Ozone Designation Recommendations For the 2015 Ozone National Ambient Air Quality Standards

Technical Support Document

Connecticut Department of Energy and Environmental Protection
Bureau of Air Management

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Abstract

On October 1, 2015, the United States Environmental Protection Agency (EPA) promulgated a more stringent National Ambient Air Quality Standard (NAAQS) for ozone, lowering the 8-hour ozone NAAQS from 0.075 parts per million (ppm) to 0.070 ppm. Pursuant to Section 107(d) of the Clean Air Act, the Connecticut Department of Energy and Environmental Protection recommends that EPA designate the entire State of Connecticut as nonattainment for the 2015 8-hour ozone NAAQS. The state should be divided into two nonattainment areas, with the same boundaries established for the 2008 8-hour ozone NAAQS, as follows:

The **Southwest Connecticut** nonattainment area, comprised of Fairfield, New Haven and Middlesex Counties, as part of a larger multi-state New York City metropolitan nonattainment area; and
The **Greater Connecticut** nonattainment area, comprised of Litchfield, Hartford, Tolland, Windham and New London Counties.

These recommendations (depicted on a map in Figure 19) are based on an analyses of air quality, emissions, meteorological, population, traffic and other data relevant under EPA guidance.

Ideally, EPA will combine Connecticut's nonattainment areas with the broader regional area which significantly contributes to Connecticut's nonattainment through transport of air pollutants.

1.0 Introduction

On October 1, 2015, the United States Environmental Protection Agency (EPA) promulgated a revised National Ambient Air Quality Standard (NAAQS) for 8-hour ozone. This document presents the Connecticut Department of Energy and Environmental Protection (CTDEEP) recommendations regarding attainment and nonattainment designations and boundaries for the 2015 ozone NAAQS as required by Section 107 of the Clean Air Act (CAA).

Specifically, CTDEEP recommends that all of the State of Connecticut be divided into two nonattainment areas, as follows:

The **Southwest Connecticut** nonattainment area, comprised of Fairfield, New Haven and Middlesex Counties, as part of a larger multi-state New York City metropolitan nonattainment area; and
The **Greater Connecticut** nonattainment area, comprised of Litchfield, Hartford, Tolland, Windham and New London Counties.

Ideally, EPA will combine Connecticut's nonattainment areas with the broader regional area which significantly contributes to Connecticut's nonattainment through transport of air pollutants.

CTDEEP's recommendations are consistent with the 2008 ozone NAAQS area designations in Connecticut. EPA's 2008 promulgation of the 8-hour ozone NAAQS set the level of both the primary and secondary standards at 0.075 parts per million (ppm)**.** Based on recommendations provided by CTDEEP and its own analysis, EPA established two nonattainment areas in Connecticut under the 2008 ozone NAAQS, with boundaries exactly as CTDEEP is recommending for the 2015 ozone NAAQS. Both of these nonattainment areas were originally classified as "marginal" under the 2008 NAAQS, with an attainment date of December 31, 2015. On June 3, 2016, both areas were reclassified as "moderate" with an effective attainment date of July 20th, 2018. The nonattainment boundaries for the 2008 ozone NAAQS are shown in Figure 1.

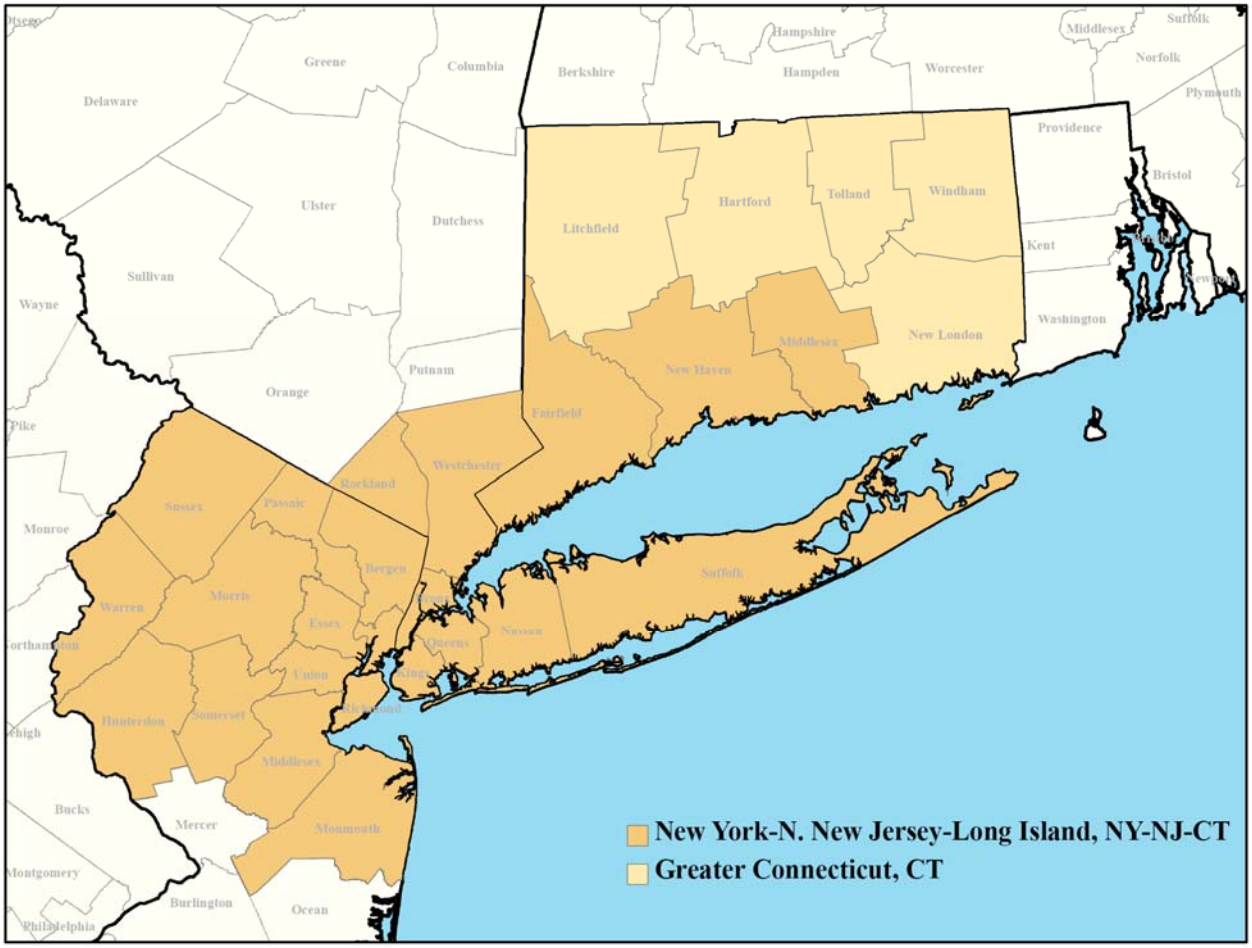

Figure 1. 2008 8-Hour Ozone NAAQS Nonattainment Areas in Connecticut

In October 2015, EPA revised both the primary and secondary 8-hour NAAQS to 0.070 ppm (8-hour average) after evaluating the results of numerous new scientific studies conducted over the intervening decade. Based on an expanded body of scientific evidence that includes thousands of studies on the effects of ozone on health, the EPA Administrator concluded that the 2008 standard of 75 ppb is not sufficient to protect public health with an adequate margin of safety, as required by law. The Administrator considered the science, focusing on new studies that have become available since EPA last reviewed the standards in 2008. Those studies include new clinical studies, which provide the most certain evidence of health effects in adults. Those studies provide information clearly showing that ozone concentrations as low as 72 ppb can be harmful to healthy exercising adults.

Section 107(d) of the CAA specifies the process for designating areas as attainment and nonattainment following the establishment of new or revised NAAQS. States are required to submit to EPA recommendations concerning both the attainment status and geographical boundary for each area in the state not later than one year after the promulgation of a new or

revised standard – in this case by October 1, 2016 for the 2015 ozone NAAQS. Areas should be identified as attaining, or not attaining, the revised ozone standard, or as not classifiable on the basis of available information. Because the 2015 revised primary and secondary ozone NAAQS are identical, EPA expects that each area will have the same designation and boundary for both standards. EPA ordinarily completes the designation process within two years of the effective date of a new or revised standard.

CAA section 107(d)(1) requires an area to be designated as nonattainment if it is violating the NAAQS or contributing to a violation in a nearby area. EPA recommends that states identify violating areas using the most recent three years of air quality data. In most cases, initial state recommendations will be based on calendar year 2013-2015 data that are stored in the EPA Air Quality System (AQS). In general, violations are identified using data from Federal reference method (FRM) and Federal equivalent method (FEM) monitors that are sited and operated in accordance with 40 CFR 58, as revised on July 1, 2015 (see 71 FR 61296).

To evaluate an area's contribution to a violation in a nearby area, EPA's guidance document recommends[1] using relevant information associated with the counties in the Combined Statistical Area (CSA) or, where appropriate, the Core Based Statistical Area (CBSA) in which the violating monitor(s) are located. Each CBSA consists of a county or counties containing at least one urban core plus adjacent counties that have a high degree of social and economic integration with the urban core as measured by commuting ties. The EPA emphasizes it does not intend the statistical area boundary to be a presumed nonattainment area boundary. The area-specific analyses may support nonattainment boundaries that are smaller or larger than the CSA or CBSA. Where a violating monitor is not located in a CSA or CBSA, the EPA intends to review relevant information associated with the county containing the monitor and, if appropriate, other adjacent nearby counties. The EPA will determine the nonattainment area boundaries through a weight-of-evidence analysis for the area based on synthesizing the assessments of the five factors identified below.

Figure 2 depicts the 2013 nearby Combined Statistical Area (CSA) boundaries that per EPA's recommended approach, would be a starting point for drawing the nonattainment area for the 2015 ozone NAAQS. The current[2] county-based CSAs included in Connecticut, are the Hartford-West Hartford-Willimantic, CT CSA; the New York-Newark-Bridgeport, NY-NJ-CT-PA CSA and the Boston-Worcester-Providence, MA-RI-NH-CT CSA. For reasons discussed below, these boundaries are not completely appropriate for designating air quality areas in Connecticut.

[1] "Area Designations for the 2015 Ozone National Ambient Air Quality Standards" Memorandum from Janet G. McCabe (EPA Acting Assistant Administrator) to EPA Regional Administrators; February 25, 2016.
[2] See: https://www.whitehouse.gov/sites/default/files/omb/bulletins/2015/15-01.pdf

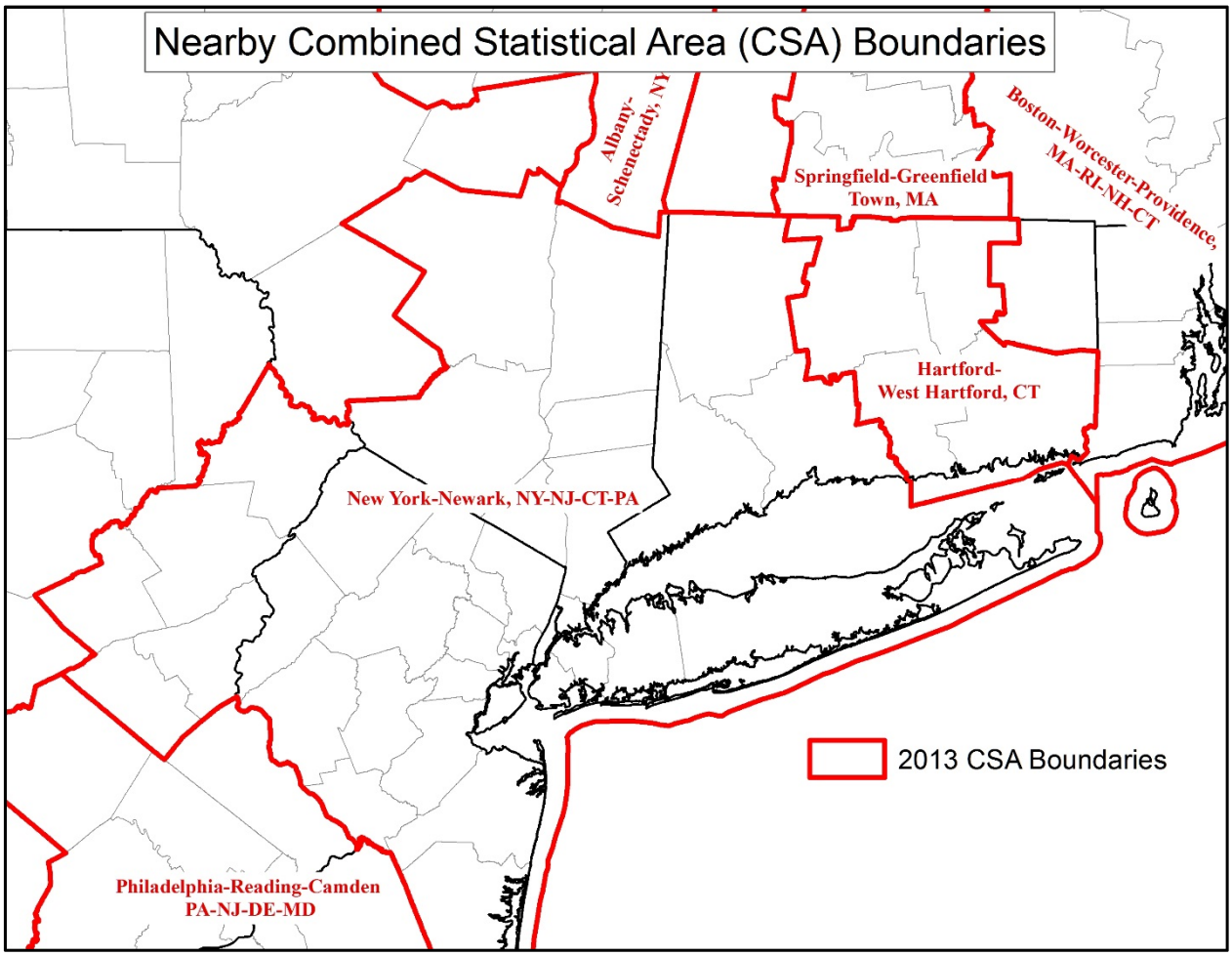

Figure 2. 2013 CSA Boundaries for the Connecticut, New York and New Jersey Area

In addition to county-based CSA classifications, OMB has established a separate town-based classification scheme for the New England states, known as New England City and Town Areas (NECTAs).[3] The NECTA classification scheme recognizes that towns are traditionally a more important level of government than counties in the New England region. As discussed in Section 2.5, CTDEEP's recommended nonattainment area boundaries use NECTA classifications to make some adjustments to the presumptive boundaries derived from county-level CSA and CBSA classifications.

[3] See: Ibid.

2.0 Five Factor Analysis

EPA's guidance[4] for determining the boundaries of 8-hour ozone NAAQS nonattainment areas suggests that, when making boundary recommendations for nonattainment areas, states should evaluate each area on a case-by-case basis. The CAA requires that a nonattainment area must include not only the area that is violating the standard, but also *nearby* areas that contribute to the violation. Thus, for each ambient ozone monitor or group of monitors that indicate violations of the standard, the EPA intends to determine the appropriate nearby[5] areas to include within the nonattainment area boundary, based on that area's emissions contribution to the monitored violations.

Attainment of the 2015 8-hour ozone NAAQS is achieved when the maximum design value measured in a nonattainment area does not exceed 0.070 ppm. The design value for each monitoring site is determined by averaging the 4th-highest daily maximum 8-hour ozone concentration for each of the three most recent calendar years.

EPA recommends that states base their boundary recommendations for violating areas on an evaluation of the five factors identified below, as well as on any other relevant factors or circumstances specific to a particular area:

1) Air quality data;
2) Emissions and emissions related data;
3) Meteorological data;
4) Geography/topography; and
5) Jurisdictional boundaries;

CTDEEP's recommended deviations from the presumptive nonattainment area boundaries are influenced largely by air quality data, commuting patterns, meteorology and jurisdictional boundaries, while emissions data, population data, growth rates and topography were found to be largely non-determinative. The recommended area boundaries are also administratively efficient since the planning process and structures are based on the same areas as the 2008 8-hour ozone NAAQS. Such administrative considerations are important to facilitate coordination in a multistate area such as the New York City metropolitan area (NY/NJ/CT area).

[4] "Area Designations for the 2015 Ozone National Ambient Air Quality Standards" Memorandum from Janet G. McCabe (EPA Acting Assistant Administrator) to EPA Regional Administrators; February 25, 2016.

[5] The Court of Appeals for the D.C. Circuit upheld the EPA's interpretation of the term "nearby" as being reasonable and consistent with the statute. ***Miss. Comm'n on Envtl. Quality v. EPA***, 790 F.3d 138, 160 (D.C. Cir. 2015).

2.1 Factor 1: Air Quality

The CTDEEP's monitoring network includes twelve Federal Reference Method (FRM) ozone monitors. Table 1 lists the 4th highest 8-hour concentrations recorded at each site for each year from 2013 to 2015 and the corresponding 2015 design value. The 2015 design values indicate that most all of the monitoring locations violated the 2015 8-hour ozone NAAQS of 70 ppb, supporting a nonattainment designation for all of Connecticut. The highest design value was recorded at Westport with 84 ppb, which is part of the Southwest Connecticut portion of the NY/NJ/CT nonattainment area established for the 2008 8-hour ozone NAAQS. The highest design value for the current Greater Connecticut nonattainment area is 76 ppb, occurring at both Stafford and East Hartford. Figure 3 plots these design values on a map of these nonattainment areas.

Table 1. Connecticut 2015 Design Values. Orange shaded design values exceed the current ozone standard.

	Site Name	2013 4th High 8-hr Ozone	2014 4th High 8-hr Ozone	2015 4th High 8-hr Ozone	8-hour Ozone 2015 DV ppb
SWCT Portion of NYC Area	Danbury	76	74	79	76
	Greenwich	82	78	84	81
	Madison	85	69	81	78
	Middletown	82	80	78	80
	New Haven - Criscuolo Park	75	72	81	76
	Stratford	90	74	86	83
	Westport	86	81	87	84
Greater CT	Cornwall	68	66	76	70
	East Hartford	77	77	75	76
	Groton Fort Griswold	85	65	77	75
	Stafford	81	77	72	76
	Abington	69	67	70	68

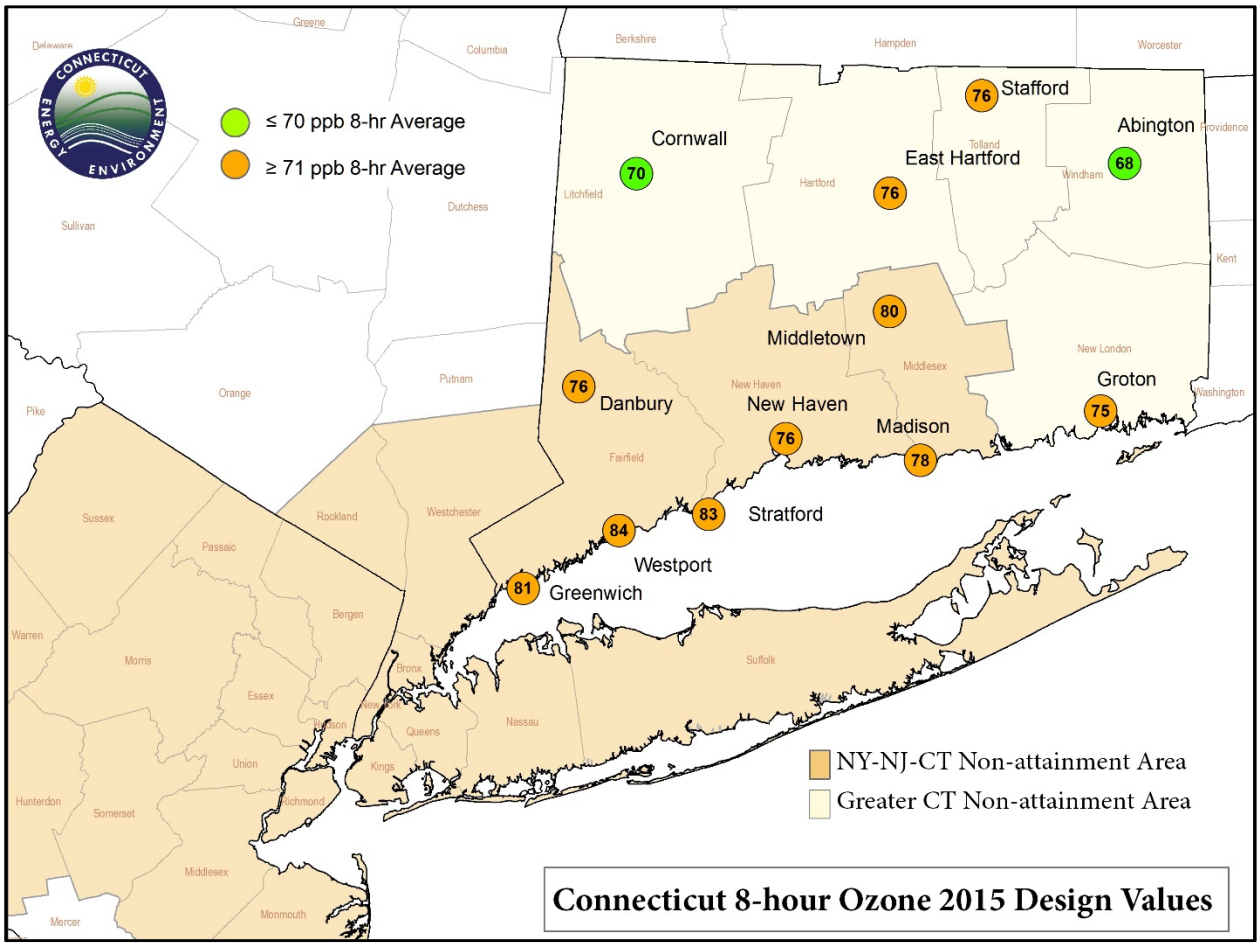

Figure 3. Ozone Monitors in Connecticut with 2015 Design Values

Design value trends over the past 25 years are presented in Figures 4 and 5 for monitors in the current Southwest Connecticut and Greater Connecticut nonattainment areas, respectively. There is a discernable downward trend in design values over the period (1983 through 2015) at all monitors. Note that the ozone levels are plotted in units of parts per billion (e.g., 0.084 ppm = 84 ppb).

Since the highest 2015 design values occurred in Southwest Connecticut, it makes sense to retain the current nonattainment area boundaries for the 2015 NAAQS. These boundaries will link Connecticut's highest measuring monitors to the upwind emissions region around New York City, where a significant portion of Connecticut's measured ozone originates.

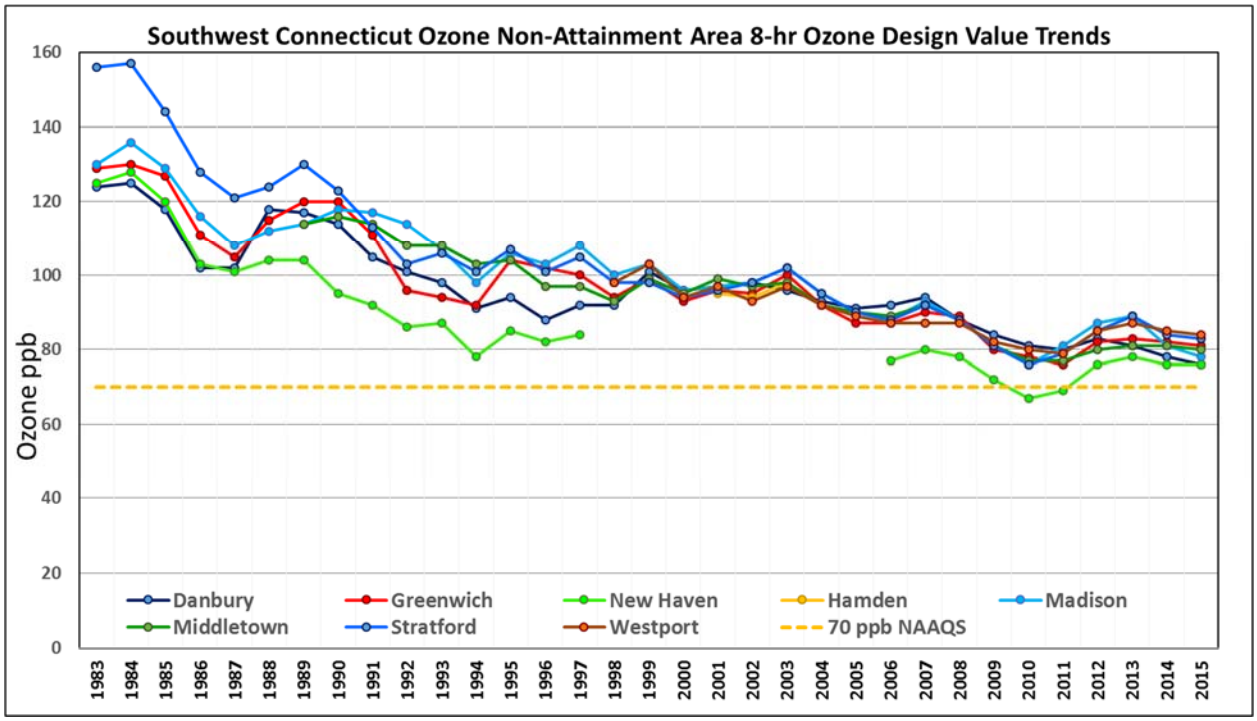

Figure 4. 8-Hour Ozone Design Value Trends for the Southwest Connecticut non-attainment area

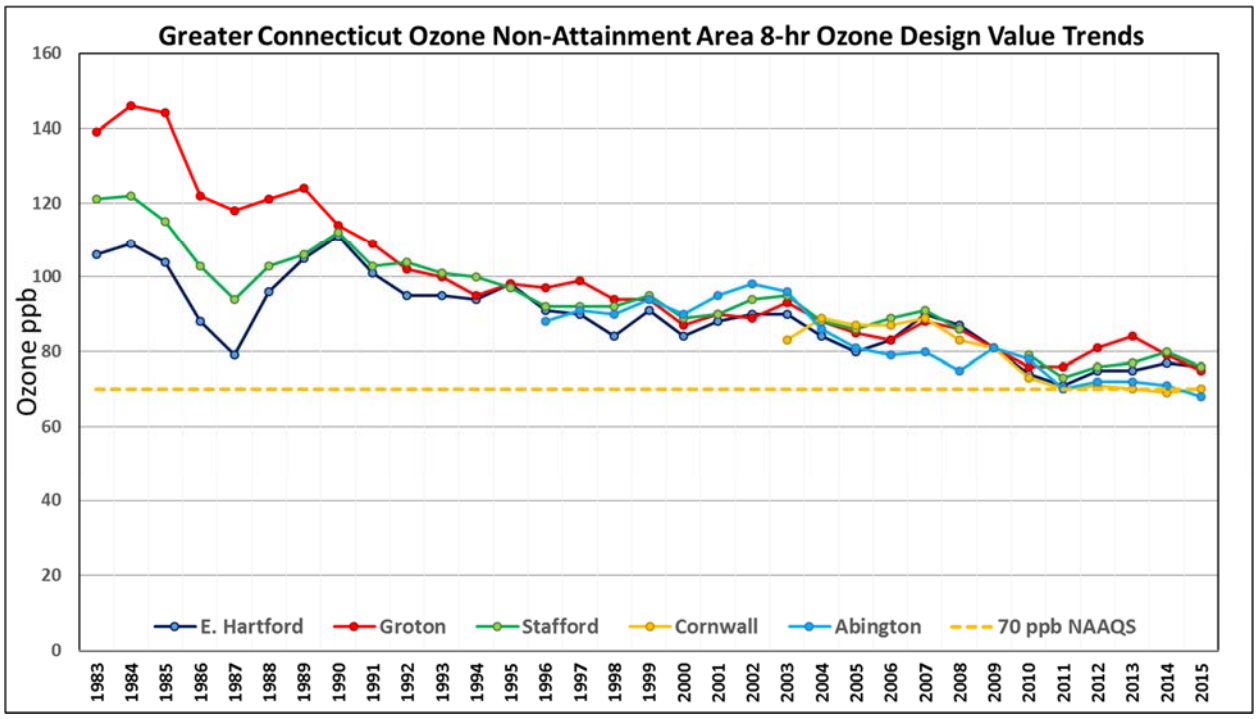

Figure 5. 8-Hour Ozone Design Value Trends for the Current Greater Connecticut non-attainment area

2.2 Factor 2: Emissions

Emissions data can be used as an indicator of the potential for an area to contribute to nearby observed violations. The emissions analysis examines emissions of precursors (NOx and VOCs) that form ozone in the county with the violating monitor and in nearby counties. Emissions data are derived from the 2011 National Emissions Inventory (NEI) version 2, and are given in tons per year in Table 2. The 2011 NEI version 2 data is the most recent NEI information available for this analysis. These county-level estimates of nitrogen oxides (NOx) and volatile organic compounds (VOC) emitted annually were downloaded from the EPA Ozone Designations Guidance and Data web site.[6] Figures 6 and 7 provide a further breakdown of NOx and VOC emissions, respectively, by source sector[7]. NEI "event" sources include fires that are reported in a day-specific format: wildfires and prescribed burns, but these contribute very little in Connecticut.

Table 2. NEI 2011 NOx and VOC Annual Emissions for Connecticut Counties

County	NOx Tons	VOC Tons
Fairfield	18,429	27,282
Hartford	17,743	26,037
Litchfield	3,273	15,619
Middlesex	4,782	10,458
New Haven	16,050	24,781
New London	7,835	16,558
Tolland	2,761	9,343
Windham	2,498	10,963
State Total	**73,371**	**141,043**

The on-road mobile source sector is the largest contributor to total NOx emissions in all counties, while the Non-Point stationary source sector is the largest contributor to total VOC emissions in all counties. Connecticut's three most populated urban counties (Fairfield, Hartford and New Haven) produce the highest levels of ozone precursor emissions. Conversely, Connecticut's more rural counties (Litchfield, Middlesex, Tolland and Windham) produce much lower emissions of NOx and VOC. The relatively low level of emissions in Litchfield and Middlesex Counties is not determinative for area designations and supports flexibility in assigning these counties to either a New York City-based or a Hartford-based nonattainment area.

[6] See: https://www.epa.gov/ozone-designations/ozone-designations-guidance-and-data .

[7] Connecticut's 2011 periodic emission inventory (PEI), which was submitted to EPA in March 2016, has similar summer day emission distributions on the county and source sector level as are shown here using EPA's 2011 NEI annual emissions.

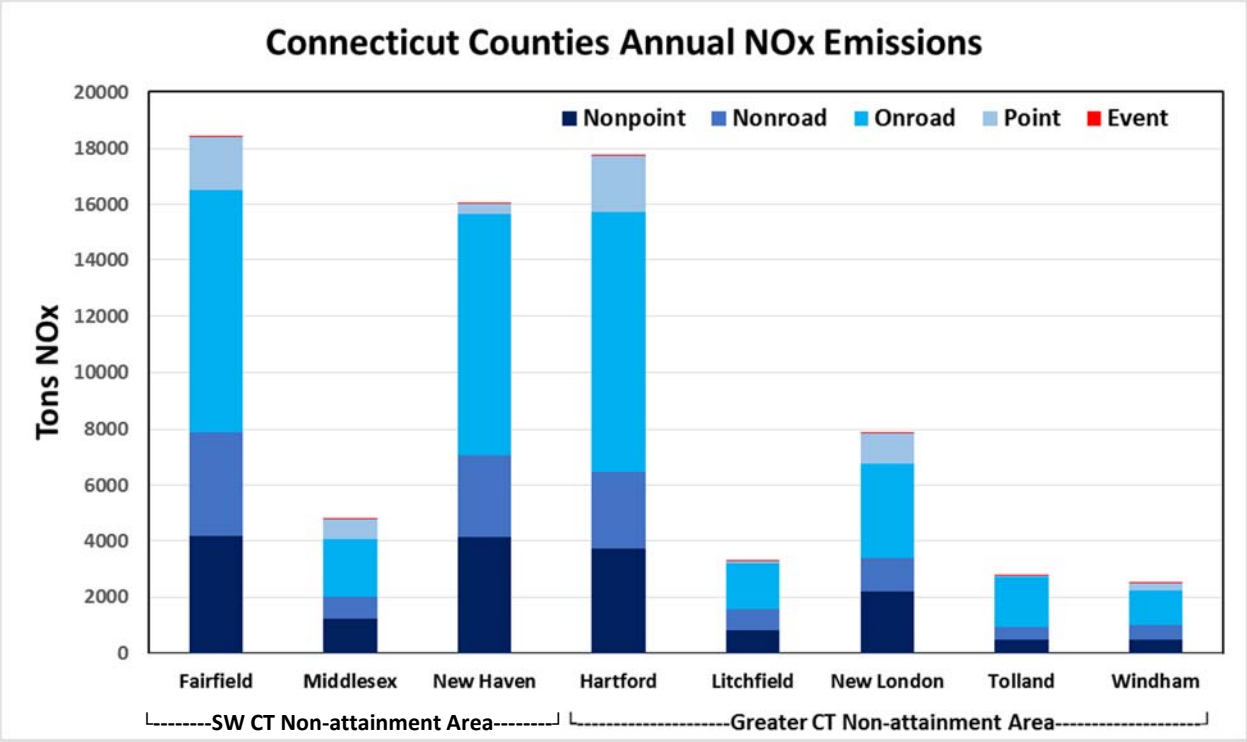

Figure 7. NEI 2011 v.2 NOx Annual Emissions for Connecticut Counties

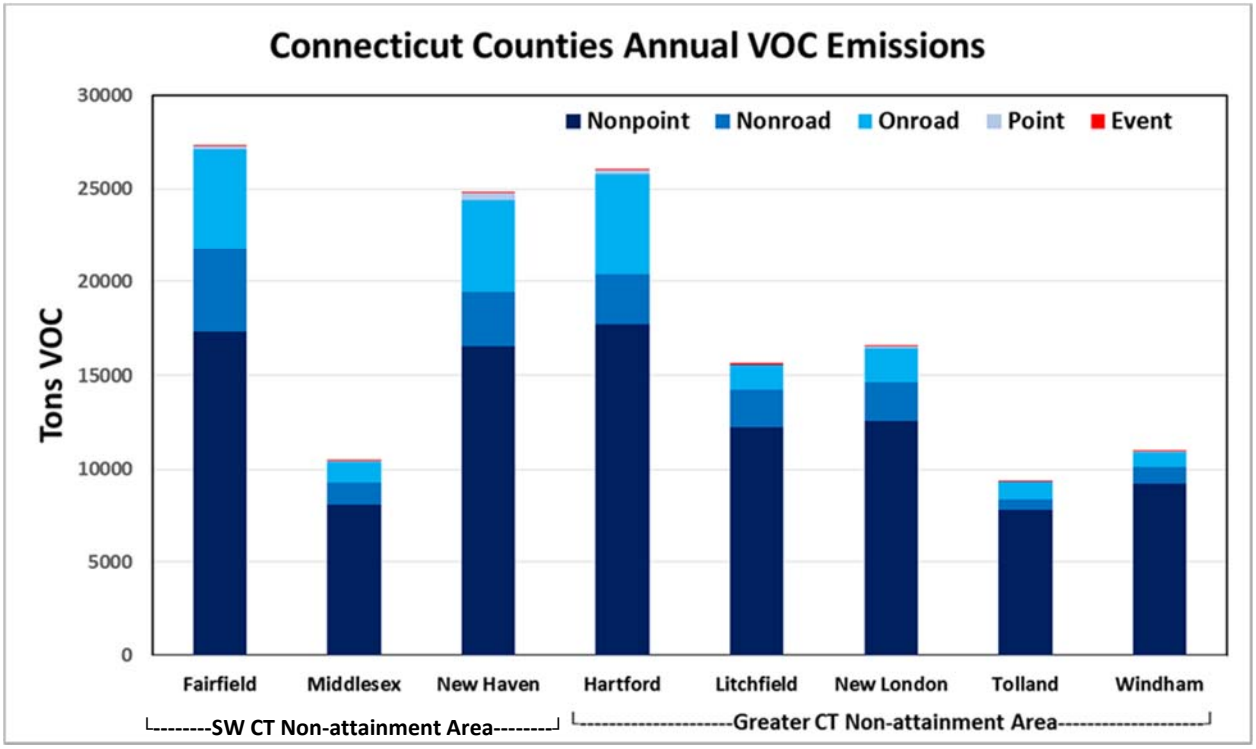

Figure 7. NEI 2011 v.2 VOC Annual Emissions for Connecticut Counties

2.2.1 Traffic and Commuting Patterns

Table 3 provides data[8] for annual vehicle miles traveled (VMT) and the daily commuting patterns between Connecticut counties and the existing NY/NJ/CT and Greater Connecticut 8-hour ozone nonattainment areas.[9] Annual VMT totals are highest in Fairfield, New London and Hartford Counties, reflecting the higher population densities in those counties. This table does not include commuting to non-attainment areas outside of the State, which is generally a much smaller percentage than that between Connecticut Counties.

Table 3. Year 2014 VMT and Year 2009-2013 Commuting Data for Connecticut Counties

County	2014 VMT (10^6 miles)	Commutes to Existing NY/NJ/CT Non-Att Area	Commutes to Existing GrCT Non-Att Area	Non-Attainment Area Total Commutes	% of Commutes to Existing NY/NJ/CT Non-Att Area	% of Commutes to Existing GrCT Non-Att Area
Fairfield	6,876	427,584	7,532	435,116	98.27%	1.73%
Hartford	7,490	24,469	386,946	411,415	5.95%	94.05%
Litchfield	1,348	29,470	65,972	95,442	30.88%	69.12%
Middlesex	1,707	16,324	67,485	83,809	19.48%	80.52%
New Haven	6,976	364,258	37,058	401,316	90.77%	9.23%
New London	2,747	3,581	127,112	130,693	2.74%	97.26%
Tolland	1,465	1,862	72,203	74,065	2.51%	97.49%
Windham	979	849	47,271	48,120	1.76%	98.24%
Totals	29,588	868,397	811,579	1,679,976	51.69%	48.31%

Commuting patterns show that Fairfield and New Haven Counties in Connecticut have the greatest total and percentage of commuters into the existing NY/NJ/CT nonattainment area. Although 31% of Litchfield County residents' commutes are to the existing NY/NJ/CT nonattainment area, the vast majority of the commutes (i.e., 69%) are made into the existing Greater Connecticut nonattainment area. Similarly, the majority of commutes from New London County are to the existing Greater Connecticut nonattainment area. Middlesex County, which is much more rural than Fairfield and New Haven Counties, has a majority of its commutes to the

[8] Table 3 data were obtained from U.S. Census Bureau 2009-2013 5-Year American Community Survey Commuting Flows analysis. See: http://www.census.gov/hhes/commuting/files/2013/Table%201%20County%20to%20County%20Commuting%20Flows-%20ACS%202009-2013.xlsx

[9] The existing NY/NJ/CT nonattainment area is comprised of the following counties. New Jersey Counties: Bergen, Essex, Hudson, Hunterdon, Middlesex, Monmouth, Morris, Passaic, Somerset, Sussex, Union, Warren; New York Counties: Bronx, Kings, Nassau, New York, Queens, Richmond, Rockland, Suffolk, Westchester; Connecticut Counties: Fairfield, New Haven, Middlesex. The existing GrCT nonattainment area is comprised of Connecticut Counties: Hartford, Litchfield, New London, Tolland and Windham.

Greater Connecticut nonattainment area. Although Middlesex County commuting patterns are more tied to the existing Greater Connecticut area, other factors described in this TSD support the continued inclusion of Middlesex County in the NY/NJ/CT nonattainment area.

2.2.2 VMT Growth Rates

Projected vehicle miles traveled (VMT) is another aspect of growth that may bear on area boundaries. Connecticut Department of Transportation projections[10] of summer day VMT on Connecticut roads are summarized in Table 4 for the 2014 through 2028 period. Annual VMT is summarized in Table 5 and it shows nearly identical patterns. Future average VMT growth is not expected to exceed 1% annually for any county during the 14 year period in Connecticut. Given the relative and consistent low rates of VMT growth throughout Connecticut, that aspect of growth is not determinative of area boundaries. Figure 8 shows annual VMT for counties in New York, New Jersey and Connecticut. The highest VMT counties are found on Long Island, NY with high VMT following I-91 from Hartford to New Haven and then along I-95 into New York City. This is reflected in the relatively high proportion of on-road mobile NOx found in the emission inventories from those counties.

Table 4. CTDOT VMT Projections through 2028 (Miles Traveled per Summer Day)

DOT VMT Series 31 - Summer Day					
County	**2014**	**2017**	**2020**	**2028**	**Change 2014 to 2028**
Fairfield	21,497,783	21,772,720	22,022,687	23,163,627	7.7%
Middlesex	5,348,624	5,453,692	5,519,872	5,876,539	9.9%
New Haven	21,809,691	22,126,391	22,483,490	23,786,909	9.1%
CT Portion of NY-NJ-LI area	**48,656,098**	**49,352,803**	**50,026,049**	**52,827,075**	8.6%
Hartford	23,418,990	23,707,468	24,352,446	25,914,041	10.7%
Litchfield	4,250,259	4,316,618	4,372,529	4,709,061	10.8%
New London	8,614,620	8,862,593	8,952,787	9,491,794	10.2%
Tolland	4,605,783	4,699,720	4,775,552	5,104,317	10.8%
Windham	3,089,380	3,145,145	3,175,139	3,376,336	9.3%
Greater CT Portion	**43,979,032**	**44,731,543**	**45,628,453**	**48,595,549**	10.5%
State Total	**92,635,129**	**94,084,346**	**95,654,502**	**101,422,624**	9.5%

[10] Series 31 DOT VMT projections will be used to develop proposed mobile source emission budgets in Connecticut's Ozone Attainment SIPs for the 2008 ozone NAAQS.

Table 5. CTDOT VMT Projections through 2028 (Miles Traveled Annually)

DOT VMT Series 31 - Annual					
County	**2014**	**2017**	**2020**	**2028**	**Change 2014 to 2028**
Fairfield	6,876,222,918	6,964,102,049	7,044,031,998	7,408,846,664	7.7%
Middlesex	1,707,432,080	1,740,951,380	1,761,716,870	1,875,491,917	9.8%
New Haven	6,976,434,604	7,077,696,829	7,191,869,352	7,608,771,242	9.1%
CT Portion of NY-NJ-LI area	**15,560,089,603**	**15,782,750,258**	**15,997,618,220**	**16,893,109,823**	8.6%
Hartford	7,490,962,833	7,583,183,616	7,789,408,625	8,288,908,293	10.7%
Litchfield	1,348,620,658	1,369,663,671	1,387,420,192	1,494,225,171	10.8%
New London	2,747,441,709	2,826,348,103	2,855,001,204	3,026,780,135	10.2%
Tolland	1,465,101,129	1,494,973,024	1,519,077,424	1,623,568,638	10.8%
Windham	979,305,125	997,018,226	1,006,518,619	1,070,256,101	9.3%
Greater CT Portion	**14,031,431,453**	**14,271,186,640**	**14,557,426,065**	**15,503,738,339**	10.5%
State Total	**29,591,521,056**	**30,053,936,898**	**30,555,044,285**	**32,396,848,162**	9.5%

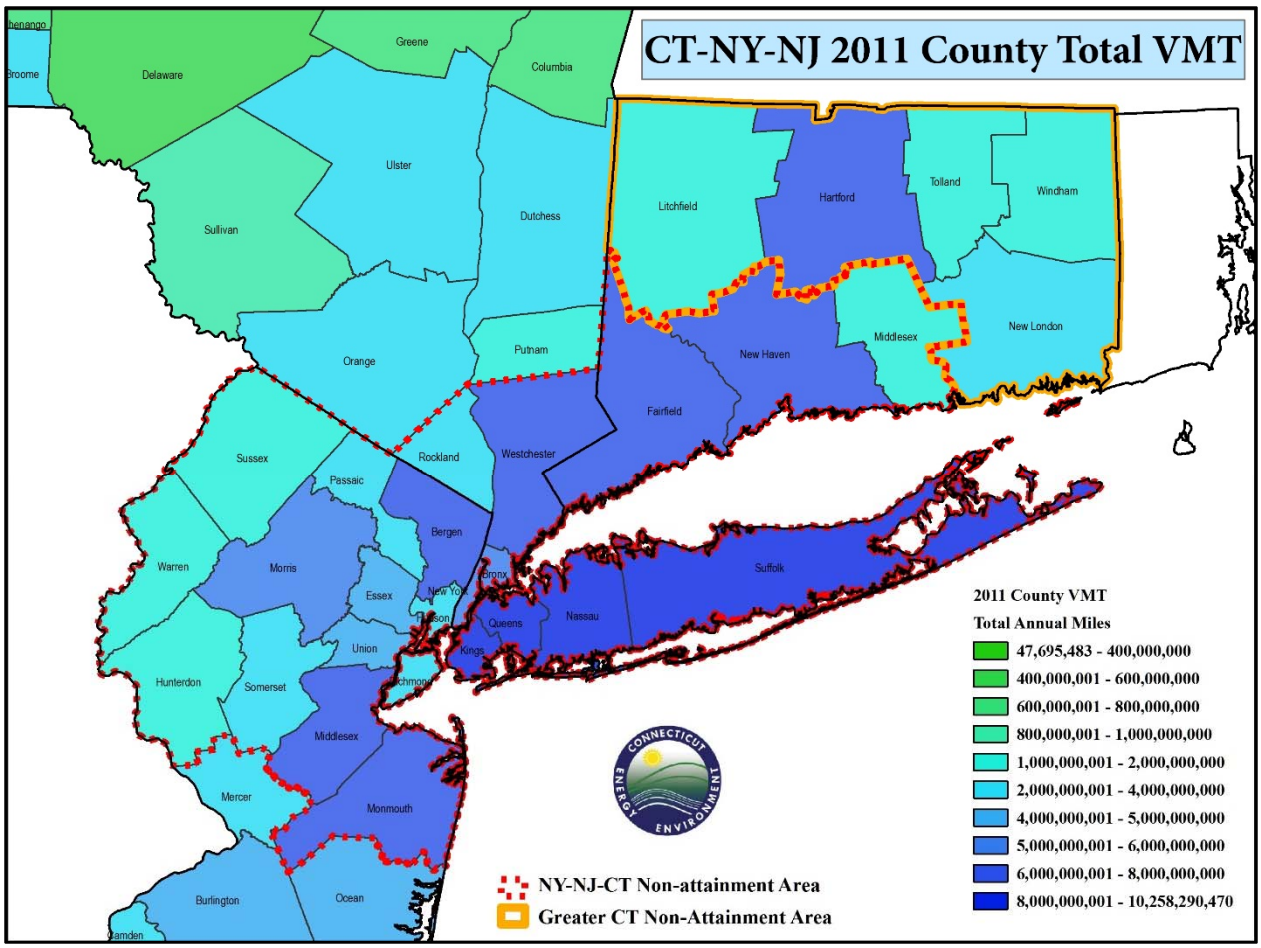

Figure 8. NY-NJ-CT County VMT for 2011

2.2.3 Population Growth Rates and Patterns

Table 6 summarizes the Connecticut Data Center's population growth estimates for 2015-2025[11]. Overall, the projected population growth in Connecticut during this period is estimated at 2.7%, with Hartford, New Haven, Tolland and Windham Counties growing at rates less than the state average. The projected fastest growing county (on a percentage basis), Windham, is located in rural northeast Connecticut. Litchfield County, has the lowest population density and shows a population growth of .48%, the lowest in the State. The three most populous counties, Fairfield, Hartford and New Haven, are clearly set out from the remaining counties in Figure 9, although the slight differences in growth rates identified in Table 4 are difficult to discern due to the scale of the graph.

[11] http://ctsdc.uconn.edu/2015_2025_projections/

Table 6. Connecticut Data Center's Population Growth Estimates

COUNTY	2015 TOTAL	2020 TOTAL	2025 TOTAL	AREA (Square Miles)	Population Density 2015	2025-2015 %Change
Fairfield County	932,377	944,692	954,479	624.9	1492.0	**2.37%**
Hartford County	910,924	925,492	936,810	735.1	1239.2	**2.84%**
Litchfield County	192,188	193,116	193,112	920.6	208.8	**0.48%**
Middlesex County	168,833	170,518	170,976	369.3	457.2	**1.27%**
New Haven County	881,374	898,514	912,056	604.5	1458.0	**3.48%**
New London County	279,755	283,665	285,773	664.9	420.7	**2.15%**
Tolland County	155,924	158,606	160,759	410.2	380.1	**3.10%**
Windham County	122,718	126,432	129,527	512.9	239.3	**5.55%**
State Total	**3,644,093**	**3,701,035**	**3,743,492**	**4842.4**	**752.5**	**2.73%**

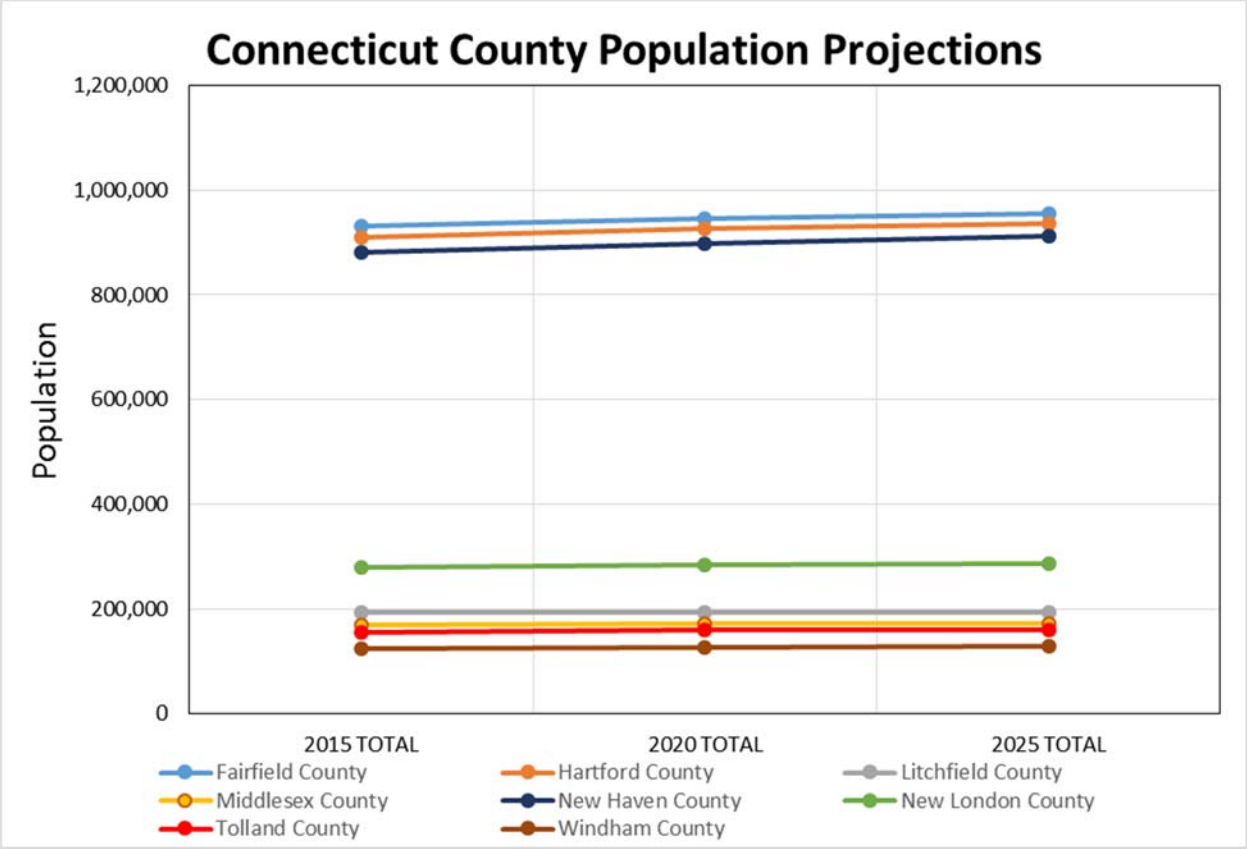

Figure 9. Connecticut Data Center's Population Growth Estimates 2015-2025

2.3 Factor 3: Meteorology

Meteorology is a significant factor in CTDEEP's nonattainment area designations. In sum, ozone precursors transported from the south and west contribute significantly to Connecticut's ozone exceedance days. The meteorological basis for the common ozone transport regimes and the relationship between wind direction and ozone concentration are summarized here.

Conceptual Description of the Ozone Problem[12]

Ozone exceedances in Connecticut can be classified into four categories based on spatial patterns of measured ozone and the contributing meteorological conditions. Typically, most exceedances occur on sunny summer days with inland maximum surface temperatures approaching or above 90°F, surface winds from the south and west (favorable for transport of pollutants from the Northeast Megalopolis) and aloft winds from the west-southwest to west-northwest (favorable for transport of pollutants from Midwest power plants).

- **Inland-only Exceedances (Figure 10):** Ozone is transported aloft from the west and mixed down to the surface as daytime heating occurs. At times, transport from the southwest can also occur overnight at lower levels aloft due to the formation of a nocturnal jet. Strong southerly surface winds during the day bring in clean maritime air from the Atlantic Ocean, resulting in relatively low ozone levels along the coast. The maritime front may not penetrate very far inland, and therefore does not mitigate transported and local pollutants' contribution to inland exceedances.
- **Coastal-only Exceedances (Figure 11):** Strong westerly surface winds transport dirty air down Long Island Sound from source regions to the west (e.g., New York and New Jersey). The relatively cool waters of Long Island Sound confine the pollutants in the shallow marine boundary layer. Afternoon heating over coastal land creates a sea breeze with a southerly component, resulting in ozone exceedances along the coast. Inland winds from the west prevent sea breeze penetration and can sometimes contribute to the formation of a convergence zone that can further concentrate ozone along the coast.
- **Western Boundary-only Exceedances (Figure 12):** Southerly maritime surface flow invades the eastern two-thirds of Connecticut, keeping ozone levels in that portion of the state low. The south-southwest urban winds out of New York City result in exceedances along Connecticut's western boundary. Winds aloft are often weak for this scenario.
- **State-wide Exceedances (Figure 13):** This is the classical worst-case pattern, with flow at the surface in the Northeast up the Interstate-95 corridor, transport at mid-levels also from the southwest via the low level jet and flow at upper levels from the west. All of these flows are from emission-rich upwind areas, serving to transport ozone precursors and previously formed ozone into Connecticut. A weak sea breeze may also develop, transporting ozone pooling over Long Island Sound into the State.

[12] For a more detailed discussion, see *Connecticut's 8-Hour Ozone Attainment Demonstration Technical Support Document*, February 1, 2008, available at http://www.ct.gov/dep/lib/dep/air/regulations/proposed_and_reports/section_2.pdf and *The Nature of the Ozone Air Quality Problem in the Ozone Transport Region: A Conceptual Description*, NESCAUM, Revised August 2010, available at http://www.nescaum.org/documents/2010_o3_conceptual_model_final_revised_20100810.pdf/ .

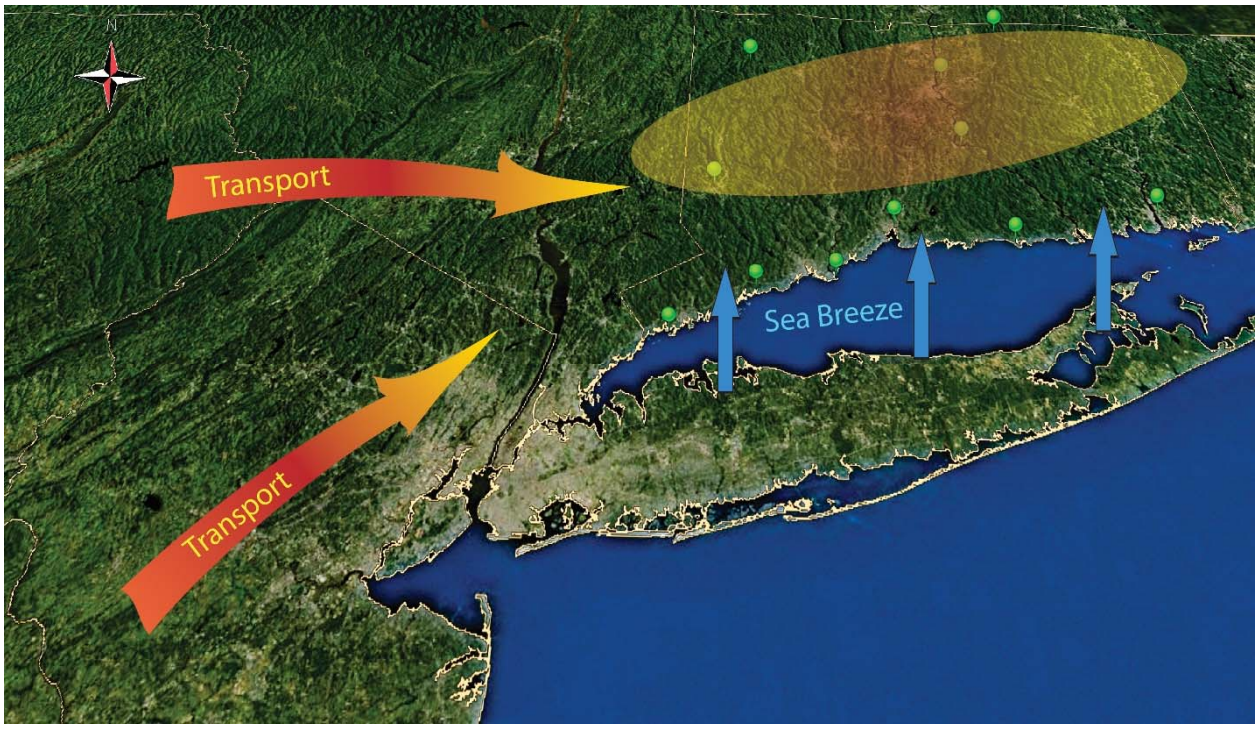

Figure 10. In-land Only Ozone Exceedance Scenario

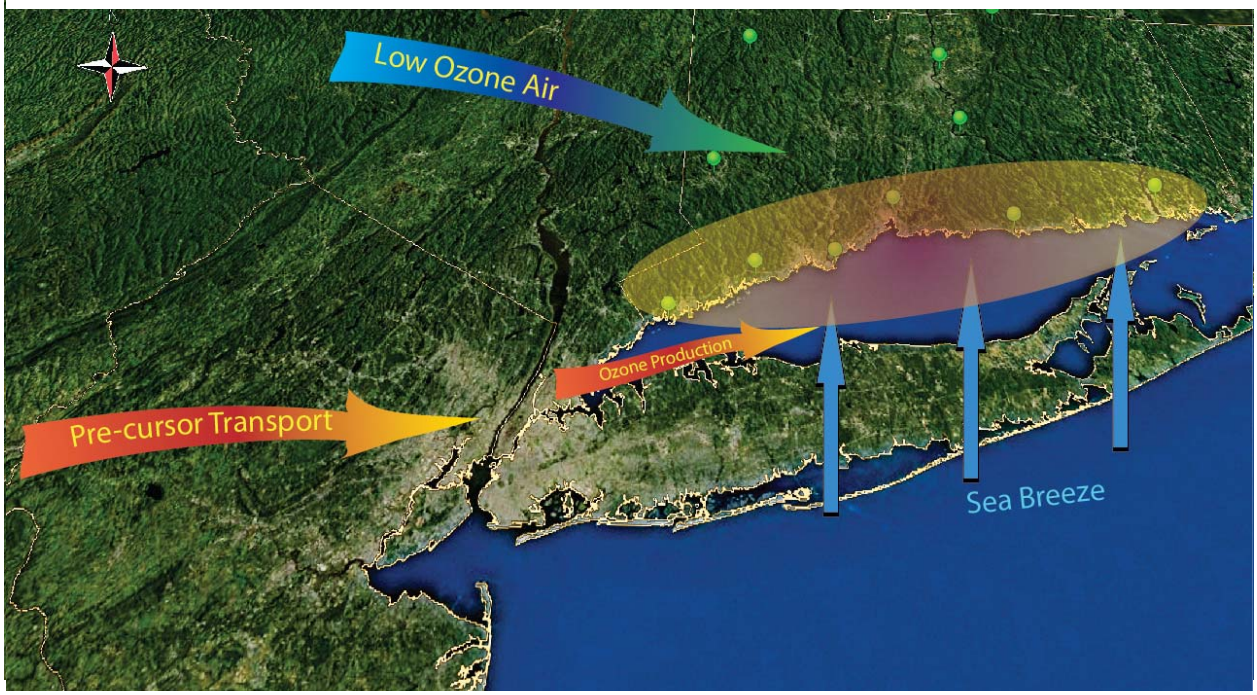

Figure 11. Coastal Only Ozone Exceedance Scenario

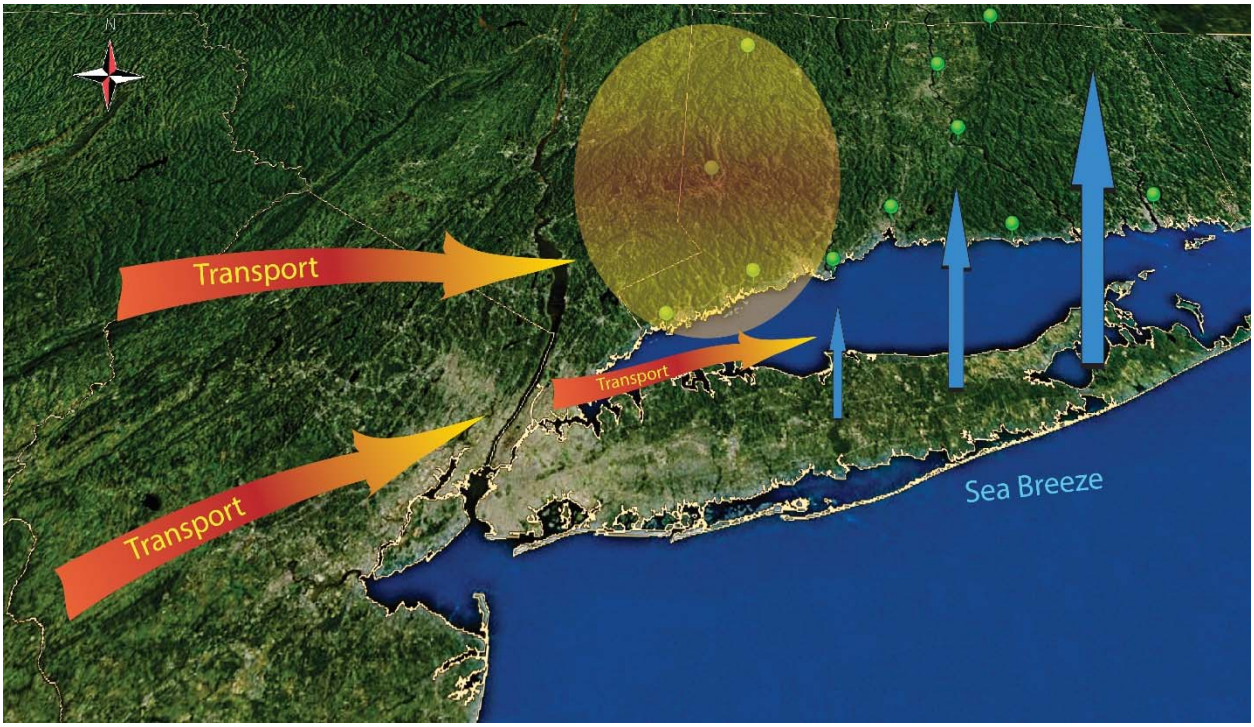

Figure 12. Western Boundary Only Ozone Exceedance Scenario

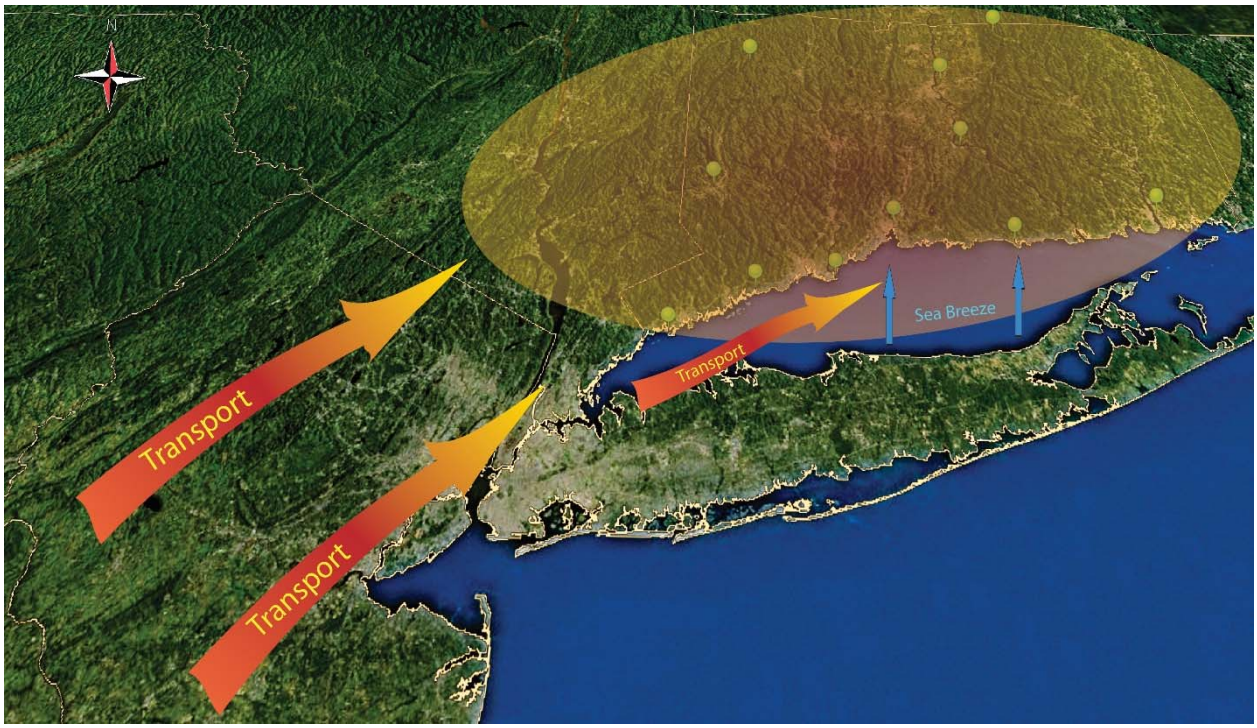

Figure 13. State-wide Exceedance Scenario

Pollution Frequency Plots

Figures 14 and 15, respectively, provide ozone concentration/wind direction frequency plots for a coastal (Westport) and inland monitoring (East Hartford) site in Connecticut for 2014. Each of these pollution wind roses depicts ozone season wind frequencies for all hours from June 1-August 31st of 2014.

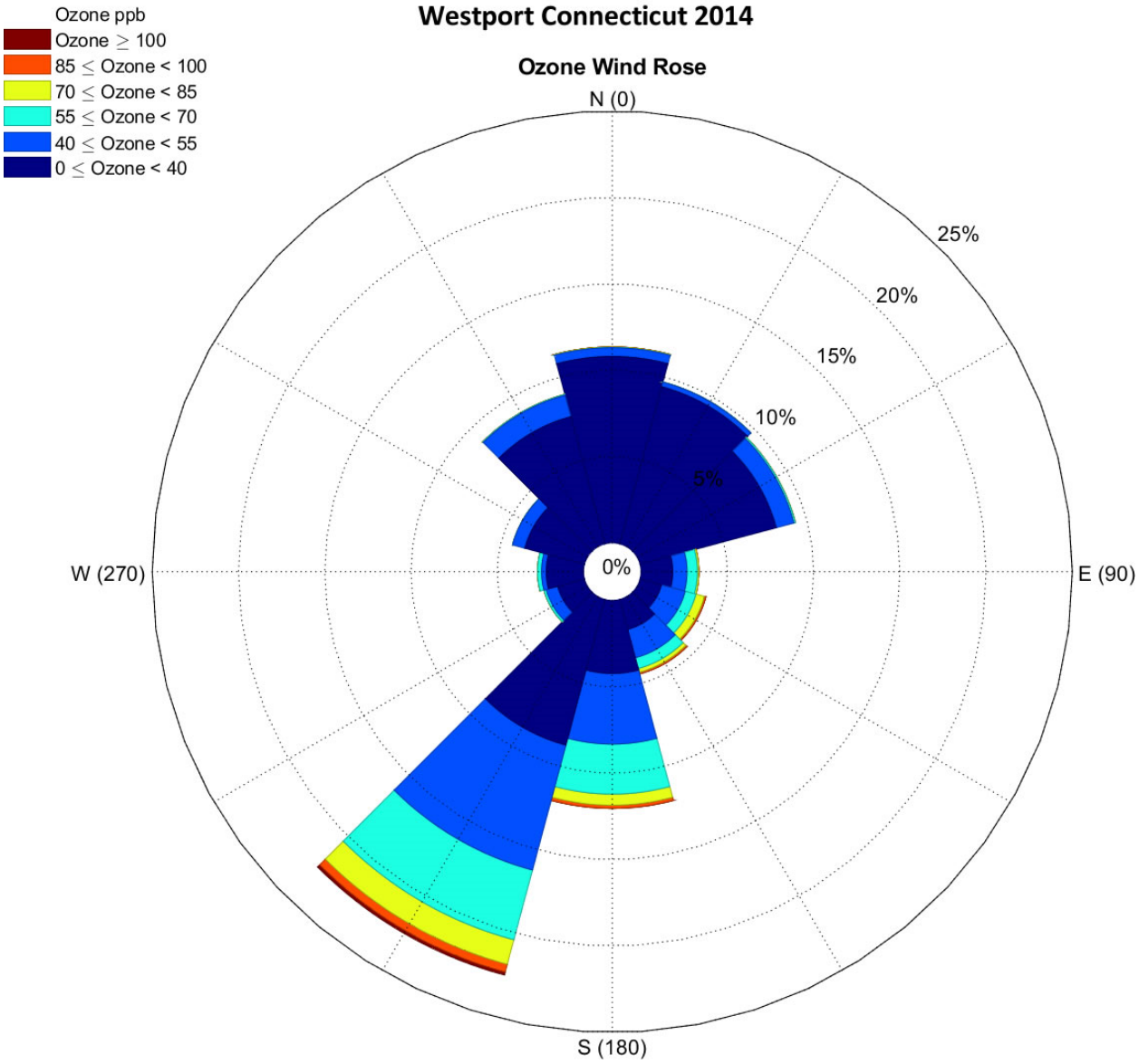

Figure 14. Ozone Concentration/Wind Direction Frequency Plots for a Coastal Monitor (Westport)

For all monitoring locations, the vast majority of high ozone days occur when winds are from the south and southwest direction. At Westport, the peak ozone wind direction has a more southwesterly component than that of the East Hartford monitor because the Connecticut River Valley tends to channel the prevailing winds in a more south to north orientation for the East

Hartford site. Channeling of the ozone plume from Long Island Sound up the Connecticut River valley may further enhance ozone concentrations at inland monitoring locations such as Middletown. When considered together, these ozone wind roses support the observation that most high ozone days in Connecticut are strongly associated with emissions transported from upwind sources located to the west and south of the state.

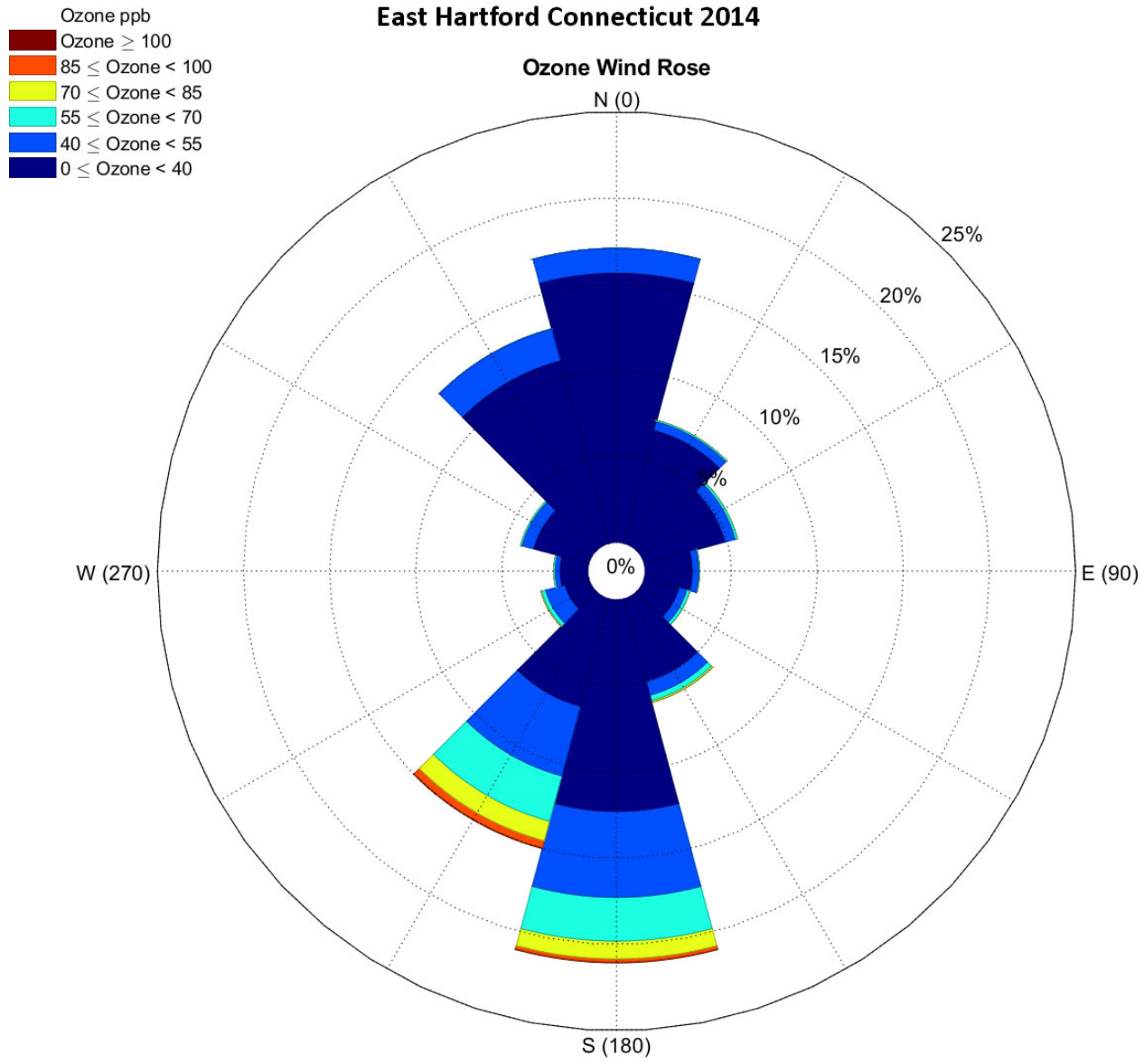

Figure 15. Ozone Concentration/Wind Direction Frequency Plot for In-land Site (East Hartford)

The HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) modeling system was used by EPA to produce 24-hour back trajectories that illustrated the 3-dimensional paths traveled by air parcels to a violating monitor. The EPA provided back trajectories in the *Ozone Mapping Tool* for all violating monitors, for each day of high ozone concentration (i.e., daily maximum 8 hour values that exceed the 70 ppb NAAQS) at those monitors. The trajectories were modeled at three ending heights: 100, 500 and 1000 meters. The 1000 meter height (green) is near the top of the boundary layer on most days and represents long distance transport. Figure 16 shows the back trajectories for the East Hartford monitor (Greater CT area) with nearly all of the trajectories originating in States to the west and southwest of Connecticut. Likewise, Figure 17 shows the back trajectories for the Westport monitor with much the same results, except that two of the days show a distinct contribution from the northwest in New York State. These back trajectories also corroborate the findings of EPA's modeling for the Cross-State Air Pollution Rule Update released in September 2016, which showed the majority of upwind state ozone contributions to Connecticut coming from New York, New Jersey and Pennsylvania.

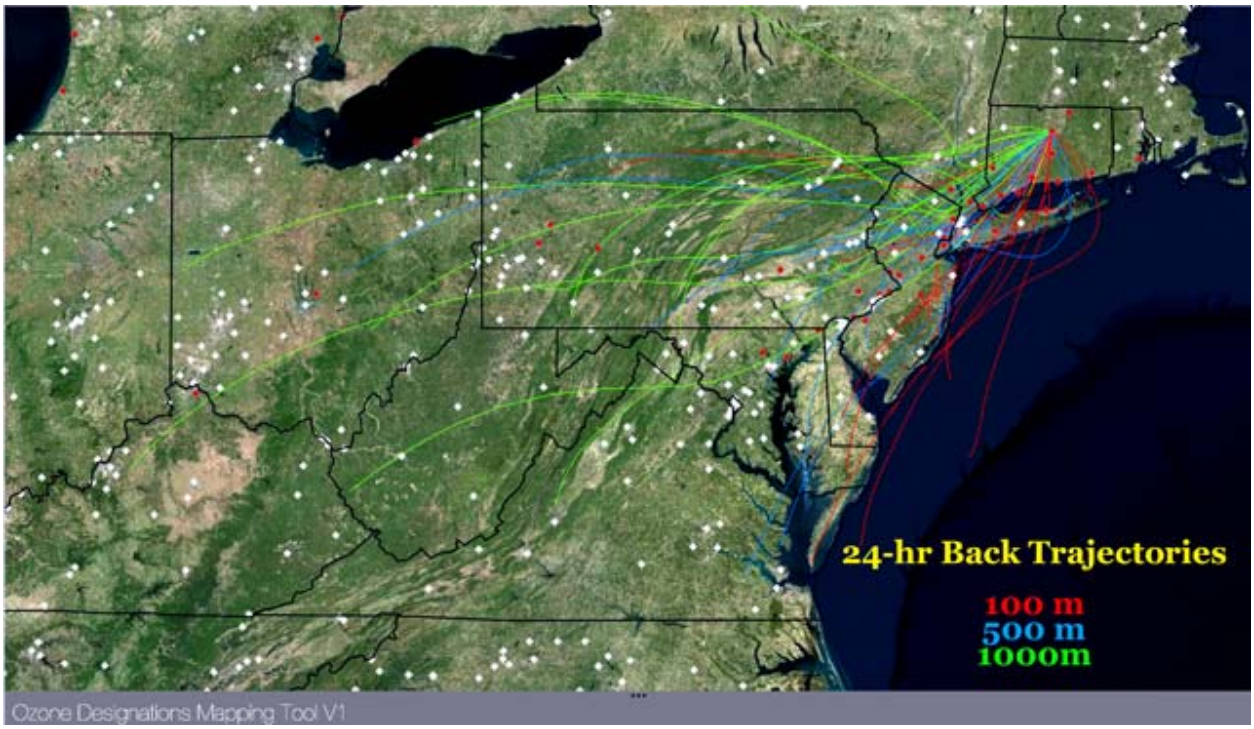

Figure 16. Back Trajectories on Ozone Exceedance Days, East Hartford CT

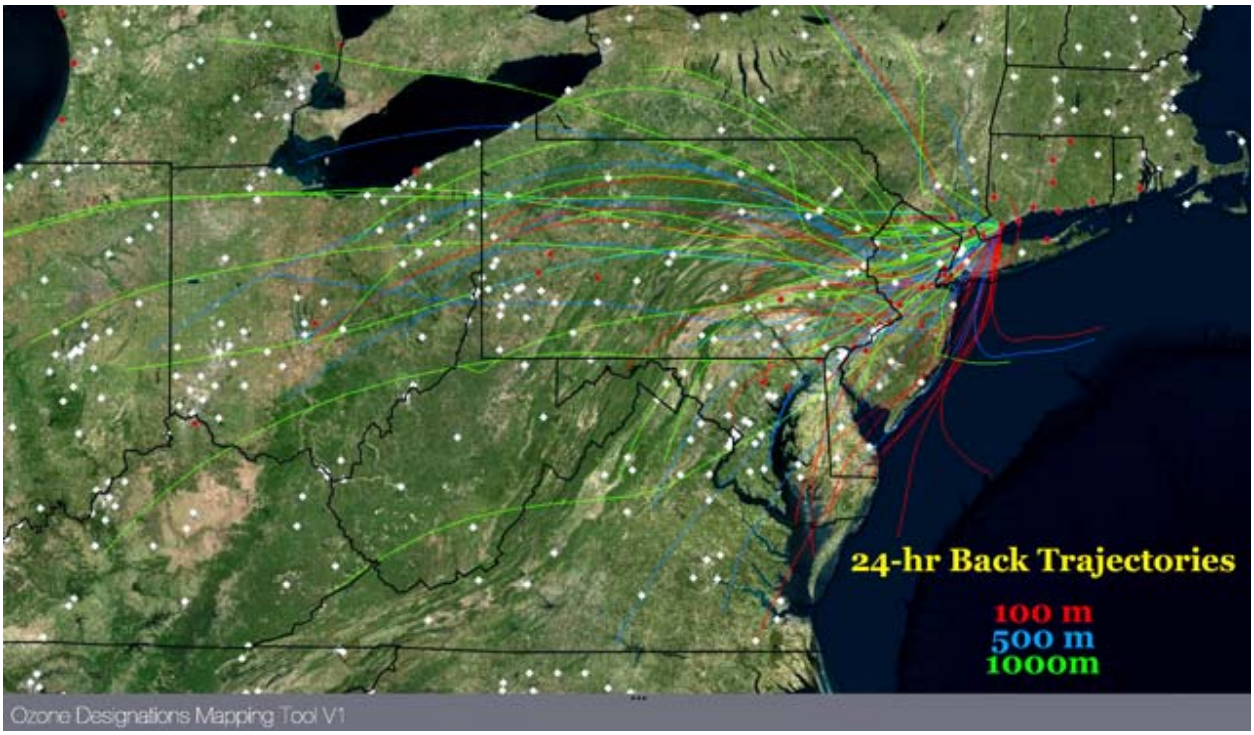

Figure 17. Back Trajectories on Ozone Exceedance Days, Westport CT

2.4 Factor 4: Geography/Topography

Connecticut is a small state geographically, with topographical features that do not have a significant effect on air shed boundaries. Long Island Sound (LIS) does play a role in ozone production, especially when the New York City 'pollutant' plume has multiple hours of residency over LIS before being blown ashore into the coastal Connecticut monitors. As was shown in Table 1, Connecticut's highest design values occur at the LIS coastal monitors in the current NY/NJ/CT nonattainment area (from Greenwich eastward to Madison). This chemistry is not well understood and needs more research, but it does reinforce the fact that the NYC area and southwest Connecticut should share the same nonattainment area boundaries.

2.5 Factor 5: Jurisdictional Boundaries

A variety of jurisdictional issues should be considered when determining appropriate nonattainment boundaries for the revised 8-hour ozone NAAQS.

- **Existing Nonattainment Area Boundaries:** As depicted in Figure 1, the entire State of Connecticut is currently classified as nonattainment for the 2008 8-hour ozone NAAQS. Fairfield, New Haven and Middlesex Counties are included as the Southwest Connecticut portion of the NY/NJ/CT nonattainment area, which is also comprised of several southern New York and northern New Jersey counties in the New York City metropolitan area. Connecticut's remaining five counties are included in the Greater Connecticut

nonattainment area. As discussed above, there is no compelling technical evidence to support a change in nonattainment boundaries.

- **Alternative NECTA Boundaries:** In addition to the county based CSA/CBSA's that EPA identifies as the presumptive nonattainment boundaries (see Figure 2), NECTAs are available as an alternate set of statistical areas for the New England states. The NECTA classification scheme recognizes towns as a more important level of government than counties in the New England region (see Figure 18).

  The NECTA classifications for Connecticut[13] support retention of the current ozone nonattainment boundaries. The Hartford-West Hartford-Torrington Combined NECTA (comparable to a county-based CSA) extends to six towns in Litchfield County, including the Torrington Micropolitan NECTA. Torrington is the most populous municipality in Litchfield County. Based on NECTA classifications, it is appropriate to retain Litchfield County in the Greater Connecticut ozone nonattainment area.

  CTDEEP also prefers to retain New London County in the Greater Connecticut nonattainment area rather than establishing a separate New London County nonattainment area. Although the NECTA scheme identifies a Norwich-New London NECTA, which includes the bulk of towns in New London County, the Hartford-West Hartford-Torrington Combined NECTA does include two towns from New London County (Colchester and Lebanon).

  Finally, the Bridgeport-New Haven-Stamford Combined NECTA includes eight Middlesex County towns. Most of these towns are located near the Long Island Sound shoreline, where some of the highest ozone events occur. It makes sense to continue to include Middlesex County, along with Fairfield and New Haven Counties, as part of the NY/NJ/CT nonattainment area to directly link Connecticut's highest measuring monitors to the emission rich region around New York City, where a significant portion of Connecticut's measured ozone originates.

[13] See: http://www.whitehouse.gov/omb/assets/omb/bulletins/fy2009/09-01.pdf.

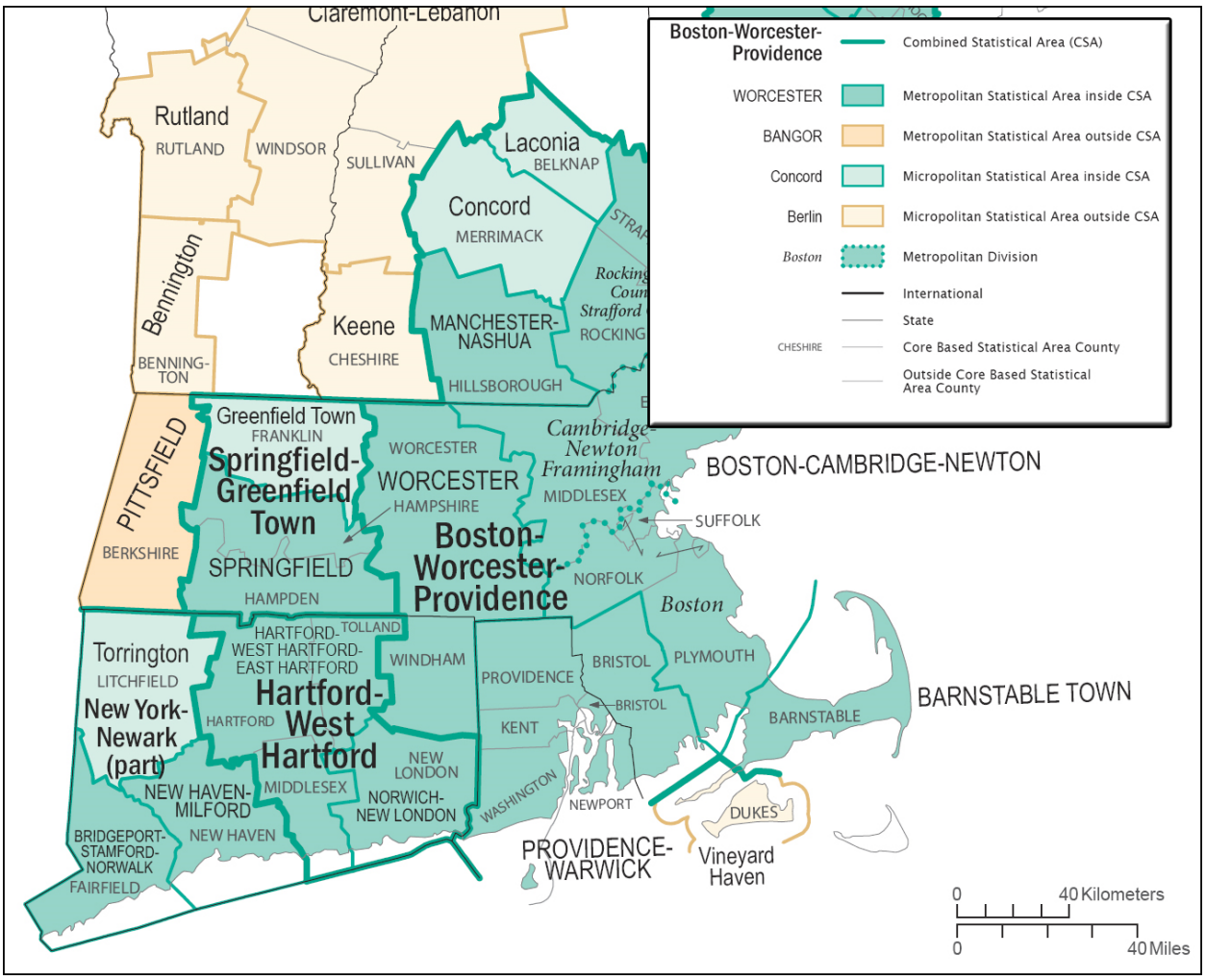

Figure 18. New England Metropolitan Divisions

- **Transportation Conformity Process:** The current transportation conformity process is implemented using budgets developed using the nonattainment boundaries established for the 2008 ozone NAAQS. The consultation mechanisms in place between CTDEEP, the Connecticut Department of Transportation and the numerous metropolitan planning organizations are based on these boundaries and work fairly well. It is desirable, both from an administrative and air quality perspective, to minimize any disruption to the existing process, especially during the transition phase before new conformity budgets can be established for the 2015 NAAQS.

- **CTDEEP Regulatory Process:** Historically, CTDEEP has elected to adopt regulatory control requirements on a statewide basis, rather than requiring different levels of control based on nonattainment boundaries or severity. CTDEEP expects to continue this general practice into the future. Given that the entire state is recommended for a nonattainment designation for the 2015 ozone NAAQS, it makes little difference from a regulatory perspective where the boundary between the two nonattainment areas is assigned.

3.0 Conclusions

Considering the above five factors together, CTDEEP recommends that Fairfield, New Haven and Middlesex Counties be designated as nonattainment for the 2015 8-hour ozone NAAQS as part of a multi-state NY/NJ/CT nonattainment area, and the remaining five counties in Connecticut be designated as nonattainment as part of a Greater Connecticut nonattainment area (see Figure 19). These recommended designations and boundaries are identical to those of the existing nonattainment areas established by EPA for the 2008 8-hour ozone NAAQS. CTDEEP's recommended area boundaries are influenced largely by air quality data, commuting patterns, meteorology, jurisdictional boundaries and administrative efficiencies.

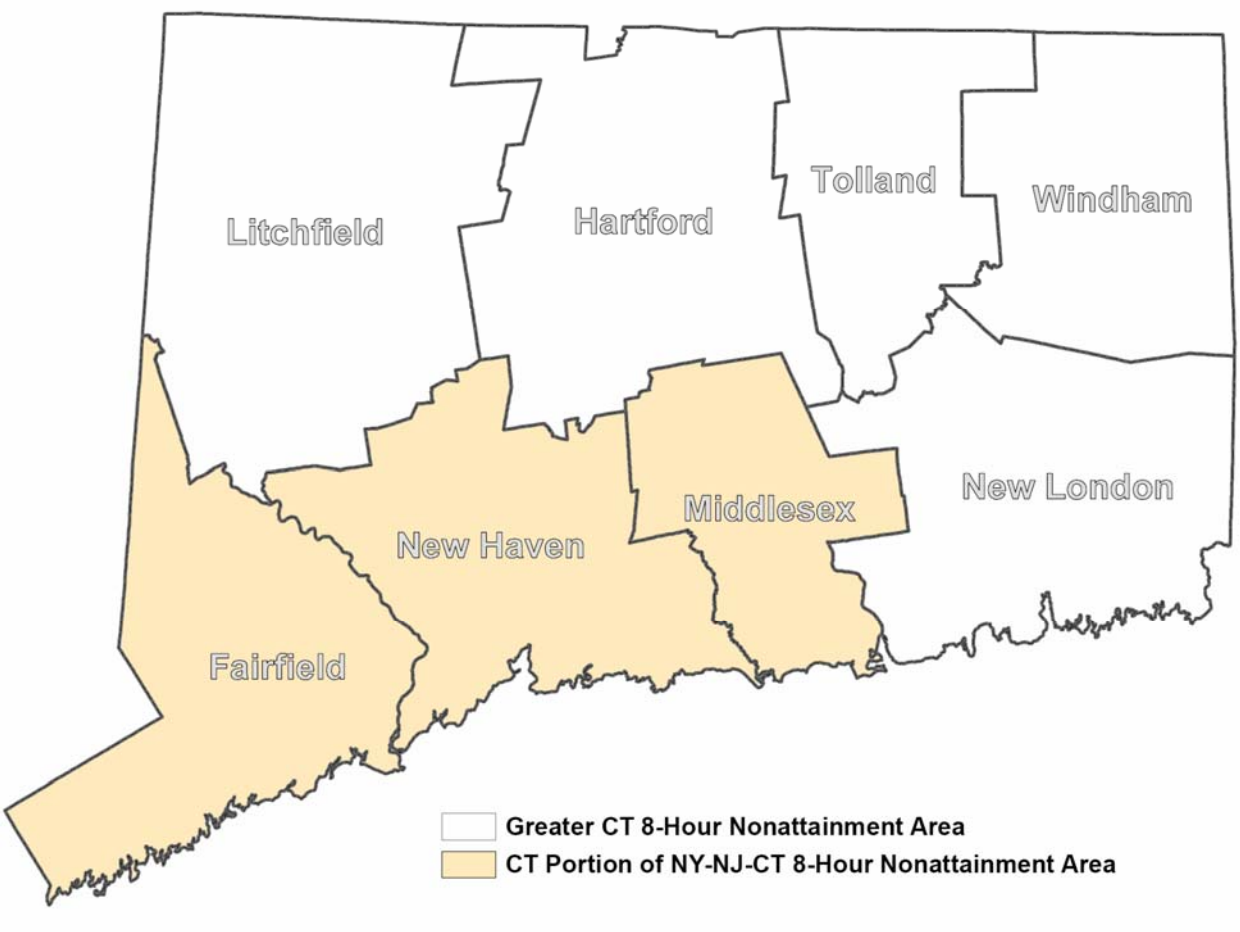

Figure 19. Map of Connecticut's Recommendation for the 2015 8-hour Ozone NAAQS Nonattainment Boundaries