	13,041	13,250	1.016
27025	Chisago	43,321	59,310	1.369
27027	Clay	51,629	52,780	1.022
27029	Clearwater	8,494	9,130	1.075
27031	Cook	5,385	7,134	1.325
27033	Cottonwood	12,092	12,026	0.995
27035	Crow Wing	57,491	77,012	1.34
27037	Dakota	370,438	461,880	1.247
27039	Dodge	18,155	21,778	1.2
27041	Douglas	33,629	40,776	1.213
27043	Faribault	16,037	15,834	0.987
27045	Fillmore	21,241	22,692	1.068
27047	Freeborn	32,806	34,524	1.052
27049	Goodhue	44,692	49,786	1.114
27051	Grant	6,293	6,620	1.052
27053	Hennepin	1,133,884	1,249,232	1.102
27055	Houston	19,923	21,808	1.095

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
27057	Hubbard	19,090	24,854	1.302
27059	Isanti	32,264	38,986	1.208
27061	Itasca	44,703	50,370	1.127
27063	Jackson	11,213	11,300	1.008
27065	Kanabec	15,786	19,388	1.228
27067	Kandiyohi	41,706	45,540	1.092
27069	Kittson	5,231	5,154	0.985
27071	Koochiching	14,177	13,244	0.934
27073	Lac qui Parle	7,924	7,324	0.924
27075	Lake	11,199	12,450	1.112
27077	Lake of the Woods	4,589	5,100	1.111
27079	Le Sueur	25,820	28,608	1.108
27081	Lincoln	6,385	6,392	1.001
27083	Lyon	25,503	26,226	1.028
27085	McLeod	35,447	39,344	1.11
27087	Mahnomen	5,222	5,472	1.048
27089	Marshall	10,001	9,258	0.926
27091	Martin	21,617	21,104	0.976
27093	Meeker	22,994	26,098	1.135
27095	Mille Lacs	23,102	29,500	1.277
27097	Morrison	32,067	35,198	1.098
27099	Mower	38,834	41,278	1.063
27101	Murray	9,051	8,638	0.954
27103	Nicollet	30,199	32,966	1.092
27105	Nobles	20,887	21,702	1.039
27107	Norman	7,377	7,140	0.968
27109	Olmsted	127,654	153,218	1.2
27111	Otter Tail	58,307	69,350	1.189
27113	Pennington	13,670	14,260	1.043
27115	Pine	27,302	33,588	1.23
27117	Pipestone	9,789	9,290	0.949
27119	Polk	31,177	31,122	0.998
27121	Pope	11,282	12,000	1.064
27123	Ramsey	516,633	552,076	1.069
27125	Red Lake	4,295	4,396	1.023
27127	Redwood	16,733	16,946	1.013
27129	Renville	17,104	17,220	1.007
27131	Rice	58,271	70,890	1.217
27133	Rock	9,689	9,826	1.014
27135	Roseau	16,543	18,200	1.1
27137	St. Louis	201,457	211,366	1.049
27139	Scott	96,259	147,138	1.529
27141	Sherburne	69,006	101,934	1.477
27143	Sibley	15,566	17,390	1.117
27145	Stearns	136,352	160,364	1.176
27147	Steele	34,256	38,210	1.115
27149	Stevens	10,060	10,112	1.005

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
27151	Swift	11,994	12,784	1.066
27153	Todd	24,620	26,798	1.088
27155	Traverse	4,052	3,744	0.924
27157	Wabasha	21,938	24,614	1.122
27159	Wadena	13,872	15,082	1.087
27161	Waseca	19,716	21,184	1.074
27163	Washington	211,906	286,342	1.351
27165	Watonwan	11,906	12,250	1.029
27167	Wilkin	7,083	6,986	0.986
27169	Winona	50,491	54,190	1.073
27171	Wright	94,096	123,258	1.31
27173	Yellow Medicine	11,000	10,826	0.984
MISSOURI				
29001	Adair	23,945	22,652	0.946
29003	Andrew	15,808	17,000	1.075
29005	Atchison	6,733	5,873	0.872
29007	Audrain	24,287	24,807	1.021
29009	Barry	36,132	46,461	1.286
29011	Barton	12,300	13,717	1.115
29013	Bates	16,176	17,637	1.09
29015	Benton	17,773	21,214	1.194
29017	Bollinger	12,027	13,823	1.149
29019	Boone	137,011	168,775	1.232
29021	Buchanan	82,652	80,828	0.978
29023	Butler	41,397	43,463	1.05
29025	Caldwell	8,817	9,554	1.084
29027	Callaway	39,168	45,700	1.167
29029	Camden	36,567	45,152	1.235
29031	Cape Girardeau	68,404	75,037	1.097
29033	Carroll	9,858	8,889	0.902
29035	Carter	6,753	8,226	1.218
29037	Cass	86,299	112,085	1.299
29039	Cedar	13,700	15,350	1.12
29041	Chariton	8,477	7,884	0.93
29043	Christian	56,199	86,229	1.534
29045	Clark	7,480	7,549	1.009
29047	Clay	183,989	216,063	1.174
29049	Clinton	19,590	23,030	1.176
29051	Cole	70,819	76,706	1.083
29053	Cooper	16,849	18,354	1.089
29055	Crawford	23,944	29,357	1.226
29057	Dade	8,365	9,348	1.117
29059	Dallas	16,983	22,566	1.329
29061	Daviess	7,940	8,189	1.031
29063	DeKalb	13,482	14,488	1.075
29065	Dent	14,332	14,662	1.023
29067	Douglas	12,541	13,246	1.056

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
29069	Dunklin	32,627	31,891	0.977
29071	Franklin	96,978	116,194	1.198
29073	Gasconade	15,267	17,259	1.13
29075	Gentry	6,884	7,200	1.046
29077	Greene	237,440	260,399	1.097
29079	Grundy	10,141	9,592	0.946
29081	Harrison	8,181	7,931	0.969
29083	Henry	21,840	23,383	1.071
29085	Hickory	9,360	10,807	1.155
29087	Holt	5,398	4,903	0.908
29089	Howard	9,725	9,906	1.019
29091	Howell	38,114	45,840	1.203
29093	Iron	11,154	11,721	1.051
29095	Jackson	653,141	668,410	1.023
29097	Jasper	103,291	118,819	1.15
29099	Jefferson	205,743	247,773	1.204
29101	Johnson	50,194	59,158	1.179
29103	Knox	4,271	4,074	0.954
29105	Laclede	32,042	38,311	1.196
29107	Lafayette	33,443	36,866	1.102
29109	Lawrence	34,399	40,134	1.167
29111	Lewis	10,023	9,700	0.968
29113	Lincoln	38,970	53,491	1.373
29115	Linn	14,060	14,681	1.044
29117	Livingston	14,385	14,000	0.973
29119	McDonald	21,109	26,954	1.277
29121	Macon	15,088	14,876	0.986
29123	Madison	11,734	12,819	1.092
29125	Maries	8,496	9,169	1.079
29127	Marion	28,015	28,953	1.033
29129	Mercer	4,325	4,859	1.123
29131	Miller	23,815	28,155	1.182
29133	Mississippi	12,979	11,247	0.867
29135	Moniteau	14,560	16,349	1.123
29137	Monroe	8,847	8,904	1.006
29139	Montgomery	12,067	13,007	1.078
29141	Morgan	19,328	23,273	1.204
29143	New Madrid	20,428	19,695	0.964
29145	Newton	50,569	58,237	1.152
29147	Nodaway	20,521	18,673	0.91
29149	Oregon	10,506	11,236	1.069
29151	Osage	12,751	13,503	1.059
29153	Ozark	10,322	11,596	1.123
29155	Pemiscot	21,471	21,369	0.995
29157	Perry	18,005	19,443	1.08
29159	Pettis	38,000	40,961	1.078
29161	Phelps	39,610	42,920	1.084

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
29163	Pike	16,780	16,719	0.996
29165	Platte	75,949	95,760	1.261
29167	Polk	27,597	34,199	1.239
29169	Pulaski	41,942	37,494	0.894
29171	Putnam	4,934	4,625	0.937
29173	Ralls	9,112	9,811	1.077
29175	Randolph	23,863	23,397	0.98
29177	Ray	23,519	26,189	1.114
29179	Reynolds	6,722	6,536	0.972
29181	Ripley	14,997	18,480	1.232
29183	St. Charles	295,337	399,603	1.353
29185	St. Clair	9,375	10,254	1.094
29186	Ste. Genevieve	17,581	19,427	1.105
29187	St. Francois	57,936	66,648	1.15
29189	St. Louis	1,000,468	972,728	0.972
29195	Saline	22,426	21,654	0.966
29197	Schuyler	4,517	4,845	1.073
29199	Scotland	4,795	4,756	0.992
29201	Scott	40,920	42,065	1.028
29203	Shannon	8,500	9,450	1.112
29205	Shelby	6,747	6,682	0.99
29207	Stoddard	29,132	28,107	0.965
29209	Stone	31,887	44,919	1.409
29211	Sullivan	6,770	7,288	1.077
29213	Taney	39,389	53,373	1.355
29215	Texas	24,647	26,637	1.081
29217	Vernon	19,555	20,427	1.045
29219	Warren	26,349	35,226	1.337
29221	Washington	23,758	27,109	1.141
29223	Wayne	13,715	15,786	1.151
29225	Webster	31,186	40,596	1.302
29227	Worth	2,277	2,102	0.923
29229	Wright	21,191	26,671	1.259
29510	St. Louis City	308,084	203,291	0.66
	NEBRASKA			
31001	Adams	31,573	35,093	1.111
31003	Antelope	7,325	6,432	0.878
31005	Arthur	438	390	0.891
31007	Banner	810	743	0.918
31009	Blaine	561	410	0.731
31011	Boone	6,135	5,419	0.883
31013	Box Butte	11,998	10,816	0.901
31015	Boyd	2,352	1,760	0.748
31017	Brown	3,475	3,135	0.902
31019	Buffalo	43,358	52,767	1.217
31021	Burt	7,786	7,703	0.989
31023	Butler	8,807	9,355	1.062

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
31025	Cass	24,932	30,776	1.234
31027	Cedar	9,453	8,445	0.893
31029	Chase	3,996	3,496	0.875
31031	Cherry	6,086	5,570	0.915
31033	Cheyenne	9,915	10,650	1.074
31035	Clay	7,015	6,887	0.982
31037	Colfax	10,650	12,812	1.203
31039	Cuming	10,186	10,564	1.037
31041	Custer	11,637	10,555	0.907
31043	Dakota	21,004	28,123	1.339
31045	Dawes	9,103	9,356	1.028
31047	Dawson	25,038	31,659	1.264
31049	Deuel	2,069	1,900	0.918
31051	Dixon	6,354	6,581	1.036
31053	Dodge	36,719	42,744	1.164
31055	Douglas	475,053	575,897	1.212
31057	Dundy	2,236	1,815	0.812
31059	Fillmore	6,547	6,018	0.919
31061	Franklin	3,513	3,113	0.886
31063	Frontier	3,098	3,105	1.002
31065	Furnas	5,275	4,970	0.942
31067	Gage	23,078	24,509	1.062
31069	Garden	2,259	2,034	0.9
31071	Garfield	1,848	1,487	0.804
31073	Gosper	2,143	2,160	1.008
31075	Grant	732	625	0.854
31077	Greeley	2,639	2,097	0.795
31079	Hall	54,710	66,217	1.21
31081	Hamilton	9,510	10,598	1.114
31083	Harlan	3,755	3,627	0.966
31085	Hayes	1,032	767	0.743
31087	Hitchcock	3,002	2,232	0.743
31089	Holt	11,289	9,473	0.839
31091	Hooker	769	740	0.962
31093	Howard	6,640	7,321	1.102
31095	Jefferson	8,233	7,519	0.913
31097	Johnson	4,484	4,561	1.017
31099	Kearney	6,933	7,415	1.07
31101	Keith	8,947	9,453	1.056
31103	Keya Paha	960	778	0.811
31105	Kimball	4,078	4,021	0.986
31107	Knox	9,293	8,699	0.936
31109	Lancaster	259,022	339,780	1.312
31111	Lincoln	35,207	40,975	1.164
31113	Logan	754	619	0.821
31115	Loup	703	651	0.926
31117	McPherson	526	499	0.948

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
31119	Madison	35,797	41,896	1.17
31121	Merrick	8,221	8,511	1.035
31123	Morrill	5,464	5,720	1.047
31125	Nance	3,984	3,608	0.906
31127	Nemaha	7,518	7,029	0.935
31129	Nuckolls	4,923	3,939	0.8
31131	Otoe	15,678	18,653	1.19
31133	Pawnee	3,036	2,760	0.909
31135	Perkins	3,163	2,934	0.928
31137	Phelps	9,734	9,705	0.997
31139	Pierce	7,868	7,975	1.014
31141	Platte	32,052	36,498	1.139
31143	Polk	5,621	5,569	0.991
31145	Red Willow	11,389	11,002	0.966
31147	Richardson	9,450	8,973	0.95
31149	Rock	1,700	1,292	0.76
31151	Saline	14,109	16,745	1.187
31153	Sarpy	127,219	167,476	1.316
31155	Saunders	20,130	23,249	1.155
31157	Scotts Bluff	37,472	43,116	1.151
31159	Seward	16,635	18,095	1.088
31161	Sheridan	6,104	5,437	0.891
31163	Sherman	3,233	2,620	0.81
31165	Sioux	1,455	1,247	0.857
31167	Stanton	6,481	6,728	1.038
31169	Thayer	5,928	5,042	0.85
31171	Thomas	704	527	0.749
31173	Thurston	7,271	8,147	1.12
31175	Valley	4,545	3,835	0.844
31177	Washington	19,312	24,628	1.275
31179	Wayne	9,973	11,028	1.106
31181	Webster	4,007	3,726	0.93
31183	Wheeler	861	703	0.817
31185	York	14,660	15,532	1.06
	OKLAHOMA			
40001	Adair	21,743	27,960	1.286
40003	Alfalfa	6,063	5,900	0.973
40005	Atoka	14,167	17,040	1.203
40007	Beaver	5,834	5,960	1.022
40009	Beckham	20,039	22,800	1.138
40011	Blaine	12,066	13,500	1.119
40013	Bryan	37,360	44,060	1.179
40015	Caddo	30,210	31,820	1.053
40017	Canadian	89,538	104,960	1.172
40019	Carter	45,893	49,600	1.081
40021	Cherokee	44,073	56,420	1.28
40023	Choctaw	15,365	15,920	1.036

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
40025	Cimarron	3,169	3,360	1.06
40027	Cleveland	212,930	245,480	1.153
40029	Coal	6,139	7,400	1.205
40031	Comanche	116,758	130,360	1.117
40033	Cotton	6,568	6,660	1.014
40035	Craig	15,250	17,940	1.176
40037	Creek	68,220	76,040	1.115
40039	Custer	26,445	28,800	1.089
40041	Delaware	38,326	48,620	1.269
40043	Dewey	4,686	4,500	0.96
40045	Ellis	4,005	3,740	0.934
40047	Garfield	58,048	60,640	1.045
40049	Garvin	27,246	28,080	1.031
40051	Grady	46,110	51,620	1.12
40053	Grant	5,126	5,160	1.007
40055	Greer	5,997	5,900	0.984
40057	Harmon	3,250	3,300	1.015
40059	Harper	3,537	3,400	0.961
40061	Haskell	12,115	14,940	1.233
40063	Hughes	14,412	17,100	1.186
40065	Jackson	28,743	31,540	1.097
40067	Jefferson	6,731	6,660	0.989
40069	Johnston	10,708	12,720	1.188
40071	Kay	48,248	50,480	1.046
40073	Kingfisher	14,156	16,740	1.183
40075	Kiowa	10,136	9,900	0.977
40077	Latimer	10,735	11,380	1.06
40079	Le Flore	48,505	54,700	1.128
40081	Lincoln	32,568	37,200	1.142
40083	Logan	34,874	42,540	1.22
40085	Love	9,139	11,940	1.307
40087	McClain	28,764	37,320	1.297
40089	McCurtain	34,601	36,880	1.066
40091	McIntosh	19,874	23,780	1.197
40093	Major	7,527	7,500	0.996
40095	Marshall	13,910	20,040	1.441
40097	Mayes	39,061	45,460	1.164
40099	Murray	12,854	14,760	1.148
40101	Muskogee	69,671	72,820	1.045
40103	Noble	11,527	12,480	1.083
40105	Nowata	10,821	13,340	1.233
40107	Okfuskee	11,808	12,120	1.026
40109	Oklahoma	668,989	728,840	1.089
40111	Okmulgee	40,091	44,560	1.111
40113	Osage	45,022	50,260	1.116
40115	Ottawa	33,516	36,820	1.099
40117	Pawnee	16,887	19,800	1.172

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
40119	Payne	70,194	82,360	1.173
40121	Pittsburg	44,172	46,960	1.063
40123	Pontotoc	35,326	37,420	1.059
40125	Pottawatomie	66,393	73,880	1.113
40127	Pushmataha	11,920	14,380	1.206
40129	Roger Mills	3,422	3,400	0.994
40131	Rogers	72,465	88,040	1.215
40133	Seminole	24,896	25,840	1.038
40135	Sequoyah	39,863	47,280	1.186
40137	Stephens	43,069	43,280	1.005
40139	Texas	21,344	31,420	1.472
40141	Tillman	9,252	9,360	1.012
40143	Tulsa	570,659	625,040	1.095
40145	Wagoner	59,285	71,220	1.201
40147	Washington	49,118	50,600	1.03
40149	Washita	11,585	12,220	1.055
40151	Woods	9,093	9,200	1.012
40153	Woodward	18,612	19,840	1.066
		TEXAS		
48001	Anderson	55,825	62,092	1.112
48003	Andrews	13,238	15,107	1.141
48005	Angelina	81,575	94,579	1.159
48007	Aransas	22,934	26,209	1.143
48009	Archer	9,024	10,468	1.16
48011	Armstrong	2,158	2,290	1.061
48013	Atascosa	40,167	53,775	1.339
48015	Austin	24,077	28,473	1.183
48017	Bailey	6,735	8,082	1.2
48019	Bandera	18,390	25,243	1.373
48021	Bastrop	61,069	94,372	1.545
48023	Baylor	4,055	3,877	0.956
48025	Bee	32,849	36,562	1.113
48027	Bell	246,823	314,037	1.272
48029	Bexar	1,427,012	1,671,927	1.172
48031	Blanco	8,718	11,557	1.326
48033	Borden	733	781	1.065
48035	Bosque	17,437	20,107	1.153
48037	Bowie	89,580	91,580	1.022
48039	Brazoria	250,581	326,663	1.304
48041	Brazos	156,104	186,034	1.192
48043	Brewster	8,926	10,029	1.124
48045	Briscoe	1,804	1,932	1.071
48047	Brooks	8,144	9,519	1.169
48049	Brown	38,032	41,331	1.087
48051	Burleson	16,885	20,825	1.233
48053	Burnet	35,695	50,786	1.423
48055	Caldwell	33,656	48,066	1.428

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
48057	Calhoun	21,104	24,148	1.144
48059	Callahan	13,015	14,012	1.077
48061	Cameron	350,379	483,238	1.379
48063	Camp	11,822	14,014	1.185
48065	Carson	6,549	6,818	1.041
48067	Cass	30,445	30,639	1.006
48069	Castro	8,485	10,065	1.186
48071	Chambers	27,049	36,395	1.346
48073	Cherokee	47,518	55,687	1.172
48075	Childress	7,756	8,283	1.068
48077	Clay	11,083	11,653	1.051
48079	Cochran	3,801	4,447	1.17
48081	Coke	3,842	3,837	0.999
48083	Coleman	9,219	9,345	1.014
48085	Collin	526,153	822,200	1.563
48087	Collingsworth	3,184	3,160	0.992
48089	Colorado	20,586	22,907	1.113
48091	Comal	81,730	116,670	1.428
48093	Comanche	14,078	14,909	1.059
48095	Concho	4,005	4,113	1.027
48097	Cooke	36,899	42,123	1.142
48099	Coryell	77,652	101,132	1.302
48101	Cottle	1,892	1,928	1.019
48103	Crane	4,076	4,674	1.147
48105	Crockett	4,171	4,720	1.132
48107	Crosby	7,195	8,188	1.138
48109	Culberson	3,050	3,524	1.155
48111	Dallam	6,367	7,305	1.147
48113	Dallas	2,284,143	2,865,380	1.254
48115	Dawson	15,188	16,641	1.096
48117	Deaf Smith	19,054	22,958	1.205
48119	Delta	5,331	5,362	1.006
48121	Denton	465,947	753,768	1.618
48123	DeWitt	20,169	21,436	1.063
48125	Dickens	2,749	2,689	0.978
48127	Dimmit	10,495	12,165	1.159
48129	Donley	3,826	3,776	0.987
48131	Duval	13,353	14,883	1.115
48133	Eastland	18,293	18,668	1.02
48135	Ector	123,150	142,079	1.154
48137	Edwards	2,185	2,331	1.067
48139	Ellis	115,879	159,805	1.379
48141	El Paso	703,516	904,018	1.285
48143	Erath	34,293	41,401	1.207
48145	Falls	18,747	20,606	1.099
48147	Fannin	31,641	35,727	1.129
48149	Fayette	22,019	25,273	1.148

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
48151	Fisher	4,308	4,070	0.945
48153	Floyd	7,874	8,875	1.127
48155	Foard	1,618	1,618	1
48157	Fort Bend	373,357	540,789	1.448
48159	Franklin	9,552	10,277	1.076
48161	Freestone	18,062	20,161	1.116
48163	Frio	16,725	20,219	1.209
48165	Gaines	14,799	17,918	1.211
48167	Galveston	253,900	283,666	1.117
48169	Garza	4,942	5,472	1.107
48171	Gillespie	21,030	23,313	1.109
48173	Glasscock	1,425	1,654	1.161
48175	Goliad	7,036	7,739	1.1
48177	Gonzales	18,950	21,801	1.15
48179	Gray	22,624	22,406	0.99
48181	Grayson	111,888	123,924	1.108
48183	Gregg	112,696	125,782	1.116
48185	Grimes	24,203	30,486	1.26
48187	Guadalupe	92,465	123,890	1.34
48189	Hale	37,285	42,886	1.15
48191	Hall	3,799	3,951	1.04
48193	Hamilton	8,252	8,873	1.075
48195	Hansford	5,440	6,269	1.152
48197	Hardeman	4,720	4,746	1.006
48199	Hardin	48,944	55,591	1.136
48201	Harris	3,503,977	4,416,624	1.26
48203	Harrison	63,224	73,646	1.165
48205	Hartley	5,629	6,275	1.115
48207	Haskell	6,056	6,000	0.991
48209	Hays	106,152	174,701	1.646
48211	Hemphill	3,384	3,668	1.084
48213	Henderson	75,340	94,009	1.248
48215	Hidalgo	603,081	911,390	1.511
48217	Hill	33,057	40,340	1.22
48219	Hockley	23,092	25,645	1.111
48221	Hood	42,466	55,163	1.299
48223	Hopkins	32,358	36,114	1.116
48225	Houston	23,266	24,481	1.052
48227	Howard	33,901	36,108	1.065
48229	Hudspeth	3,417	3,945	1.155
48231	Hunt	80,012	105,234	1.315
48233	Hutchinson	23,974	25,212	1.052
48235	Irion	1,783	1,810	1.015
48237	Jack	8,840	9,508	1.076
48239	Jackson	14,622	16,558	1.132
48241	Jasper	36,303	42,026	1.158
48243	Jeff Davis	2,229	2,312	1.037

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
48245	Jefferson	254,598	273,841	1.076
48247	Jim Hogg	5,377	6,197	1.153
48249	Jim Wells	40,067	45,874	1.145
48251	Johnson	131,417	175,962	1.339
48253	Jones	20,871	22,002	1.054
48255	Karnes	15,785	18,764	1.189
48257	Kaufman	74,604	107,395	1.44
48259	Kendall	24,885	35,870	1.441
48261	Kenedy	424	499	1.177
48263	Kent	848	823	0.971
48265	Kerr	44,086	48,298	1.096
48267	Kimble	4,487	4,585	1.022
48269	King	359	401	1.117
48271	Kinney	3,403	3,513	1.032
48273	Kleberg	33,117	41,183	1.244
48275	Knox	4,238	4,340	1.024
48277	Lamar	48,834	51,485	1.054
48279	Lamb	14,911	16,850	1.13
48281	Lampasas	18,234	22,529	1.236
48283	La Salle	6,050	7,479	1.236
48285	Lavaca	19,194	19,632	1.023
48287	Lee	16,086	20,471	1.273
48289	Leon	15,593	17,889	1.147
48291	Liberty	72,445	93,467	1.29
48293	Limestone	22,368	25,486	1.139
48295	Lipscomb	3,065	3,215	1.049
48297	Live Oak	12,488	13,788	1.104
48299	Llano	16,945	16,260	0.96
48301	Loving	67	63	0.94
48303	Lubbock	249,130	278,019	1.116
48305	Lynn	6,648	7,364	1.108
48307	McCulloch	8,244	8,680	1.053
48309	McLennan	216,167	247,741	1.146
48311	McMullen	852	877	1.029
48313	Madison	13,176	15,081	1.145
48315	Marion	11,091	12,025	1.084
48317	Martin	4,847	5,700	1.176
48319	Mason	3,725	3,609	0.969
48321	Matagorda	38,580	44,184	1.145
48323	Maverick	49,212	65,897	1.339
48325	Medina	40,817	54,778	1.342
48327	Menard	2,363	2,442	1.033
48329	Midland	117,378	132,227	1.127
48331	Milam	24,569	27,688	1.127
48333	Mills	5,170	5,589	1.081
48335	Mitchell	9,723	9,930	1.021
48337	Montague	19,275	20,913	1.085

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
48339	Montgomery	309,930	461,971	1.491
48341	Moore	20,762	26,367	1.27
48343	Morris	13,099	13,530	1.033
48345	Motley	1,425	1,367	0.959
48347	Nacogdoches	59,776	67,457	1.128
48349	Navarro	46,048	55,397	1.203
48351	Newton	15,325	17,183	1.121
48353	Nolan	15,989	17,389	1.088
48355	Nueces	321,277	384,672	1.197
48357	Ochiltree	9,198	10,968	1.192
48359	Oldham	2,214	2,423	1.094
48361	Orange	85,840	91,950	1.071
48363	Palo Pinto	27,446	31,612	1.152
48365	Panola	22,978	24,587	1.07
48367	Parker	91,640	119,974	1.309
48369	Parmer	10,208	12,008	1.176
48371	Pecos	17,083	19,202	1.124
48373	Polk	42,165	51,096	1.212
48375	Potter	116,392	142,151	1.221
48377	Presidio	7,584	9,955	1.313
48379	Rains	9,402	11,529	1.226
48381	Randall	106,619	125,769	1.18
48383	Reagan	3,405	4,101	1.204
48385	Real	3,051	3,040	0.996
48387	Red River	14,351	14,641	1.02
48389	Reeves	13,369	14,786	1.106
48391	Refugio	7,943	8,652	1.089
48393	Roberts	897	998	1.113
48395	Robertson	16,287	19,279	1.184
48397	Rockwall	45,533	67,942	1.492
48399	Runnels	11,577	12,475	1.078
48401	Rusk	47,780	51,956	1.087
48403	Sabine	10,523	10,716	1.018
48405	San Augustine	9,069	9,770	1.077
48407	San Jacinto	22,977	29,104	1.267
48409	San Patricio	69,800	93,570	1.341
48411	San Saba	6,222	6,843	1.1
48413	Schleicher	2,970	3,342	1.125
48415	Scurry	16,476	17,562	1.066
48417	Shackelford	3,337	3,574	1.071
48419	Shelby	25,639	29,603	1.155
48421	Sherman	3,237	3,594	1.11
48423	Smith	177,083	201,037	1.135
48425	Somervell	6,979	8,490	1.217
48427	Starr	56,216	79,415	1.413
48429	Stephens	9,731	10,457	1.075
48431	Sterling	1,402	1,543	1.101

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
48433	Stonewall	1,694	1,695	1.001
48435	Sutton	4,181	4,814	1.151
48437	Swisher	8,496	9,523	1.121
48439	Tarrant	1,489,319	1,847,868	1.241
48441	Taylor	128,262	141,533	1.103
48443	Terrell	1,081	1,095	1.013
48445	Terry	12,997	14,910	1.147
48447	Throckmorton	1,860	1,866	1.003
48449	Titus	28,786	34,989	1.215
48451	Tom Green	105,294	116,825	1.11
48453	Travis	845,053	1,080,424	1.279
48455	Trinity	13,942	15,034	1.078
48457	Tyler	21,250	24,626	1.159
48459	Upshur	35,908	41,645	1.16
48461	Upton	3,461	3,902	1.127
48463	Uvalde	26,616	32,217	1.21
48465	Val Verde	46,318	57,703	1.246
48467	Van Zandt	49,269	59,968	1.217
48469	Victoria	86,205	102,198	1.186
48471	Walker	63,272	72,115	1.14
48473	Waller	34,583	49,277	1.425
48475	Ward	11,060	12,051	1.09
48477	Washington	30,752	35,292	1.148
48479	Webb	206,306	325,594	1.578
48481	Wharton	41,738	46,881	1.123
48483	Wheeler	5,231	4,997	0.955
48485	Wichita	133,000	143,299	1.077
48487	Wilbarger	14,793	16,126	1.09
48489	Willacy	20,651	25,372	1.229
48491	Williamson	267,736	434,237	1.622
48493	Wilson	33,943	48,616	1.432
48495	Winkler	7,273	7,999	1.1
48497	Wise	50,769	68,763	1.354
48499	Wood	37,500	43,929	1.171
48501	Yoakum	7,488	8,997	1.202
48503	Young	17,982	18,841	1.048
48505	Zapata	12,587	16,344	1.298
48507	Zavala	11,887	14,101	1.186

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