

HGB SIP SUMMARY

This unofficial summary of the HGB SIP was taken from “Revisions to the State Implementation Plan (SIP) for the Control of Ozone Air Pollution, HOUSTON/GALVESTON/BRAZORIA (HGB) OZONE NONATTAINMENT AREA”, Adopted December 1, 2004. PROJECT NO. 2004-042-SIP-NR. This 12/1/2004 one-hour HGB SIP consists of 205 pages, and has been condensed in this summary to 12 pages. The entire document can be downloaded from:

<http://www.tceq.state.tx.us/implementation/air/sip/siplans.html#sips>

The contents of the one-hour ozone HGB SIP document are:

- Chapter 1: Executive Summary (16 pages)
- Chapter 2: General (3 pages)
- Chapter 3: Photochemical Modeling (153 pages)
- Chapter 4: Data Analysis (16 pages)
- Chapter 5: Required Control Strategy Elements (15 pages)
- Chapter 6: Future Attainment Plans (2 pages)

A summary of each section follows.

I. Chapter 1: Executive Summary

A. Background

Originally the Environmental Protection Agency (EPA) published Federal Clean Air Act (FCAA) standards in 1977 requiring states to have State Implementation Plans that address ozone levels in excess of national standards or “ozone non-attainment” by 1982. Texas submitted plans in 1982 for all impacted areas, except for Harris County, which was granted an extension until 1987. In 1990 EPA gave “HGB” (the Houston/Galveston/Brazoria area, which also includes the 5 additional counties of Fort Bend, Waller, Montgomery, Liberty and Chambers) a non-attainment designation of “Severe-17” with regards to ozone. The 1990 provisions included for the first time the ability of the EPA to take punitive actions (e.g. an area not in compliance by the established deadlines could lose all federal highway funding). The Severe-17 designation required the HGB area to be in compliance with the one-hour ozone standard (0.12 ppm) by November 15, 2007. The new eight hour ozone standard at 0.80 ppm is widely considered to be more difficult to attain, however the compliance deadline is not until 2010. Although meeting the one-hour ozone standard by the 2007 date is no longer a requirement, the EPA has incorporated a “no backsliding” rule, which states that the controls that were implemented to reduce ozone for compliance with the one-hour standard cannot be retracted.

Originally the EPA required that areas identify how they would reach attainment of the ozone standard using the Urban Airshed Model (UAM). In 1994 HGB submitted to EPA UAM results which indicated that a reduction in NO_x could actually create an increase in ozone. In May 1997, as the modeling issues were being worked out, HGB, at the request of EPA, submitted a rate of progress (ROP) SIP, which included control measures to reduce ozone precursors by 3% each year from 1997-1999, using 1990 as the base. In December 2000 the TCEQ adopted a SIP for HGB that was heavily focused on reducing NO_x. Findings from the TexAQS 2000 Air Quality Study and a lawsuit from concerned commercial interests led to less stringent NO_x controls (80% reductions from point sources instead of 90%) and added controls to reduce emissions of highly reactive volatile organic compounds (HRVOCs).

TCEQ was preparing for a mid-course review of the one-hour ozone standard when EPA announced that a new eight hour standard would be promulgated, and would eventually replace the one-hour standard. However, a “no backsliding” provision became part of the eight hour rule, preventing areas from dropping controls that have been planned or implemented to reduce ozone. The one-hour ozone values have reduced significantly since the early 1980’s, however there has been no significant change in the eight hour ozone value for more than 20 years.

B. Control Strategies

The control strategies for HGB address routine emissions typical of a populated urban center with emissions from a very large industrial base and upset emissions of HRVOCs due to non-routine incidents in petrochemical facilities. HRVOC reductions will be achieved by implementing a 1200 lbs/hour not-to-exceed limit along with an annual cap on allowable emissions. In addition emission inventories of HRVOCs will become more accurate with the implementation of new regulations that require monitoring emissions at flares, cooling water tanks and vents.

Texas Environmental Research Consortium (TERC) sponsored project H-13 was used to evaluate the impact of short term HRVOC releases in a relatively small area. The results indicated that the impacts were significant and as a result TCEQ took measures to address them. TERC project H-12 was used to evaluate and verify other assumptions that were made in this document (the one-hour mid course review) to identify the control strategies that were selected.

TCEQ has been using CAMx 4.03 and Carbon IV Mechanism (CBIV) to perform their photochemical grid modeling of ozone production in HGB. TCEQ is currently reviewing using the Community Multi-scale Air Quality (CMAQ) model and the Statewide Air Pollution Research Center (SAPRC) chemical mechanism for future SIP work. The selected period for modeling was August 19 – September 6, 2000.

The photochemical modeling of the August-September 2000 episode demonstrates attainment of the 1-hour ozone standard when coupled with a weight-of-evidence argument, despite some problems modeling August 31. (The EPA allows for the option of using a weight-of-evidence argument if the modeling does not meet the required standards for evidence of compliance).

II. Chapter 2: General

A complete history of the Texas SIP can be found at:
<http://www.tnrcc.state.tx.us/oprd/sipintro.html#History>

Significant revisions to the one-hour ozone HGB SIP occurred in December 2000, September 2001 and December 2002. The December 2000 SIP was focused on NO_x, required a 90% NO_x reduction from point sources, and had a NO_x shortfall that was to be addressed in a future revision. The September 2001 made several clarifications regarding the control strategies and acknowledge that there was still a 56 ton/day NO_x gap, which would be addressed through the mid-course review (MCR) process. The December 2002 SIP was impacted by a court case from the Business Council for Clean Air (BCCA) which claimed that 10% of the 90% NO_x reduction requirements were not cost effective, and better results could be obtained with an 80% NO_x reduction and some reduction of VOCs released from upset conditions. Results from the TexAQS 2000 Field Study and modeling analysis back up these claims, and TCEQ responded to them by reducing the NO_x requirements and imposing new rules to address VOCs, especially HRVOCs from flares, cooling water towers, process vents and fugitives.

III. Chapter 3: Photochemical Modeling

A. Modeling

EPA requires that states demonstrate that they can achieve attainment of air quality standards by using photochemical modeling. The first step of the process requires taking measurements during a specific time period or episode and, using existing emissions inventories, demonstrate that the model can replicate the measurements of ozone in different locations at various times. Once the model has met the quality assurance requirements, the emissions inventories are reduced until the model provides predictions that indicate the area will be in attainment. These new emissions inventories are used as the basis for control strategies. Details about the episode selection, the models used and model performance for HGB are provided in the one-hour ozone SIP, sections 3.1-3.4.

B. Emissions Inventories

There are several different emissions inventories that can easily be confused. For example, there is the present emissions inventory, estimated based on the emissions today (or at some point in the past when the inventory was developed). There is also the base case future inventory. This represents the emissions that would occur at some point in the future based on projected growth rates and the control strategies that are currently in place. Finally there is the modeled inventory, which identifies what the emissions inventory must be at some future date in order to reach attainment.

Emissions inventories are developed in a variety of ways. Some are reported by industry based on a combination of measurements and emissions estimating calculations. For on-road mobile source emissions information about the number of vehicles, age of the vehicles, miles traveled, time of day traveled, etc. are input into a model (MOBILE6) which calculates the total emissions. Other emissions are calculated based on counting equipment (e.g. generators) or other sources (e.g. gas stations, dry cleaners, etc.) into categories and determining the total emissions. There are also “surrogates” that are used to estimate emissions for some items that are based on population, economic activity, employment and other items.

Emission sources are divided into five major categories:

1. Point Sources – refineries, chemical plants, electric power plants, etc.
2. Non-road Mobile Sources – construction, lawn & garden, locomotives, ships, etc.
3. On-road Mobile Sources – cars, trucks, motorcycles.
4. Area Sources – dry cleaning, residential fuel, solvents, etc.
5. Biogenic Sources – trees, crops, bayous, etc.

Below is a list of emissions provided for the various categories based on an August 2000 inventory.

1. Point Sources

For point sources an adjustment of VOCs was made based on the findings in the TexAQS 2000 study which indicated that the VOC emissions from petrochemical facilities were much higher than reported. This adjustment is reflected in the table below.

Table 3.5-2: HGB Point Source Emissions (tpd) - August 30, 2000

	NO _x	VOC
EGU	225.91	3.81
Non-EGU	265.96	208.86
Region 12 U/M	0	2.93
Unadjusted Totals	491.87	215.60
HGB Olefin Adjustment	0	168.01
Adjusted Totals	491.87	383.61

2. Non-road Mobile Sources

Table 3.5-25: 2000 HGB 8-County Weekday Non-road Totals
(Note: These values are for weekdays only!)

2000 HGB 8-County Weekday Non-road Mobile Totals		
	HGB Non-road Mobile NO_x	HGB Non-road Mobile VOC
Agriculture	2.93	0.46
Aircraft	5.76	2.31
Commercial	6.23	9.39
Construction	40.02	7.91
GSE	4	3.76
Industrial	17.43	4.62
Commercial Lawn & Garden	3.3	22.76
Residential Lawn & Garden	1.16	12.23
RR Maintenance	0.1	5.04
Logging	0.39	0.24
Locomotives	35.94	1.47
Oil & Gas	1.71	0.16
Recreational Equipment	0.32	7.56
Recreational Boating	0.85	16.68
Ships	34.85	0.79
Total	154.99	95.38

3. On-road Mobile Source (by county)

County	8 County Vehicle Mile Traveled (VMT)		Total Emissions (tpd)	
	Total	Distribution	NO_x	VOC
Brazoria	5,591,008	4.39%	14.92	6.79
Chambers	2,202,239	1.73%	7.76	3.09
Fort Bend	6,790,771	5.33%	18.91	8.73
Galveston	6,160,053	4.83%	16.27	7.55
Harris	95,707,669	75.09%	265.46	110.49
Liberty	2,034,665	1.60%	6.18	2.89
Montgomery	7,253,818	5.69%	21.34	8.98
Waller	1,720,671	1.35%	5.85	2.54
Total	127,460,894	100.00%	356.7	151.07

4. Area Sources

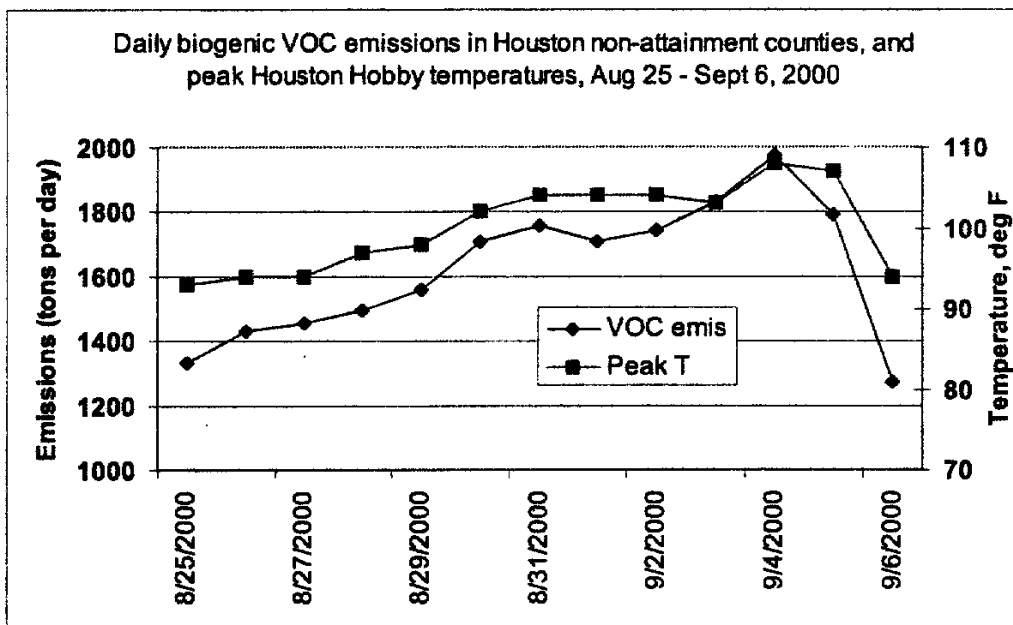
Table 3.5-26: 2000 HGB 8-County Weekday Area Source Totals
(Note: These values are for weekdays only!)

2000 HGB 8-County Weekday Area Source Totals		
	HGB Area Source NOx	HGB Area Source VOC
Architectural Coating	0	18.35
Asphalt Paving	0	6.8
Auto Refinishing	0	2.37
Bakeries & Breweries	0	0.69
Dry cleaning	0	4.34
Graphic Arts	0	0.87
Industrial Fuel	15.96	0.44
Leaking Underground ST	0	1.9
Oil & Gas Production	19.31	20.31
Open Burning	0.35	7.04
Pesticide Use	0	2.46
Petroleum transport and refueling	0	16.97
Residential Fuel Use	2.44	0.14
Solvent Use	0	53.77
Surface Cleaning	0	12.79
Surface Coating	0	11
Traffic Marking	0	0.48
Waste Treatment	0	2.75
Total	38.06	163.47

5. Biogenic Sources

Biogenic emissions are highly dependent on temperature. During the TexAQS Field Study in August 2000, temperatures varied widely, but were generally much higher than normal, creating higher levels of VOC releases. TCEQ estimates that the high temperatures resulted in higher biogenic VOC emissions by 30-45%. In the HGB area during August 2000 the VOC emissions varied from 1300 tons per day to 1900 tons per day. The plot which follows shows some of the results:

Figure 3.9-6: Daily Biogenic Emissions and Peak Temperatures in HGB, August 25 - September 6, 2000



The contribution of biogenic sources to NO_x emissions is very small.

TCEQ used these emissions inventories to run numerous scenarios with their modeling techniques. Considerations were given to variations in temperature, humidity and solar radiation. Studies were performed on highly reactive volatile organic compounds (HRVOCs) released in close proximity to NO_x sources in the Houston Ship Channel area and elsewhere. Other studies were done to address the impacts of “other VOCs” (other than HRVOCs). Attention was given to the impact of wildfires. Studies were also performed to determine source apportionment, to identify the locations of emission releases.

IV. Chapter 4: Data Analysis

HGB has more high ozone days than any other area in Texas. When analyzing the data some of the key items reviewed include:

1. Levels and trends in ozone concentrations.
2. Effects of wind patterns, such as wind speed and the land/sea breeze flow reversal, on ozone levels ;
3. Speciated VOC contribution to total reactivity and relationship to ozone;
4. Sources of emissions that contribute significantly to ozone formation.

A. Trends

The one-hour ozone levels declined from 260 ppb to 200 ppb during the 1980's (based on the "design value" calculation), but remained around 200 ppb during the 1990's. In the late 1990's values began decreasing again, and TCEQ expects that trend to continue as more controls are put in place. The eight hour ozone values have remained fairly steady in the past 20 years, however a decline has been observed in the past few years.

B. Modeling

Modeling performed in the HGB area has under predicted ozone values because of problems incorporating abrupt, short term sharp increases of HRVOCs from industry. One modeling technique that was used identified high differences in ozone readings (greater than 40 ppb) as events originating from sharp increases in HRVOCs from industry. This technique was used to separate the impacts of sudden ozone concentration increases (SOCIs) from routine emissions, and found that the one-hour ozone design value would be 144 ppb without the SOCIs, compared to the previous model result of 160 ppb. The actual calculated value from monitors was 182 ppb. It appears that the traditional model over predicts the routine (no SOCI events) design ozone and under predicts the routine plus SOCI events design ozone.

High ozone events typically occur in HGB between March and October, with peaks in August and September. Analysis suggests that there is no distinction between the number of exceedences on weekdays and weekends. Therefore TCEQ considers industry as the primary cause of ozone exceedences. This was further substantiated by looking at the location of the early peak ozone values, which most frequently occurred in the southeastern core of Houston, the industrial area. Due to these findings TCEQ has developed control strategies to address industrial emissions.

C. Wind Patterns

In HGB the wind direction typically rotates continuously throughout the day. That is, in the morning the wind blows from the northeast, by noon they blow from the east and by afternoon they are from the southeast. After sunset the wind directions shifts to the south and west, and by midnight the wind blows from the southwest. This pattern can repeat itself from day to day. This circular wind pattern tends to concentrate pollutants within the HGB area. This has been confirmed because exceedences are far less likely to occur when the wind is flowing from a single direction throughout the day. In that case the pollutants and precursors are blown out of the area.

D. Speciated VOCs

Two important items were determined from the TexAQS 2000 study regarding VOCs: 1. The amount of VOCs in the emissions inventory is severely underestimated based on the ratios of NO_x/VOC measured with aircraft, and 2. VOCs have a very

different impact on ozone creation depending on their chemical structure. Some VOCs (especially ethylene and propylene) are highly reactive, and their presence in the HGB area allows for a very rapid formation of ozone. A study by Sonoma Technology found that the organics in the air around Houston are dominated by industrial source compounds. VOCs have been analyzed and speciated by samples from canisters, auto-gas chromatographs (auto-GCs measure concentrations of 55 VOCs in air once per hour, 24 hours per day) and aircraft. The speciated information has been useful in the photochemical models in terms of identifying the relative impact of ordinary VOCs (OVOCs) and HRVOCs on forming ozone. OVOCs are much less reactive than HRVOCs, however OVOCs are more concentrated in the atmosphere, hence they still provide a contribution to the overall ozone concentration. HRVOCs, such as ethylene and propylene, come from industrial sources, whereas OVOCs can come from either industrial or non-industrial sources.

E. Future Work

TCEQ plans to spend more time developing ozone predictors for exceedences days. These may include variables such as temperature, humidity, wind direction, emission events, etc. which can be used to forecast and provide warnings to the community about air quality conditions. TCEQ also plans to spend more time investigating the impact of VOC reactivity on ozone formation. The relative contributions of OVOCs vs. HRVOCs merit more investigation. TCEQ will continue to build understanding of ozone in HGB by improving emissions inventories and continued modeling work.

V. Chapter 5: Required Control Strategy Elements

The focus of the HGB one-hour ozone SIP has changed from NO_x only to NO_x and HRVOC. New HRVOC rules call for restrictions on short term releases and longer term steady-state routine emissions.

A. Controls

POINT SOURCE MEASURES

Point Source NO _x .	-Requires a variety of minor and major stationary sources in the 8-county HGB area to meet NO _x , emission specifications, Requires an overall 80% reduction in NO _x , -Estimated NO _x , reductions 598 tpd (No change from December 2002 revision)
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Emissions Banking and Trading Program	Overall NOx Mass Emission Cap and Trade Program for the HGB area. -HRVOC Cap and Trade (HECT) Program for Harris County Annual HRVOC cap was reduced from the HRVOC cap in the December 2002 SIP revision in order to support the attainment demonstration modeling. The respective caps were then reduced by 5% as a compliance margin to address uncertainty in geographical emission shifts under a cap and trade program. Exempts the seven counties surrounding Harris County while requiring each site with a potential to emit more than 10 tpy of HRVOC to establish enforceable limits on HRVOC emissions from vent gas streams, flares, and cooling tower heat exchangers subject to the control requirements " Allow sites to convert VOC emission reduction credits to a yearly allocation of HRVOC allowances, equivalent to no more than 5 percent of a site's initial HRVOC allocation, based on a ratio of maximum incremental reactivity(MIR) for the speciated VOCs reduced and the MIR for an HRVOC.
HRVOC Requirements	Revises existing fugitive, cooling tower, and vent gas control and flare requirements. -Establishes a short-term, 12001b/hour not-to-exceed limit for each site in Harris County.

AREA NON-ROAD MEASURES

Federal area/non-road TERP	The difference of 2000 vs. 2007 area and non-road emissions, which consider the effect of federal controls and growth Provides grants for emission reduction technologies. Funding expected to achieve 38.9 tpd of emission reductions
Airport Reductions	Agreements with Continental Airlines, Southwest Airlines, and the City of Houston to make local reductions of NOx, from sources at Houston area airports. (No change from December 2000 revision)
California Spark-Ignition Engines	Statewide rule requiring manufacturers to ensure that all affected large spark ignition engines are certified to California LSI standards -Exempts agriculture and construction equipment less than 175 hp, recreational equipment, stationary engines, marine vessels, and equipment on tracks. (No change from December 2000 revision)
Gas-fired Water Heaters, Small Boilers, And Process Heaters	Manufacture requirement for state-wide sales of water heaters, small boilers, and process heaters -Delay 10 ng/J compliance date for all Type 0 water heaters by 2 years
Stationary Diesel Engines	Requires owners and operators of stationary diesel engines or dual fuel engines in the 8-county HGB area to meet new emission specifications and operation restrictions (No change from September 2001 revision)
VOC RACT	Implements RACT requirements for batch processes, bakeries, and offset lithographic printers in the 8-county HGB area (No change from December 2000 revision)

MOBILE SOURCE MEASURES

Federal on-road Inspection/Main tenance	The difference of 2000 vs. 2007 on-road emissions, which consider the effect of federal controls and growth Requires ASM 11 or equivalent testing as well as OBD testing -Began May 1, 2002 in Harris County -Began May 1, 2003 in Brazoria, Fort Bend, Galveston, and Montgomery Counties B20-Removes Chambers, Liberty, and Waller Counties
Speed Limit Reduction	Maintains the speed limits at 5 mph below what was posted before May 1, 2002, where speeds were 65 mph or higher.-Removes reinstatement of the 55 mph speed limit on May 1, 2005

Cleaner Diesel Fuel	Beginning April 1, 2005 (October 1, 2005 *)diesel fuel used in the HGB, BPA, and DFW areas, and in an additional 95 East and Central Texas counties for both on-road and non-road use does not exceed 500 ppm sulfur, contains less than 10.0% by volume of aromatic hydrocarbons, and has a minimum cetane number of 48. - Alternative diesel fuel formulations that achieve equivalent emission reductions may also be used. -Beginning June 1, 2006, the sulfur will be reduced to 15 ppm in both on-road and non-road diesel fuel in the HGB, BPA, and DFW areas, and in an additional 95 East and Central Texas counties. (No change from September 2001 revision) (*It is anticipated the j compliance date will be extended by six months to October 1, 2005. i. It is anticipated the rule will be revised by Spring 2005 as directed by the commission. See section 5.3 .5.)
VMEP	Numerous projects identified by the HGAC for inclusion in the SIP such as telecommuting, bus fare promotions, alternative fuel programs, and ozone action days -Revised credit taken for this program to 7 tpd
TCMs	Numerous projects identified by HGAC for inclusion in the SIP, such as traffic signalization and bicycle/pedestrian projects -Updated to show that projects completed prior to the year 2000 have met their commitments and those not captured in the 2000 episode modeling have been incorporated in the appropriate milestone year emissions estimates.
OTHER	
Portable Fuel Containers Rule	Establishes new design "no spill" criteria requirements for portable fuel containers sold, offered for sale, manufactured, and/or distributed in Texas beginning December 31, 2005

B. HRVOC Rules

Several new rules have been implemented to address releases of HRVOCs at petrochemical facilities. These rules involve monitoring and closer control of emissions coming from cooling water towers, flares and process vents. New rules are also implemented to address fugitive emissions including mandatory monitoring of pressure relief valves, additional requirements for monitoring frequency of other fugitive emissions and more specifications for data collection and recordkeeping.

Another method of controlling HRVOCs is with the HRVOC Emissions Cap and Trade (HECT) program in Harris County. This strategy addresses short term releases by placing a 1200 lb/hour cap on the releases. There is also a limit on the annual routine emissions. Modeling studies have shown that the HECT program is only necessary for Harris County in order for the HGB area to achieve one-hour ozone attainment.

C. Texas Emissions Reduction Program (TERP)

In 2001 the state legislature dedicated about \$130 - \$140 million per year to fund emission reductions. Originally the funding was to be from out of state vehicle titles; however this option was ruled unconstitutional. The funding was restored in the next legislative session using an increase in the state vehicle title fee and changes to the surcharges on the sale, lease or use of on-road heavy duty diesel vehicles and non-road equipment. The Emissions Reductions Incentives Grants Program, which reduces NOx emissions by providing funding to upgrade or replace diesel equipment, receives 87.5% of the total, or about \$120 million per year. It is anticipated that this program will reduce

NOx emissions by 38.8 tons/year by 2007. More information can be found on the TERP website: www.terpgrants.org.

D. Reasonably Available Control Measures (RACM)

In 2002 TCEQ determined that there does not exist “reasonably available control measures” to provide a 90% reduction in NOx from point sources, and reduced the requirements so that an 80% NOx reduction would be achieved. Modeling shows that an 80% NOx reduction from point sources, in conjunction with a reduction in HRVOCs will achieve attainment.

TCEQ adopted a new rule that requires new portable fuel containers to meet specifications that reduce VOC emissions due to spillage and evaporation. TCEQ has determined that the control measures for accomplishing this task are RACM.

Photochemical modeling shows that the following items will not provide improvement to meet the one-hour ozone standard, and will be removed from the previous HGB SIP:

1. The commercial lawn and garden provision which prevented activities from being performed in the morning hours.
2. The heavy duty diesel idling provision, which prevented diesel truck drivers from idling their trucks during breaks.
1. Remove Chambers, Liberty, and Waller Counties from the Vehicle Inspection/Maintenance Program.
2. Revoke the speed limit reduction to 55 mph (because 78th Texas Legislature determined that speed limits could not be adjusted for environmental purposes). However speed limits for areas at 65 mph or more before May 1, 2002 are reduced by 5 mph.

VI. Chapter 6: Future Attainment Plans

In the future more attention will be placed on quantifying HRVOCs and determining their impact on ozone production as well as identifying other means to reduce their presence.

The New Technologies Research and Development (NTRD) program will encourage innovative and entrepreneurial efforts to develop, certify and commercialize technologies to reduce NOx which can then be implemented with funding from the Emissions Reductions Incentives Grants Program.

TexAQS II, the second phase of the widely successful TexAQS 2000 field campaign, is planned for May 2005 through October 2006. The study will assess formation and accumulation of ozone, year-round air pollution meteorology, and inventories of ozone. Research will also be conducted on ozone transport into, within, and out of Texas.