Houston-Galveston-Brazoria, Texas
Final Area Designations for the
2008 Ozone National Ambient Air Quality Standards

This is the Technical Support Document (TSD) for the final area designations in the Houston-Galveston-Brazoria (HGB) area for the 2008 ozone national ambient air quality standards (2008 ozone NAAQS).[1] Through-out this document "we," "our," and "us" means the United States Environmental Protection Agency (EPA).

Table 1 below identifies counties in Texas that EPA is designating as nonattainment for the 2008 ozone NAAQS as part of the Houston-Galveston-Brazoria, Texas nonattainment area. In accordance with section 107(d) of the Clean Air Act, EPA must designate an area "nonattainment" if it is violating the 2008 ozone NAAQS or if it is contributing to a violation of the 2008 ozone NAAQS in a nearby area. EPA is designating two nonattainment areas within the state of Texas, the Dallas-Fort Worth (DFW) nonattainment area and the Houston-Galveston-Brazoria (HGB) nonattainment area. The technical analysis supporting the designation and boundaries for the HGB nonattainment area is provided below. This technical analysis includes evaluation of information submitted by the State of Texas and comments received from the public. The formal responses to comments received are provided in the 2008 ozone designation response to comments document which can be found in electronic docket EPA-HQ-OAR-2008-0476 (www.regulations.gov).

Table 1. Counties in Texas Included in the Houston-Galveston-Brazoria Ozone Nonattainment Area

Area	Texas' Recommended Nonattainment Counties	EPA's Designated Nonattainment Counties
Houston-Galveston-Brazoria, TX	Brazoria Chambers Fort Bend Galveston Harris Liberty Montgomery Waller	Brazoria Chambers Fort Bend Galveston Harris Liberty Montgomery Waller

EPA is designating as "unclassifiable/attainment" for the 2008 ozone NAAQS the remaining counties in Texas that are not included in the table above or in the Dallas-Fort Worth nonattainment area (see the separate TSD for this area).

The analysis below provides the basis for designated nonattainment area boundaries. It relies on our analysis of whether and which monitors are violating the 2008 ozone NAAQS, based on certified air quality monitoring data from 2008-2010 and on an evaluation of whether nearby areas are contributing to such violations. EPA has evaluated contributions from nearby areas based on a weight of evidence analysis considering the factors identified below. EPA issued guidance on December 4, 2008 that

[1] The primary 8-hour ozone standard, set to protect human health, was revised on March 27, 2008 (73 FR 16436) from 0.08 parts per million (ppm) to 0.075 ppm. The secondary ozone standard, set to protect human welfare and the environment, was revised to be consistent with the primary ozone standard.

identified these factors as ones EPA would consider in determining nonattainment area boundaries and recommended that states consider these factors in making their designations recommendations to EPA.[2]

1. Air quality data (including the design value calculated for each Federal Reference Method (FRM) or Federal Equivalent Method (FEM)[3] monitor in the area);
2. Emissions and emissions-related data (including location of sources and population, amount of emissions and emissions controls, and urban growth patterns);
3. Meteorology (weather/transport patterns);
4. Geography and topography (mountain ranges or other basin boundaries);
5. Jurisdictional boundaries (e.g., counties, air districts, existing nonattainment areas, Indian country, metropolitan planning organizations (MPOs))

Ground-level ozone generally is not emitted directly into the air, but is created by chemical reactions between oxides of nitrogen (NOx) and volatile organic compounds (VOC) in the presence of sunlight. NOx and VOC emissions from a broad range of sources over a wide area typically contribute to violations of the ozone standards. Accordingly, EPA chose to examine the 5 factors with respect to the larger of the Combined Statistical Area (CSA) or Core Based Statistical Area (CBSA) associated with the violating monitor(s).[4] All data and information used by EPA in this evaluation are the latest available to EPA and/or provided to EPA by states or tribes.

In EPA's designations guidance for the 2008 ozone NAAQS EPA recommended examining CSA/CBSAs because certain factors used to establish CSAs and CBSAs are similar to the factors EPA is using in this technical analysis to determine if a nearby area is contributing to a violation of the 2008 ozone NAAQS. Congress required a similar approach in 1990 for areas classified as serious or above for the 1-hour ozone standard and EPA used the same basic approach in the designation process for the 1997 8-hour ozone NAAQS. Where a violating monitor is not located in a CSA or CBSA, EPA's December 4, 2008, guidance recommended using the boundary of the county containing the violating monitor as the starting point for considering the nonattainment area's boundary.

[2] The December 4, 2008 guidance memorandum "Area Designations for the 2008 Revised Ozone National Ambient Air Quality Standards" refers to 9 factors. In this technical support document we have grouped the emissions-related factors together under the heading of "Emissions and Emissions-Related Data," which results in 5 categories of factors.

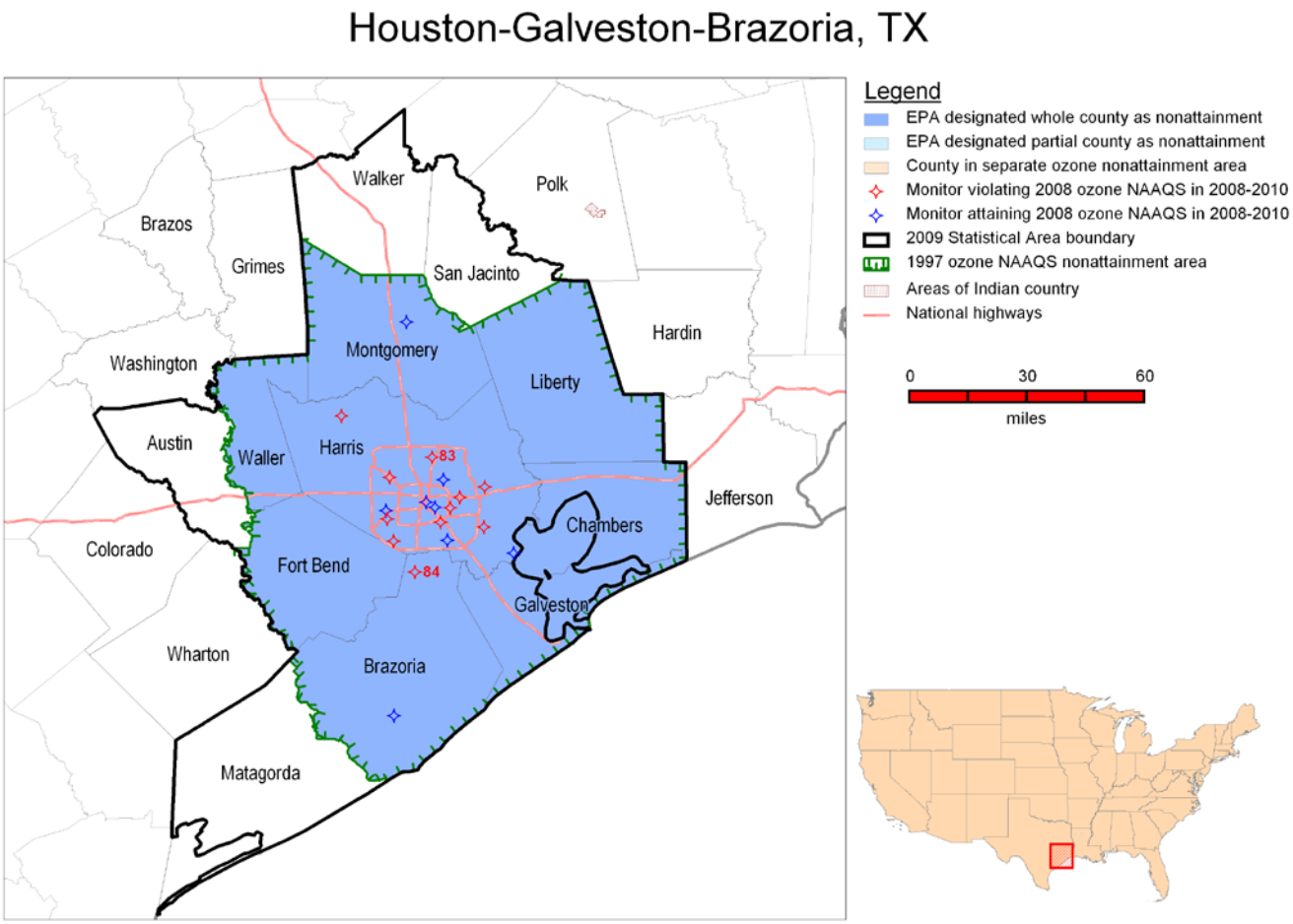
[3] FRM monitors utilize a chemi-luminescent technique to measure ozone, while many FEM monitors use a technique involving ultraviolet photometry. FEM methods began to be developed in the late 1970s/early1980s and are now the most widely utilized methods for monitoring ozone levels. Refer to 40 CFR Part 53 for a more detailed description of FEM and FRM methods. http://www.epa.gov/ttnamti1/files/ambient/criteria/reference-equivalent-methods-list.pdf

[4] Lists of CBSAs and CSAs and their geographic components are provided at www.census.gov/population/metro/. The lists are periodically updated by the Office of Management and Budget. EPA used the most recent update, based on 2008 population estimates, issued on December 1, 2009 (OMB Bulletin No. 10-02).

Technical Analysis for Houston-Galveston-Brazoria, TX

Figure 1 is a map of the HGB designated nonattainment area for the 2008 ozone standard. The map provides other relevant information including the locations and design values of air quality monitors, county and other jurisdictional boundaries, relevant statistical area boundaries, the nonattainment area boundary for 1997 8-hour ozone NAAQS, and major transportation arteries. The Houston-Baytown-Huntsville CSA is comprised of 3 CBSAs all within Texas: (1) the Houston-Sugar Land-Baytown Metropolitan Statistical Area, (2) the Huntsville Micropolitan Statistical Area (Walker County) and (3) the Bay City Micropolitan Statistical Area (Matagorda County). For purposes of the technical analysis, EPA evaluated all 12 twelve counties in the Houston-Baytown-Huntsville CSA: Austin, Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Matagorda, Montgomery, San Jacinto, Walker, and Waller Counties.

Figure 1. Houston-Galveston-Brazoria Designated Nonattainment Area



For purposes of the 1997 8-hour ozone NAAQS, this area was designated nonattainment. The boundary for the nonattainment area for the 1997 8-hour ozone NAAQS included the entire counties of Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller.

In March 2009,[5] Texas recommended the same eight counties as were included in the nonattainment area under the 1997 8-hour ozone standard, Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller, be designated as nonattainment for the 2008 ozone NAAQS based on air quality data from 2006-2008. Texas provided an update to the original recommendation in October 2011[6] based on air quality data from 2008-2010, but did not revise the recommendation for the HGB area. The recommendations from the State are based on data from FEM monitors sited and operated in accordance with 40 CFR Part 58 and an analysis by the Texas Commission on Environmental Quality (TCEQ).

On December 9, 2011, EPA initiated the 120 day consultation process by notifying Texas that based on EPA's technical analysis of the Houston-Baytown-Huntsville CSA EPA intended to add Matagorda County to the 8-counties Texas recommended be designated as the HGB nonattainment area and requesting that if the State wished to provide additional information on EPA's intended designation, they should do so by February 29, 2012. EPA also provided the public a 30-day opportunity to submit comments on EPA's intended designations in a notice in the December 20, 2011 Federal Register (76 FR 78872). In January, EPA extended the public comment period to February 3, 2012 (January 19, 2012, 77 FR 2677). The public comments we received can be found in the electronic docket at www.regulations.gov (docket EPA-HQ-OAR-2008-0476). On February 29, 2012, Texas submitted comments and additional technical information to EPA.[7]

After considering all the comments received, including the comments and additional information provided by the state of Texas, and based on EPA's technical analysis described below EPA is designating the eight counties recommended by the State of Texas (identified in Table 1 above) as "nonattainment" for the 2008 ozone NAAQS as the HGB nonattainment area.

Factor Assessment

Factor 1: Air Quality Data

For this factor, we considered 8-hour ozone design values (in ppm) for air quality monitors in counties in the Houston-Baytown-Huntsville CSA based on data for the 2008-2010 period (i.e., the 2010 design value, or DV), which are the most recent years with fully-certified air quality data. A monitor's DV is the metric or statistic that indicates whether that monitor attains a specified air quality standard. The 2008 ozone NAAQS are met at a monitor when the annual fourth-highest daily maximum 8-hour average concentration, averaged over 3 years is 0.075 ppm or less. A DV is valid only if minimum data completeness criteria are met. See 40 CFR part 50 Appendix P. Where several monitors are located in a county (or a designated nonattainment area or maintenance area), the DV for the county or area is determined by the monitor with the highest DV.

The 2010 DVs for the ozone NAAQS for counties in Houston and nearby surrounding area are provided in Table 2 below.

[5] Initial 2008 ozone NAAQS designation recommendation letter from Governor Perry to Acting Regional Administrator Starfield dated March 10, 2009.
[6] Updated 2008 ozone NAAQS designation recommendation letter from Governor Perry to Administrator Jackson dated October 31, 2011.
[7] Letter from Governor Perry to Regional Administrator Armendariz dated February 29, 2012.

Table 2. Air Quality Data.

County	Texas Recommended Nonattainment?	2008-2010 Design Value (ppm)
Austin, TX	No	--
Brazoria, TX	**Yes**	**0.084**
Chambers, TX	Yes	--
Fort Bend, TX	Yes	--
Galveston, TX	Yes	0.075
Harris, TX	**Yes**	**0.083**
Liberty, TX	Yes	--
Matagorda, TX	No	--
Montgomery, TX	Yes	0.071
San Jacinto, TX	No	--
Walker, TX	No	--
Waller, TX	Yes	--

Counties with design values exceeding the NAAQS indicated in **bold** typeface.

Ambient monitors in Brazoria and Harris Counties indicate a violation of the 2008 ozone NAAQS; therefore these counties are included in the nonattainment area. A county (or partial county) must also be designated nonattainment if it contributes to a violation in a nearby area. Each county without a violating monitor that is located near a county with a violating monitor has been evaluated, as discussed below, based on the five factors to determine whether it contributes to the nearby violation.

Factor 2: Emissions and Emissions-Related Data

EPA evaluated emissions of ozone precursors (NOx and VOC) and other emissions-related data that provide information on areas contributing to violating monitors.

Emissions Data

Significant emissions levels in a nearby area indicate the potential for the area to contribute to observed violations. EPA evaluated county-level emission data for NOx and VOC derived from (1) the 2008 National Emissions Inventory (NEI), version 1.5 and (2) emissions inventory updates provided by Texas. (See http://www.epa.gov/ttn/chief/net/2008inventory.html, and the February 29, 2012, letter from Texas Governor Perry). Based on information provided by Texas, we revised the 2008 emissions inventory for Matagorda County. The revised 2008 NOx emissions inventory is 4,079 tons per year (tpy), down from the 7,007 tpy reported in NEI version 1.5. The revised 2008 VOC emissions inventory is 18,973 tpy, down from the 19,362 tpy reported in the NEI version 1.5. Texas noted that in May 2010 the state submitted locally obtained non-road emissions data for commercial marine vessels and locomotives to the NEI. This data was not reflected in the NEI version 1.5 we used at the time we sent our letter with the intended designations in December 2011. Table 3 shows emissions of NOx and VOC for counties that we considered for inclusion in the HGB nonattainment area.

Table 3. Total 2008 NOx and VOC Emissions.

County	Texas Recommended Nonattainment?	NOx (tpy)	VOC (tpy)
Austin, TX	No	3,829	3,422
Brazoria, TX	Yes	21,894	26,294
Chambers, TX	Yes	4,517	8,119
Fort Bend, TX	Yes	12,786	15,803
Galveston, TX	Yes	32,170	26,867
Harris, TX	Yes	165,610	135,931
Liberty, TX	Yes	3,345	24,137
Matagorda, TX	No	4,079	18,983
Montgomery, TX	Yes	8,434	14,012
San Jacinto, TX	No	1,361	6,064
Walker, TX	No	3,375	2,690
Waller, TX	Yes	2,080	3,993
	Area-wide:	263,480	286,315

The counties with the highest emissions of NOx are Brazoria, Fort Bend, Galveston, Harris, and Montgomery. More than 7,000 tpy of NOx emissions originates from each of these five counties, and collectively they represent approximately 241,000 tpy of NOx, or 91 percent of the total NOx emissions for the Houston CSA. Harris County, in particular, is characterized by high NOx emissions; the 166,000 tpy of NOx originating from Harris County accounts for 62 percent of the total NOx inventory for the area. Significantly, each of these counties either has an air monitor that indicates a violation of the 2008 ozone NAAQS or is adjacent to such a county. San Jacinto and Waller Counties had comparatively low NOx emissions, while Austin, Chambers, Liberty, Matagorda and Walker Counties had a comparatively moderate level of NOx emissions.

Likewise, the counties with the highest VOC emissions in this area are Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Matagorda, and Montgomery. More than 7,000 tpy of VOC emissions originates from each of these eight counties, and collectively they represent approximately 270,000 tpy of VOC, or 94 percent of the total VOC emissions for the Houston area. Harris County, in particular, is characterized by high VOC emissions; the 136,000 tpy of VOC originating from Harris County accounts for 47 percent of the total VOC inventory for the area. As with counties characterized by high NOx emissions, each of these counties either has an air monitor that indicates a violation of the 2008 ozone NAAQS or is adjacent to such a county.

In addition to providing updated 2008 emissions inventory data for Matagorda County, Texas stated that for Matagorda County:

- NOx emissions from point sources decreased from 2,044 tpy in 2002 to 972 tpy in 2010;
- VOC emissions from oil and gas industry area sources are generally alkanes and are not expected to significantly contribute to ozone formation due their low ozone formation reactivity; and
- VOC area source emission estimates from oil and gas production declined 40% from 2008 to 2010.

Matagorda County representatives provided information regarding uncertainty of VOC emission factors used to calculate oil and gas condensate tank emissions. The information submitted by the County

representatives indicated that the VOC emissions for this source category may be overestimated. These emissions make up a large percentage of the County's VOC emissions.[8]

The information provided for Matagorda County indicates that (1) NOx emissions for the county are much less than we identified in our December 9, 2011, letter to Texas and (2) there is some uncertainty concerning the county's VOC emissions. We do note that the HGB area is generally NOx limited other than an area around the highly industrialized ship channel area in East Harris County.

Population density and degree of urbanization

EPA evaluated the population and vehicle use characteristics and trends of the area as indicators of the probable location and magnitude of non-point source emissions. These include ozone-creating emissions from on-road and off-road vehicles and engines, consumer products, residential fuel combustion, and consumer services. Areas of dense population or commercial development are an indicator of area source and mobile source NOx and VOC emissions that may contribute to ozone formation that contributes to nonattainment in the area. Rapid population or VMT growth (see below) in a county on the urban perimeter signifies increasing integration with the core urban area, and indicates that it may be appropriate to include the area associated with area source and mobile source emissions as part of the nonattainment area. Table 4 shows the population, population density, and population growth information for each county in the CSA.

Table 4. Population and Growth.

County	Texas Recommended Nonattainment?	2010 Population	2010 Population Density (1000 pop/sq mi)	Absolute change in population (2000-2010)	Population % change (2000-2010)
Austin, TX	No	28,417	0.04	4,675	20
Brazoria, TX	Yes	313,166	0.21	70,036	29
Chambers, TX	Yes	35,096	0.04	8,931	34
Fort Bend, TX	Yes	585,375	0.66	226,617	63
Galveston, TX	Yes	291,309	0.44	40,601	16
Harris, TX	Yes	4,092,459	2.30	678,528	20
Liberty, TX	Yes	75,643	0.06	5,083	7
Matagorda, TX	No	36,702	0.03	-1,244	-3
Montgomery, TX	Yes	455,746	0.42	158,405	53
San Jacinto, TX	No	26,384	0.04	3,932	18
Walker, TX	No	67,861	0.08	6,117	10
Waller, TX	Yes	43,205	0.08	10,367	32
	Area-wide:	6,051,363	0.51	1,212,048	25

Sources: U.S. Census Bureau population estimates for 2010 as of August 4, 2011 (http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_PL_GCTPL2.STO5&prodType=table)

The Houston CSA is a large metropolitan area with a total population of approximately 6 million people. For the purposes of determining the boundary of the 2008 ozone nonattainment area, EPA evaluated all 12 counties in the Houston-Baytown-Huntsville CSA, which has a total population of 6,051,363 people and an average population density of 510 people per square mile.

[8] This information was shared during meetings between EPA and Matagorda County representatives on March 21, 2012, April 9, 2012, and April 11, 2012. Please see presentations from the group in the docket for this action.

Five counties in the CSA, Brazoria, Fort Bend, Galveston, Harris, and Montgomery, are densely populated; each has 290,000 or more people and a population density exceeding 200 people per square mile. These five counties account for 95 percent of the total population of the Houston CSA. Harris County stands out from the remaining counties in the region. Harris County has approximately 4.1 million people and a population density of 2,300 people per square mile. Fort Bend and Montgomery Counties have moderately high populations and population densities; the population of Fort Bend County is 585,000 with a density of 660 people per square mile, and the population of Montgomery County is 456,000 people with a density of 420 people per square mile. Galveston and Brazoria are is the least populated of these five counties, but each still has 290,000 or more people. The remaining counties in the CSA are predominantly rural, with population densities at or below 80 people per square mile.

Between 2000 and 2010, four of the counties in this area experienced population growth in excess of 70,000 people, which represents 94 percent of the total population growth for the area: Brazoria, Fort Bend, Harris and Montgomery. Of these, the population of two of these counties grew by more than 200,000 people during the past decade: Fort Bend County (+226,617 people) and Harris County (+678,528 people). Of the 12 counties Matagorda County is the only that experienced a decrease in population between 2000 and 2010.

A final population and growth metric evaluated by EPA was the percent change in population during the period from 2000 to 2010. During this decade, all but two of the counties in the area experienced double-digit growth in percent change in population. The counties of Fort Bend and Montgomery had particularly high values for percent change in population, at 63 and 53 percent, respectively. Liberty County had a modest percent change in population while Matagorda County experienced a 3 percent decline.

The attachments to this document includes Figure 2, Houston Ozone and Ozone Precursor Monitoring Network, and Figure 3, Population Density Change Percentage Between 2000 and 2010 Census for the Houston Ozone and Ozone Precursor Monitoring Network, which present graphical information on population density and growth for the Houston area.

Traffic data

EPA evaluated the total Vehicle Miles Traveled (VMT) for each county. In combination with the population/population density data and the location of main transportation arteries (see above), this information helps identify the probable location of non-point source emissions. A county with high VMT is generally an integral part of an urban area and indicates the presence of motor vehicle emissions that may contribute to ozone formation that contributes to nonattainment in the area. Rapid population or VMT growth in a county on the urban perimeter signifies increasing integration with the core urban area, and indicates that the associated area source and mobile source emissions may be appropriate to include in the nonattainment area. Table 5 shows traffic data, including total 2008 VMT and VMT growth for each county.

Table 5. Traffic Data.

County	Texas Recommended Nonattainment?	2008 VMT* (million miles)	% Change in VMT (2002 – 2008)
Austin, TX	No	542	+18
Brazoria, TX	Yes	2,263	+16
Chambers, TX	Yes	935	+23
Fort Bend, TX	Yes	3,339	+23
Galveston, TX	Yes	2,210	+10
Harris, TX	Yes	40,379	+23
Liberty, TX	Yes	865	+12
Matagorda, TX	No	343	-1
Montgomery, TX	Yes	3,982	+22
San Jacinto, TX	No	317	+13
Walker, TX	No	944	+11
Waller, TX	Yes	759	+16
	Area-wide:	56,878	-----

* MOBILE model VMTs are those inputs into the NEI version 1.5.

Total VMT is an important metric as an indicator of potential contribution to ground level ozone concentrations. Commuters in the Houston CSA traveled a total of approximately 57 billion miles during calendar year 2008. Five counties in the Houston area, Brazoria, Fort Bend, Galveston, Harris, and Montgomery Counties, all have total VMT for calendar year 2008 in excess of 2 billion miles. These five counties have a combined VMT of 52 billion miles, or 92 percent of the total VMT for the area. Harris County has a particularly high total VMT at approximately 40 billion miles, which is 71 percent of the total VMT for the entire CSA. San Jacinto County and Matagorda County had the lowest VMT with 317 million miles and 343 million miles, respectively.

Matagorda was only county in the CSA that did not experience significant change in VMT for the period from 2002 – 2008; it experienced an approximate 1 percent decline in VMT. VMT growth for the other 11 counties exceeded 10 percent, and for 4 of those counties the growth rate exceeded 20 percent. The counties with the highest percent change in VMT for this period are Chambers County (+23%), Fort Bend County (+23%), Harris County (+23%), and Montgomery County (+22%). Austin, Brazoria, and Waller Counties each experienced growth in VMT exceeding 15 percent.

Factor 3: Meteorology (weather/transport patterns)

EPA evaluated available meteorological data to help determine how meteorological conditions, such as weather, transport patterns and stagnation conditions, would affect the fate and transport of precursor emissions contributing to ozone formation. The Houston-Baytown-Huntsville area is considered a sub-tropical coastal climate with normal recirculation occurring due to land-sea breeze oscillation. This land-sea breeze oscillation results in transport of air among numerous counties in the gulf coast region that includes the Houston-Baytown-Huntsville area. This phenomena leads to air transport of emissions to monitors in the Houston-Baytown-Huntsville area that have monitored exceedances of the 2008 ozone standard.

The attachment to this document contains Figure 2, Houston Ozone and Ozone Precursor Monitoring Network, including locations of major stationary sources, and locations of ambient monitors with their design values.

EPA has performed 24-Hour wind backward trajectories (which is an analysis of meteorological/transport patterns) specifically on days when certain critical monitors (identified below) in the Houston-Baytown-Huntsville area measured an exceedances of the 2008 NAAQS. These analyses were conducted to better understand the area's meteorological transport conditions. The analysis was conducted using National Oceanic and Atmospheric Administration's (NOAA) Hybrid Single Particle Lagrangian Integrated Trajectory Model (HYSPLIT). The HYSPLIT model yields an estimate of the path an air mass has traveled before reaching a monitor at a specific location and time. Specifically, the model provides the centerline of the probable path. By knowing where an air mass has traveled before reaching a monitor where an exceedance has occurred, one can consider what potential areas and emission sources could have contributed to the exceedance.

The HYSPLIT trajectories for 2008-2010 exceedance days at the Manvel monitor in Brazoria County were conducted and the resulting trajectories were overlaid on Figure 2 in the attachments as Figure 4. We focused on this monitor and a number of other monitors in the Houston-Baytown-Huntsville area, including the NW Harris County and Wallisville Road monitors in Harris County, and the Texas City monitor in Galveston County because these monitors have recorded some of the highest ozone levels in the region and represent a good cross-section of the monitors in the Houston-Baytown-Huntsville area that experienced exceedances in the 2006-2010 period. Since the 2008-2010 data is only for three years we evaluated more years to better understand the meteorological transport conditions that exist during ozone exceedances. When we are developing a conceptual model for understanding what types of meteorology are present when ozone exceedances occur in an area we evaluate 5 to 10 years worth of meteorological data. Due to TCEQ implementing emission reductions in HGB prior to 2006, we chose to evaluate all days that had ozone exceedances at a number of monitors that give a representative data set for the 2006-2010 period. By considering a longer period of time, we have greater assurance that the most representative weather conditions are considered and control strategies and decision making are not driven by unusual meteorology.

There are 8 figures in the attachment that include a large view and a zoom view for each of the four monitors (Manvel, NW Harris, Wallisville, and Texas City) labeled as Figures 5a through 5h. These HYSLPIT trajectories are 24-Hour back trajectories for each of these monitors on days when they had exceedances of the 75 parts per billion (ppb) standard. Evaluation of the back trajectories for the Manvel and NW Harris indicates that the areas upwind of the monitor prior to an ozone exceedance include the 8 existing counties in the Houston-Galveston-Brazoria nonattainment area for the 1997 8-hour ozone standard and also Matagorda County. We note that there are some trajectories that pass over Matagorda County and continue to the monitor without traversing over the Houston Ship Channel. The back trajectories for the Wallisville and Texas City monitors further support that air that is transported from/through Matagorda County ends up in the area of these monitors when ozone exceedances are monitored.

TCEQ provided comments and analysis of weather and transport patterns for the HGB area. TCEQ indicated that meteorological patterns are the controlling force in causing high ozone events. They also indicated that high ozone events happen when winds are light and there are rotations of air parcels due to the land-sea breeze and/or shoreline convergence zones. We agree with TCEQ that previous studies and conceptual model analyses for the HGB area confirm that light winds and recirculation and/or shoreline convergence zones are some of the most typical meteorology when high ozone occurs in HGB.

TCEQ commented that research indicates the highest background ozone transported into HGB area predominately originates from the north, northeast, east and is due to conditions with low wind speeds and/or light and variable wind speeds. TCEQ stated that winds from the southwest were not generally associated with high background ozone levels. We generally agree with Texas that winds are more frequent from the north, northeast and east on high ozone days, but we recognize that there have been numerous high ozone events when winds were out of the west or southwest in both the 2000 and 2005/6 basecase ozone modeling episodes that TCEQ created for the HGB area. Therefore, although high ozone events may not be as common with winds from the southwest as they are with winds from the northeast, the data and EPA's back trajectories do indicate that the meteorological pattern with winds from the west/southwest does occur and may be a meteorological regime that will be a concern for TCEQ as they work to bring the HGB area into attainment.

Texas commented on EPA's HYSPLIT back trajectories and indicated that they thought the starting elevation of 100 meters was too low and may lead to trajectories going to ground level. TCEQ did not provide any examples of EPA's trajectories touching the ground nor were any specific issues that were a concern with EPA's back trajectories identified. TCEQ used 800 meters as the starting point elevation for their HYSPLIT back trajectories and indicated that 800 meters was well within the mixed layer. TCEQ did not provide any examples of differences in results that occurred due to the different start heights and overall did not share any concerns with conclusions that EPA had made about the results of our analysis EPA is concerned that 800 meters is too high for a starting point for these analyses because aircraft data with downward looking LIDAR that has been used to measure ozone levels numerous times in the HGB area indicate that the ozone concentrations within the mix layer are not consistently uniform. Although we have this concern, we note that the analyses performed by Texas largely supports the analyses done by EPA.

TCEQ did not present the full back trajectories but provided an endpoint count analysis of the back trajectories. Under this approach, a 24-hour back trajectory is made up of 24 individual 1-hour points based off the start time of the back trajectory and reporting in 1-hour increments the location of the centerline of the back trajectory. Because the entire centerline is not shown, only each one hour point, this does not give as clear a picture of the overall back trajectory compared to the method that EPA is using. There are some concerns with an endpoint analysis because the full back trajectory is the centerline of the air mass back trajectory and we know that the further in time away from a trajectory start time, the wider the overall potential contributing air mass can be. For example, if at 1-hour previous to start time/origin of the back trajectory the width of potential contribution may be 1-2 km, but at 12 hours previous to the start time/origin the width of potential contribution may be 10 km or more. One way to understand this is that a back trajectory showing the overall potential contribution area would look like a plume that starts out very narrow, but becomes wider as the plume is further away and further back in time from the start point. An endpoint analysis does not allow for any consideration of this growth in width of potential contribution area. TCEQ's endpoint analysis ascribes more precision to a back trajectory than actually exists and does not allow for any consideration of this issue. For example a back trajectory may have only gone through an edge of a county and it is possible the hourly endpoints may not be in the county and would lead to a false conclusion that the trajectory would not even be in a

that county. Furthermore, if it was 20 hours before the start point of a back trajectory the area of potential contribution may have been 10 -20 kilometers on either side of the back trajectory centerline. TCEQ concluded that some trajectories traversed Matagorda County as EPA had also concludes. However, TCEQ differs with EPA regarding the percentage of trajectories that traversed Matagorda County, claiming the percentage was too small to conclude that Matagorda County emissions significantly contribute to ozone formation at the four ozone monitors they evaluated. EPA believes the endpoint count analysis performed by Texas underestimates potential contribution and does not provide as much technical information for evaluation.

In summary, EPA backward trajectories for 2006-10 exceedance days in the Houston CSA show some of the trajectories traversed Matagorda County suggesting emissions originating in Matagorda County could possibly impact monitors registering ozone exceedances EPA believes that using the entire trajectory, as presented in EPA's analyses, provides a more robust analysis that use of the endpoint counts Texas provided.

Overall, examination of the 24-hour back trajectories on high ozone days at four representative monitors in the HGB CSA indicates that air originates or passes through each of 8 counties recommended by Texas to be included as part of the nonattainment area for the 2008 ozone NAAQS, as well as Matagorda County. HYSPLIT back trajectories also indicated sometimes the air mass traversed Walker, San Jacinto, and Austin Counties prior to a monitored ozone exceedance, so based on the analysis of meteorology we cannot rule these counties out based on meteorology/transport. We did not focus on these three counties as much, since their NOx emissions were significantly lower than Matagorda County. HYSPLIT back trajectories alone do not determine inclusion or exclusion of an area with regard to ozone designations but must be weighed with other meteorological information as well as information concerning the other factors such as emissions, population growth and urbanization and, traffic/worker patterns.

TCEQ Source Apportionment Modeling

TCEQ has developed CAMx photochemical modeling for previous ozone attainment demonstrations. The TCEQ did additional modeling using these CAMx databases to provide source apportionment modeling that assessed the potential contribution of Matagorda County emissions to modeled high ozone values in the Houston area. TCEQ's analysis was performed for a period of 39 days during 2005 and 47 days during 2006 -- multiple ozone episodes were modeled but not all episode days in 2005 and 2006. They also evaluated these base episodes with a future year analysis of 2018 (2005/2006 meteorology with 2018 emission estimates). In summarizing this work, they provided average and maximum impacts to daily 8-hour modeled exceedances in the base case (2005/6) and 2018. TCEQ indicated the impacts were small and supported not including Matagorda County.

EPA Assessment:
Source apportionment analysis can be a good tool to combine the meteorology/transport of air parcels during high ozone days with the emissions of specific areas to evaluate potential impact on ozone levels from emissions in specific source areas, Matagorda County emissions in this case. EPA appreciates the efforts of TCEQ to provide the modeling to aid in decisions on designations.

One of EPA's concerns with TCEQ's Source Apportionment Modeling (SAM) is that the modeling is not inclusive of an entire ozone season. Therefore, it does include a large number of days and meteorology regimes conducive for ozone events. As a result it may be appropriate to place more weight on the maximum estimated impact and the number of days with sizeable impacts on violating monitors as compared to average impact. Another concern is that the evaluation used modeled exceedances for contribution and the modeling is underestimating exceedances on some days at some monitors and therefore is underestimating the number of days of potential contribution. EPA analyzed the 2005/6 modeling information, but felt the 2018 analysis was too far in the future to use for purposes of designations being issued in 2012. We have summarized the information provided by TCEQ in the letter from Governor Rick Perry dated February 29, 2012. This summary of SAM estimates of impacts for Matagorda County emissions is included in Table 6.

Table 6. TCEQ Source Apportionment – Matagorda County Anthropogenic Emissions

		Ozone >75 ppb	
		Average (ppb)	Maximum (ppb)
Manvel Croix	2005	0.04	0.41
	2006	0.10	1.05
NW Harris	2005	0.04	1.26
	2006	0.11	1.86
Texas City	2005	0.05	0.21
	2006	0.12	1.63
Wallisville	2005	0.09	0.44
	2006	0.18	0.46

In the course of our review, we requested and TCEQ provided additional modeling files that included SAM results at most of the monitors in HGB. EPA has reviewed this additional information and did discover some errors in TCEQ's spreadsheets.[9] EPA shared the errors with TCEQ and TCEQ confirmed that these errors ended up lowering overall estimated impacts from Matagorda County emissions. TCEQ had also used the average of the predicted ozone levels in the grid cells around the monitor, and EPA guidance is to use the maximum, so EPA reanalyzed the data using the maximum ozone levels in the grid cells around a monitor.[10]

In analyzing SAM for a specific area for designation we evaluated the average impact, maximum impact, and an additional metric, the number of days where impacts may be high enough that reductions might be beneficial in development of an attainment demonstration. Often in attainment demonstration modeling, controlling of sources is evaluated and results in only a few tenths of a ppb change, therefore we used a 1% of the standard cut point for days where we would consider Matagorda County's impact to be significant. We determined the number of days an impact was over 1% (0.75 ppb) on a modeled exceedance of the 75 ppb standard. The corrected SAM and EPA's assessment of TCEQ's SAM is included in Table 7.

Table 7. Corrected TCEQ Source Apportionment with EPA's assessment – Matagorda County Anthropogenic Emissions

		Ozone >75 ppb		# of days >0.75 ppb
		Average (ppb)	Maximum (ppb)	
Manvel Croix	2005	0.04	0.41	
	2006	0.10	0.69	
NW Harris	2005	0.04	1.26	1
	2006	0.11	0.86	
Texas City	2005	0.05	0.21	
	2006	0.12	0.55	
Wallisville	2005	0.09	0.44	
	2006	0.18	0.46	

[9] Additional information has been included in the docket and additional information is included in a zipped file "TCEQ back-up information.zip and EPA assessment of Matagorda.zip"

[10] Section 3.3 of EPA's "Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze", EPA -454/B-07-002, April 2007.

During EPA's evaluation of TCEQ's SAM we also discovered that the 2005/2006 modeling was conducted with approximately 6,059 tpy of NOx from Matagorda anthropogenic sources and most recent data from TCEQ for 2008 indicates approximately 4,079 tpy due to TCEQ incorporating local data for emission estimates. Due to this approximately 1/3 reduction in NOx emissions, the modeling significantly overestimates NOx impacts from Matagorda sources. Furthermore, HGB is generally NOx limited other than an area around the highly industrialized ship channel area in East Harris County, so the estimated impacts from Matagorda are mostly from NOx emissions and not VOCs. Therefore the impacts indicated in Table 7 significantly overestimate NOx emission impacts. If SAM was redone with the lower NOx emissions, we would expect the results to be significantly less than Table 7's values. We cannot give an exact estimate of how much lower the impacts would be, but the data in Table 7 has fairly low average impacts most of the time and only one day with impacts over 1 ppb at a monitor.

Factor 4: Geography/topography (mountain ranges or other air basin boundaries)

The geography/topography analysis evaluates the physical features of the land that might affect the airshed and, therefore, the distribution of ozone over the area. The HGB area does not have any geographical or topographical barriers significantly limiting air pollution transport within or into the HGB air shed. Therefore, this factor did not play a significant role in this evaluation.

Factor 5: Jurisdictional boundaries

Once we identified the general areas we anticipated we would include in the nonattainment area, we then considered existing jurisdictional boundaries for the purposes of providing a clearly defined legal boundary and to help identify the areas appropriate for carrying out the air quality planning and enforcement functions for nonattainment areas. Examples of jurisdictional boundaries include existing or prior nonattainment area boundaries for ozone or other urban-scale pollutants, county lines, air district boundaries, township boundaries, areas covered by a metropolitan planning organization, state lines, Reservation boundaries, and urban growth boundaries. Where existing jurisdictional boundaries were not adequate or appropriate to describe the nonattainment area, other clearly defined and permanent landmarks or geographic coordinates were considered.

The HGB area has previously established nonattainment boundaries associated with the 1-hour and 1997 8-hour ozone NAAQS. Texas has recommended that the boundary for the 2008 ozone NAAQS be the same as for the 1997 8-hour ozone NAAQS.

Conclusion

Based on the assessment of factors described above, EPA has concluded that the following counties should be included as part of the Houston-Galveston-Brazoria nonattainment area because they are either violating the 2008 ozone NAAQS or contributing to a violation in a nearby area: Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller Counties. These are the same counties that are included in the Houston-Galveston-Brazoria nonattainment area for the 1997 8-hour ozone NAAQS and are the same counties recommended by Texas.

The air quality monitors in Brazoria and Harris Counties are currently monitoring violations of the 2008 ozone NAAQS based on the 2010 design values (2008-2010 monitoring data), therefore these counties must be included in the nonattainment area because they are not meeting the NAAQS.

Chambers, Fort Bend, Galveston, Liberty, Montgomery, and Waller Counties are nearby counties that do not have monitors indicating concentrations of ozone in excess of 75 ppb. As an initial matter, we note that Texas has recommended these counties be included as part of the designated nonattainment area. Moreover, based on the analysis in our TSD, we conclude that these areas contribute violations of the 2008 ozone NAAQS. We did not receive comments on our inclusion of these counties in the nonattainment area.

We are not including Matagorda County as part of the designated nonattainment area. TCEQ submitted emissions data that indicates NOx emissions are much less and VOC emissions slightly less than we identified in our December 9, 2011, letter to Texas. The amount of NOx emissions is particularly important, because the HGB monitors outside the core industrial area are NOx limited, which means ozone formation is primarily limited by the amount of available NOx. While we continue to believe that air emissions from Matagorda County are transported towards HGB on some high ozone days, TCEQ submitted source apportionment modeling that indicates that the contribution from Matagorda County on high ozone days is not large. Moreover, this modeling relied on NOx emissions similar to those relied on by EPA for its intended designation, but Texas has since developed more accurate inventories that show a significantly lower NOx inventory. Thus, the modeling is overestimating Matagorda's contribution and does not give a strong indication that Matagorda should be included. Therefore, in consideration of the new information, especially the new emissions information, we are concluding that data for Matagorda County does not support its inclusion in the HGB nonattainment designation for the 2008 ozone standard.

Our evaluation of data for Austin, San Jacinto and Walker Counties does not support a nonattainment designation.

ATTACHMENTS

Figure 2. Houston Ozone and Ozone Precursor Monitoring Network, with Population Density.

Figure 3. Population Density Change Percentage Between 2000 and 2010 Census for Houston Ozone and Ozone Precursor Monitoring Network

Figure 4. Overlay of 24-hour HYSPLIT back trajectories of all 75 ppb exceedances at the Manvel monitor for the 2008-2010 period.

Figure 5a. NOAA HYSPLIT MODEL 24-Hour Back Trajectory Manvel Exceedances (2006-10).

Figure 5b. NOAA HYSPLIT MODEL 24-Hour Back Trajectory Manvel Exceedances (2006-10) (zoom view).

Figure 5c. NOAA HYSPLIT MODEL 24-Hour Back Trajectory NW Harris Exceedances (2006-10).

Figure 5d. NOAA HYSPLIT MODEL 24-Hour Back Trajectory NW Harris Exceedances (2006-10) (zoom view).

Figure 5e. NOAA HYSPLIT MODEL 24-Hour Back Trajectory Wallisville Exceedances (2006-10).

Figure 5f. NOAA HYSPLIT MODEL 24-Hour Back Trajectory Wallisville Exceedances (2006-10) (zoom view).

Figure 5g. NOAA HYSPLIT MODEL 24-Hour Back Trajectory Texas City Exceedances (2006-10).

Figure 5h. NOAA HYSPLIT MODEL 24-Hour Back Trajectory Texas City Exceedances (2006-10) (zoom view).

Figure 2. Houston Ozone and Ozone Precursor Monitoring Network, with Population Density

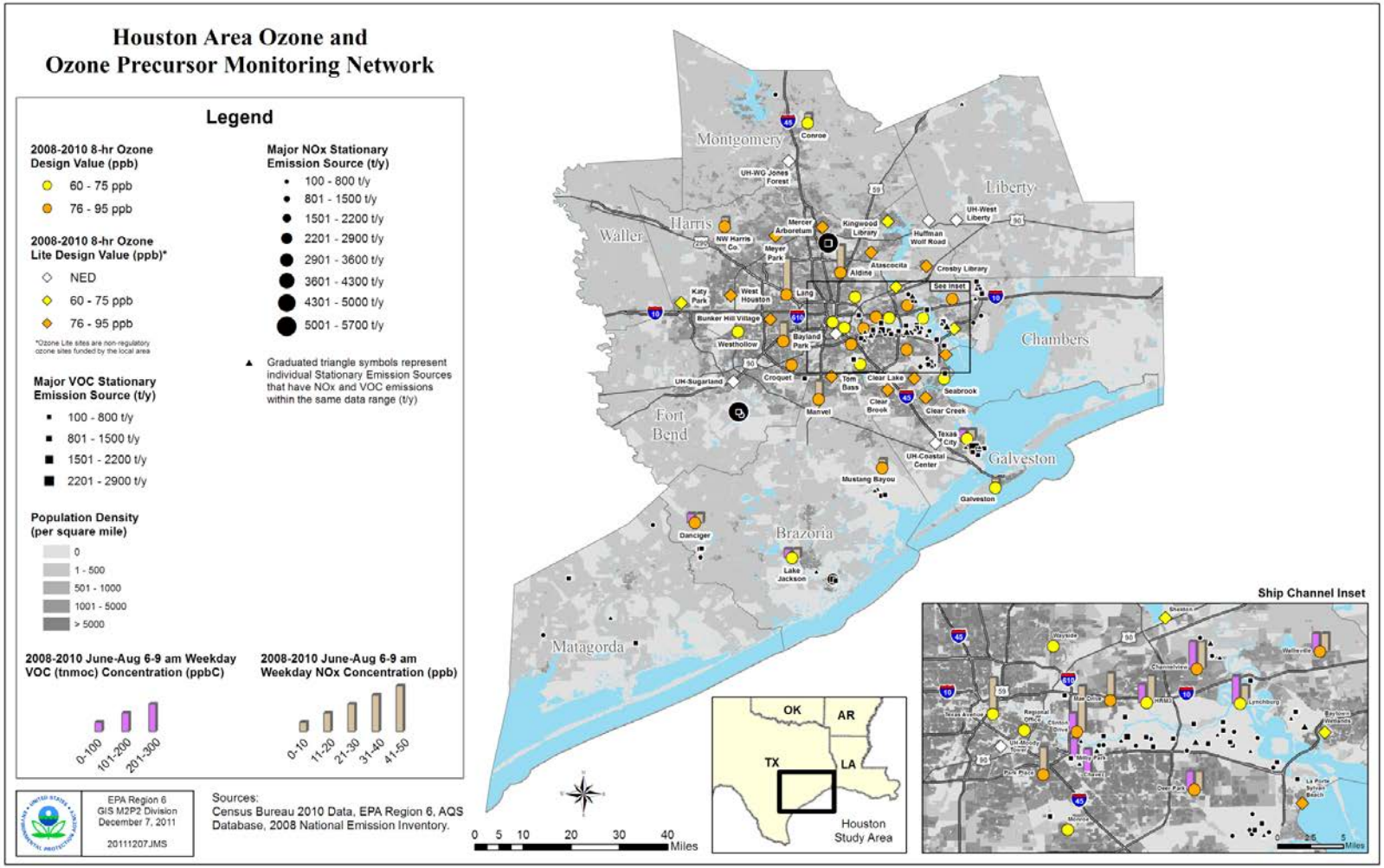


Figure 3. Population Density Change Percentage Between 2000 and 2010 Census for Houston Ozone and Ozone Precursor Monitoring Network

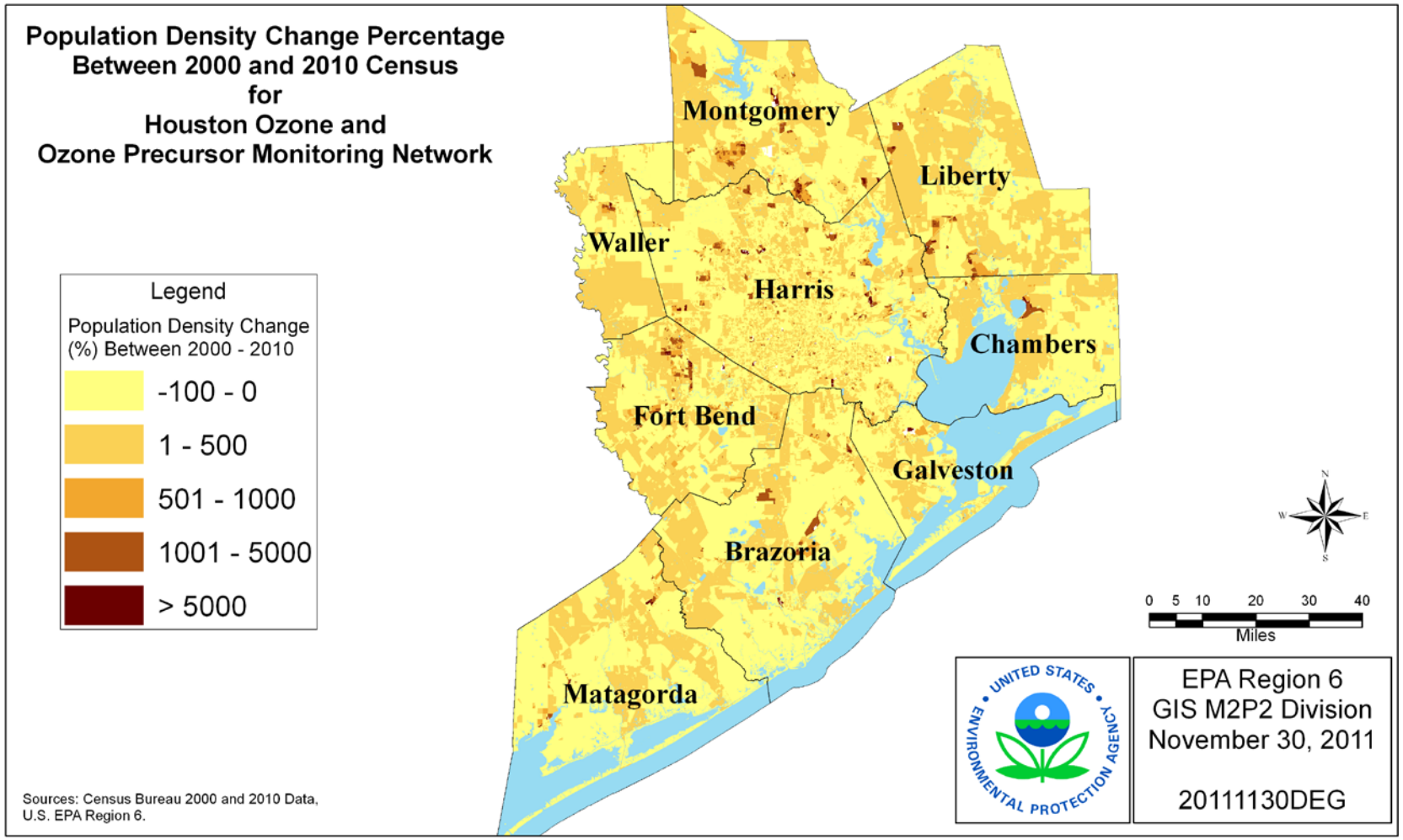


Figure 4. Overlay of 24-hour HYSPLIT back trajectories of all 75 ppb exceedances at the Manvel monitor for the 2008-2010 period

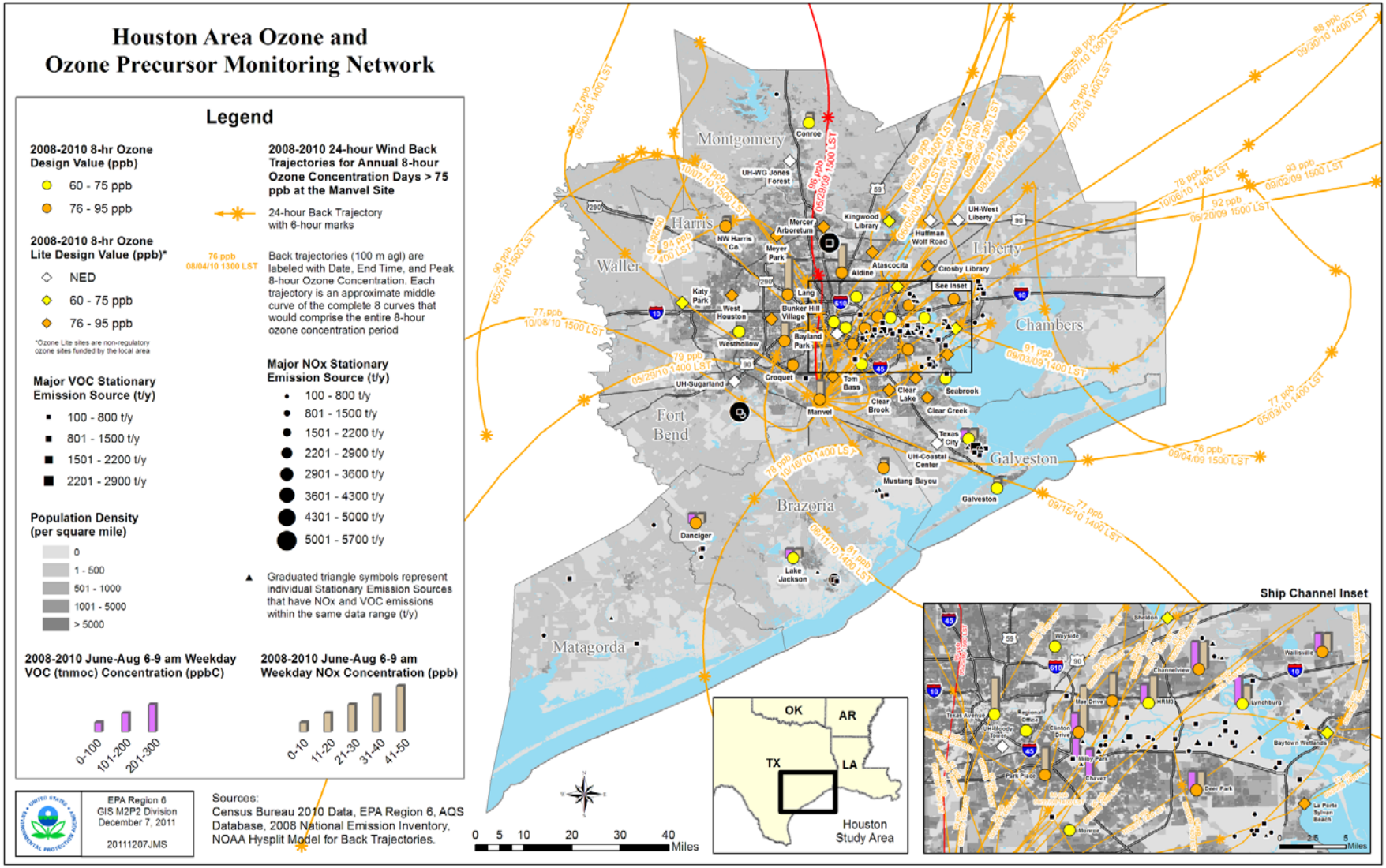


Figure 5a. NOAA HYSPLIT MODEL 24-Hour Back Trajectory Manvel Exceedances (2006-10).

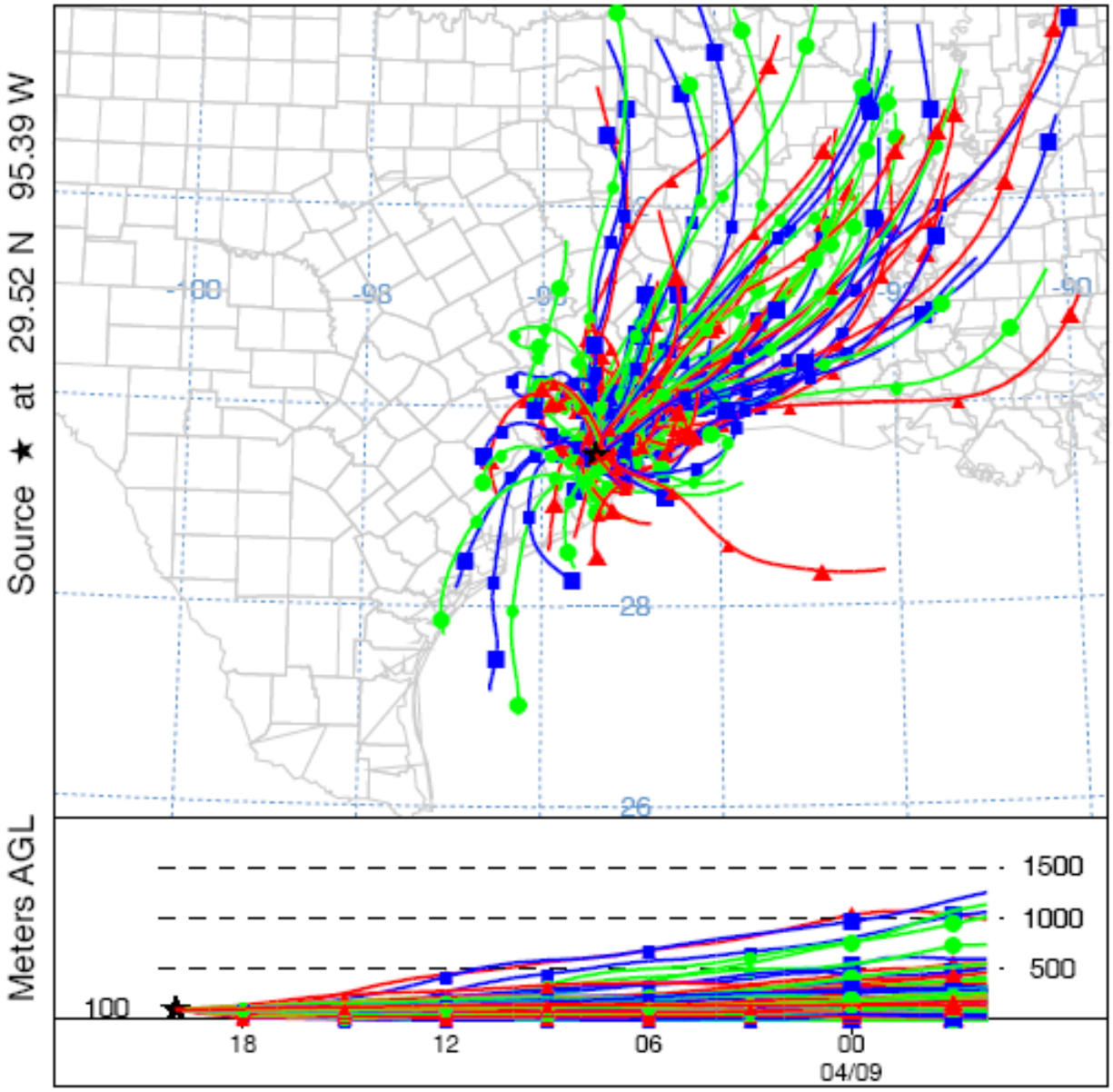


Figure 5b. NOAA HYSPLIT MODEL 24-Hour Back Trajectory Manvel Exceedances (2006-10) (zoom view).

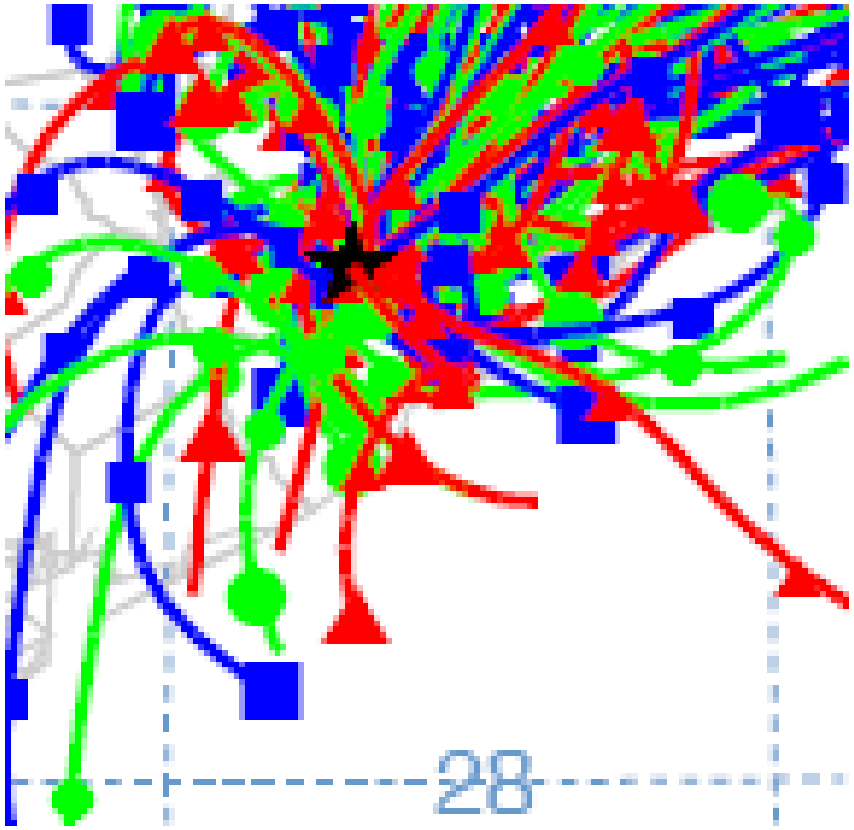


Figure 5c. NOAA HYSPLIT MODEL 24-Hour Back Trajectory NWHarris Exceedances (2006-10).

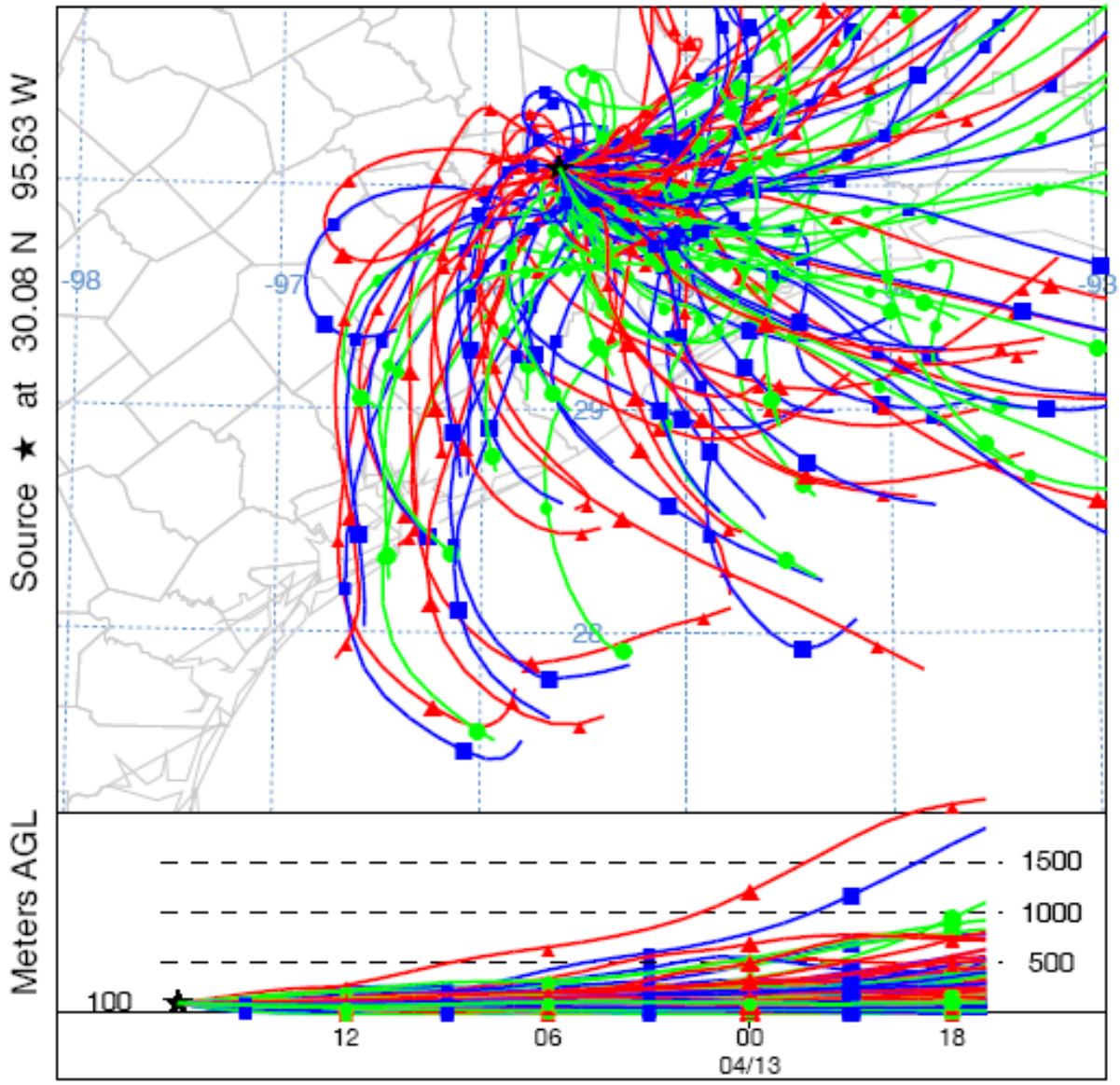


Figure 5d. NOAA HYSPLIT MODEL 24-Hour Back Trajectory NWHarris Exceedances (2006-10) (zoom view).

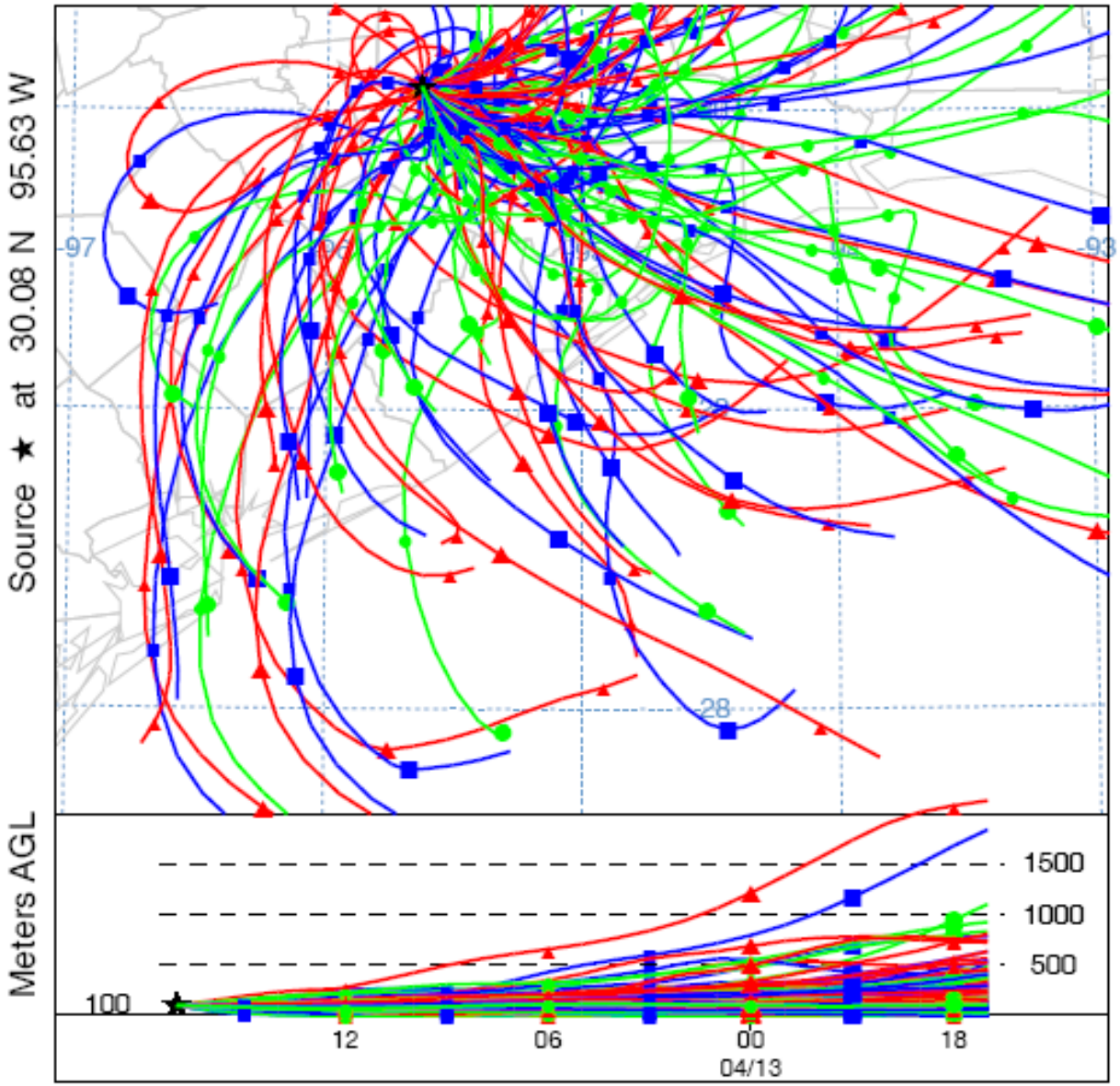


Figure 5e. NOAA HYSPLIT MODEL 24-Hour Back Trajectory Wallisville Exceedances (2006-10).

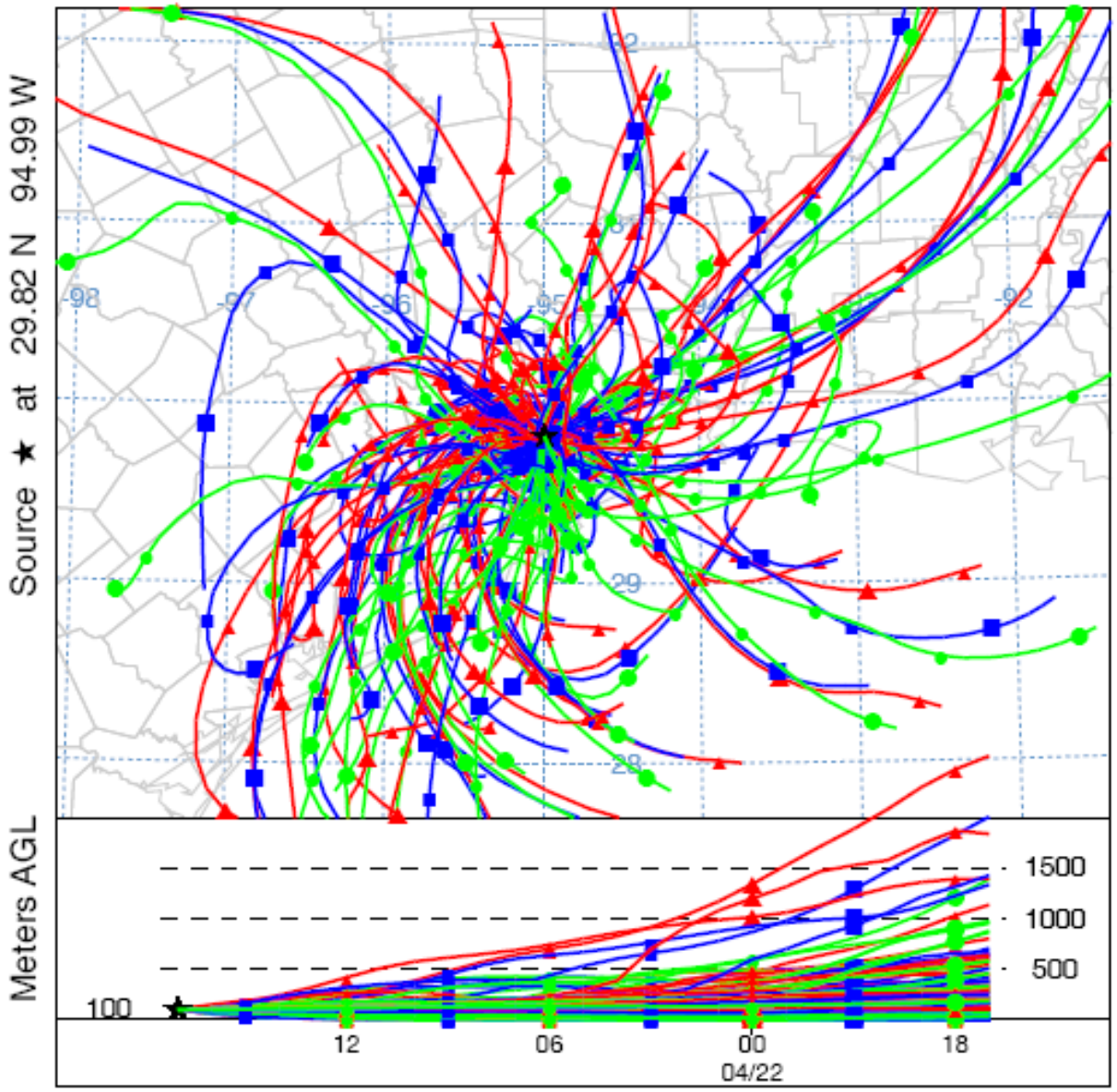
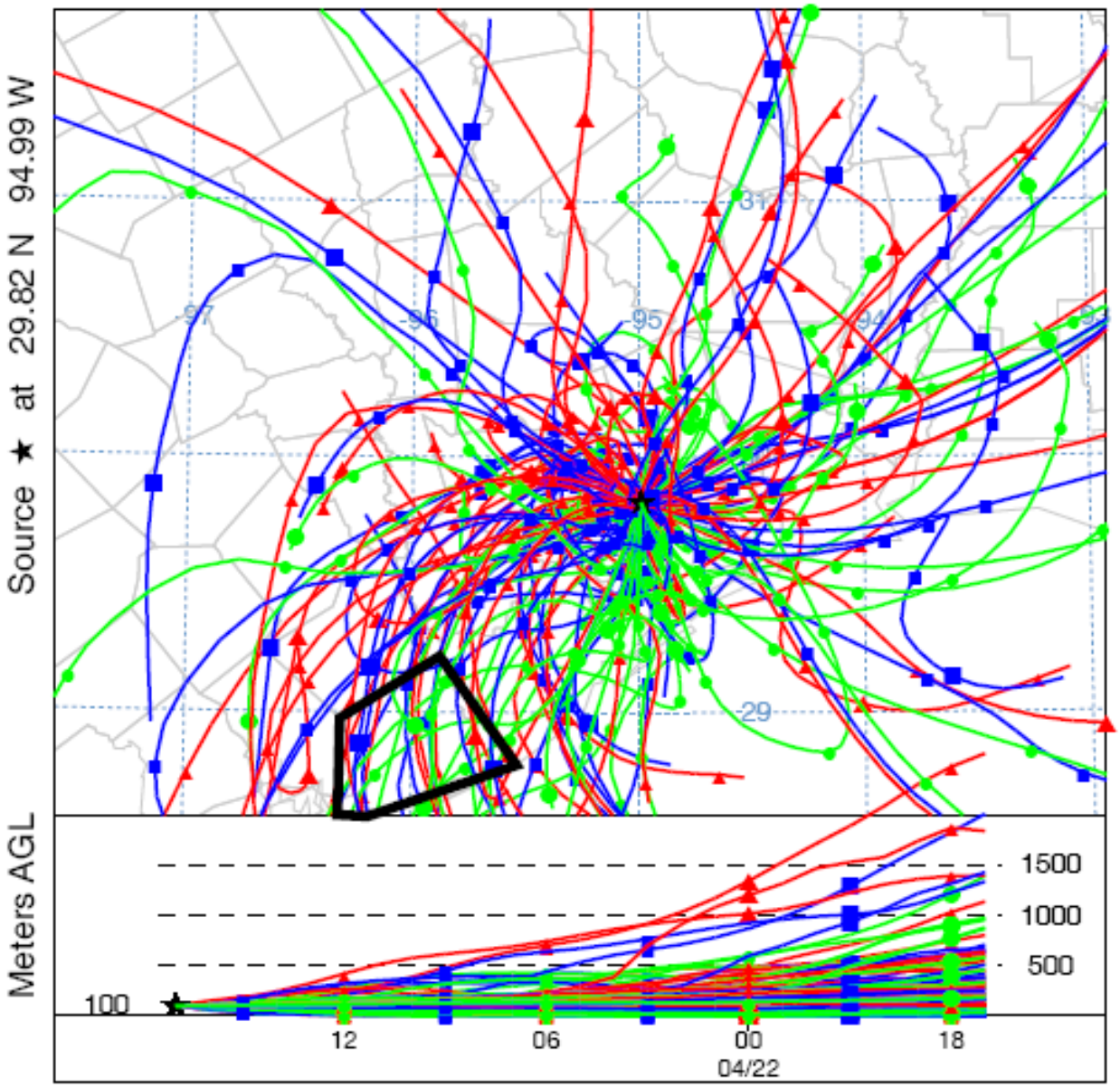


Figure 5f. NOAA HYSPLIT MODEL 24-Hour Back Trajectory Wallisville Exceedances (2006-10) (zoom view).



Black Polygon is the approximate boundaries of Matagorda County

Figure 5g. NOAA HYSPLIT MODEL 24-Hour Back Trajectory Texas City Exceedances (2006-10).