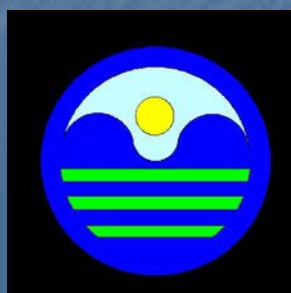


Recommended Annual PM2.5 Nonattainment Area Designations in Illinois

October 2013

**Illinois Environmental Protection Agency
1021 North Grand Avenue, East
Springfield, IL 62794-9276
www.epa.state.il.us**

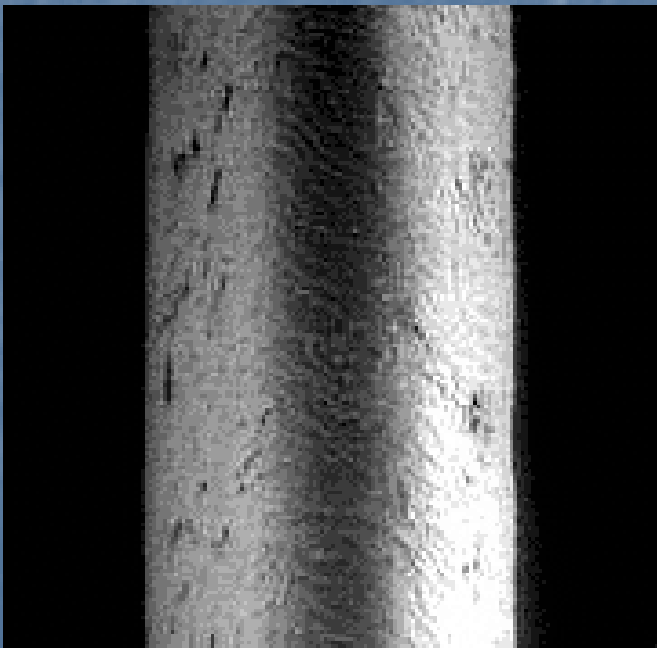


Overview

- Background on PM_{2.5}
- New Primary Annual PM_{2.5} Standard
- Requirements and Timeline to meet the new PM_{2.5} standard
- Boundary Designation Process
- Proposed Illinois Nonattainment boundaries for the new PM_{2.5}

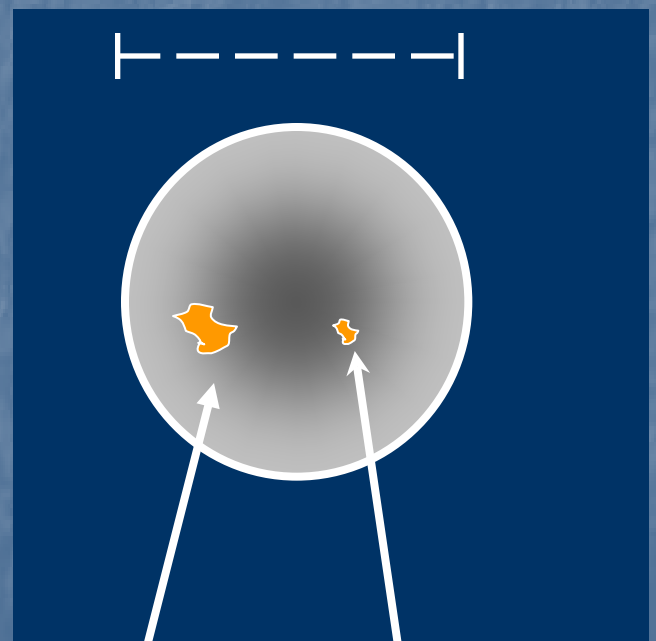
Particulate Matter

- PM = All particulate matter
 - PM₁₀ = All particulate matter less than or equal to 10 microns in diameter
 - PM_{2.5} = All particulate matter less than or equal to 2.5 microns in diameter



Human Hair (70 μm diameter)

Hair cross section (70 μm)

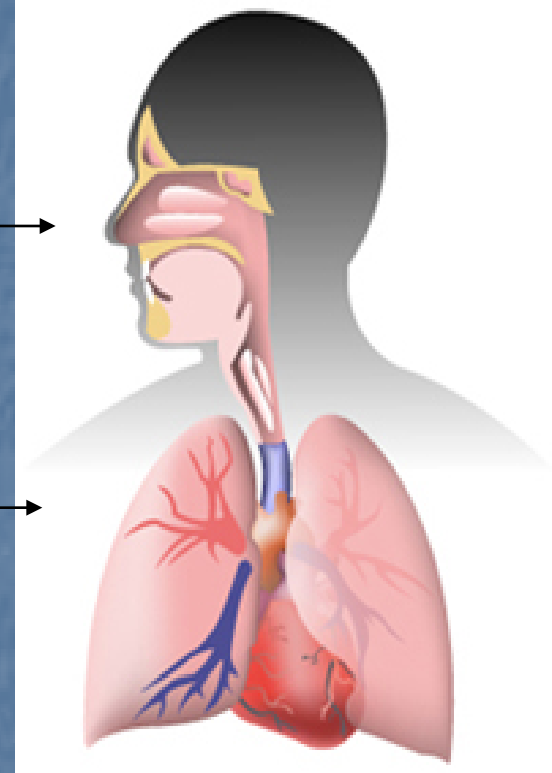


PM₁₀
(10 μm)

PM_{2.5}
(2.5 μm)

Particulate Matter

- Larger particles ($> PM_{10}$) deposit in the upper respiratory tract
- Smaller, inhalable particles ($\leq PM_{10}$) penetrate deep into the lungs



- Both coarse particles and fine particles can penetrate to lower regions of the lung
- Deposited particles may accumulate, react, be cleared or absorbed

Public Health Risks from PM_{2.5} Are Significant

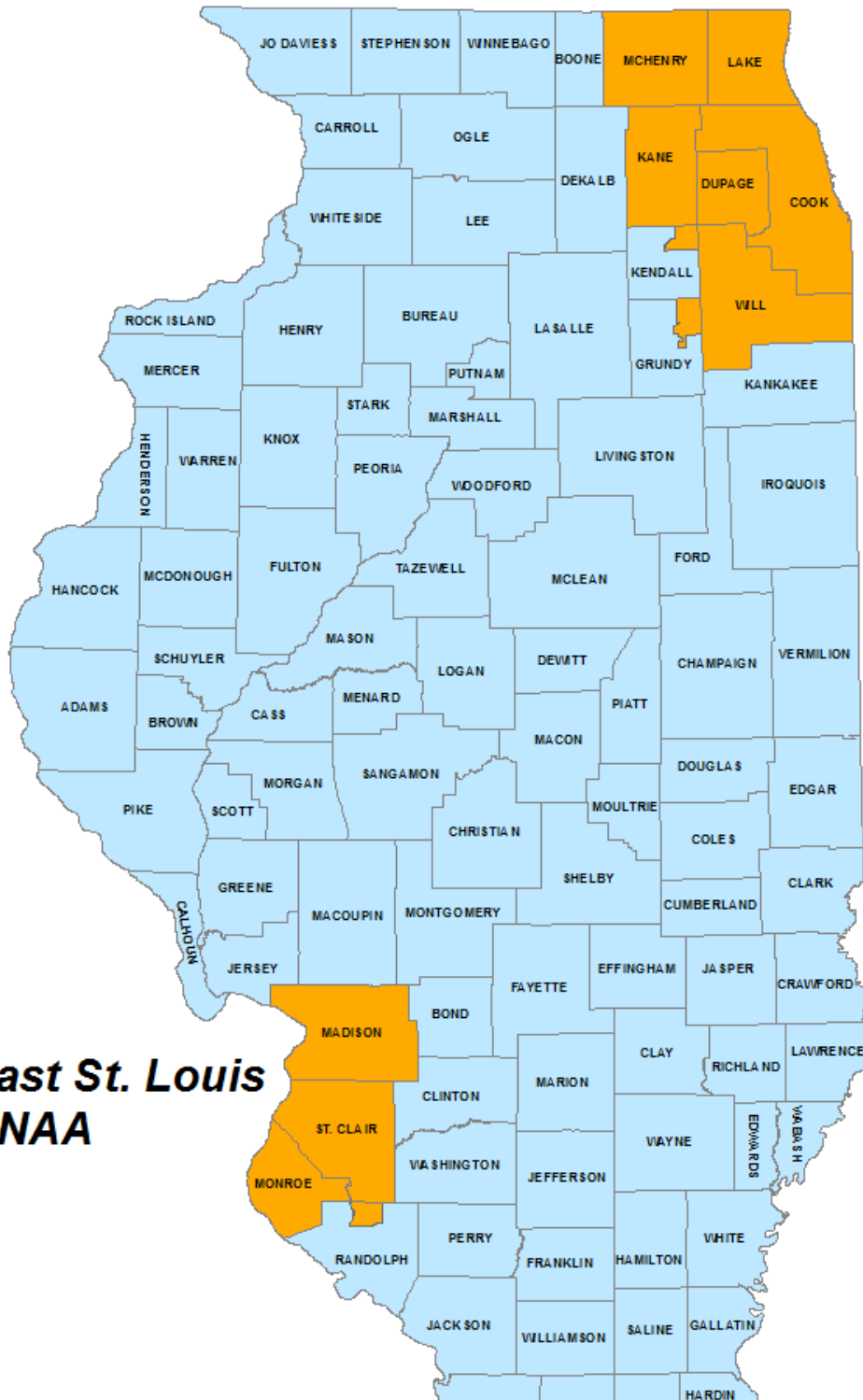
Particles are linked to:

- Premature death from heart and lung disease
- Aggravation of heart and lung diseases
- Increases in:
 - Hospital admissions
 - Doctor and ER visits
 - Medication use
 - School and work absences
- And possibly to
 - Lung cancer deaths
 - Infant mortality
 - Developmental problems, such as low birth weight in children

What is a Nonattainment Area?

- The Clean Air Act defines a **nonattainment area** as the area that is violating the national ambient air quality standard **OR** a nearby area that is contributing to a violation of the standards.
- The $PM_{2.5}$ standards are based on averaging air quality measurements both **annually and on a 24 hour basis**.
- **The annual standard for $PM_{2.5}$** is met whenever the 3 year average of the annual mean $PM_{2.5}$ concentrations for designated monitoring sites in an area is less than or equal to **$12.0 \mu\text{g}/\text{m}^3$** .
- The **24 hour** standard for $PM_{2.5}$ is met whenever the 3 year average of the annual 98th percentile of values at designated monitoring sites in an area is less than or equal to **$35 \mu\text{g}/\text{m}^3$** .

1997 Annual PM2.5 NAA/MA Areas



**Chicago
Maintenance
Area**

**Metro-East St. Louis
NAA**

- Areas that exceeded the 1997 National Ambient Air Quality Standard (NAAQS) for Annual PM2.5 (15 ug/m³)

EPA's PM_{2.5} Standards: Old and New

Primary	2006 Standards		2012 Standards	
	Annual (retained)	24-hour	Annual (strengthened)	24-hour
PM _{2.5} (Fine Particles)	15 µg/m³ Annual arithmetic mean, averaged over 3 years	35 µg/m³ 24- hour average, 98 th percentile, averaged over 3 years	12 µg/m³ Annual arithmetic mean, averaged over 3 years	35 µg/m³ 24- hour average, 98 th percentile, averaged over 3 years
Secondary PM _{2.5} (Fine Particles)	15 µg/m³ Annual arithmetic mean, averaged over 3 years	35 µg/m³ 24- hour average, 98 th percentile, averaged over 3 years	15 µg/m³ Annual arithmetic mean, averaged over 3 years	35 µg/m³ 24- hour average, 98 th percentile, averaged over 3 years

Designation Requirements

Section 107(d)(1) of the CAA governs the process for area designations

- Applicable when NAAQS is promulgated or revised
- Addresses designations of nonattainment or attainment/unclassifiable
- Provides states an opportunity to make recommendations for NAA to USEPA within 1 year of promulgation
 - Letter provided by the Governor of the State to USEPA
- Sets the Timeline for meeting the NAAQS
- Requires areas to be designated nonattainment if they do not meet the standard or contribute to ambient air quality in a nearby area that does not meet the standard – **Not optional**

Expected Timeline for 2012 Revised Primary Annual PM_{2.5} NAAQS

Milestone	Date
Promulgated – Revised Primary Annual PM _{2.5} NAAQS	December 14, 2012 (78 FR 3086, January 15, 2013)
State Designation Recommendation to USEPA due	December 13, 2013
USEPA notifies the State of Modifications	120 Days prior to final – No later than August 14, 2014
USEPA Final Designations	December 12, 2014
SIP Due	August 2016
Attainment Date	December 2021 (mod) 2025 (serious)

Boundary Designations Guidance

- USEPA Issued guidance for states to consider on April 16, 2013
- Areas with monitored violations must be classified as "***nonattainment***"
- Nonattainment areas should contain the area violating (the area around the monitor) and any adjacent counties that have the potential to contribute to the violation
- **NO Presumptive boundary** – "Reasonable Starting Point" (CBSA)
- Evaluated and determined on a **Case by Case Basis (Study Areas)**
- 5 Factors to consider: air quality data; emissions data & emissions related data; meteorology; geography/topography; and jurisdictional boundaries
- All other areas will be classified as "***attainment/unclassifiable***"

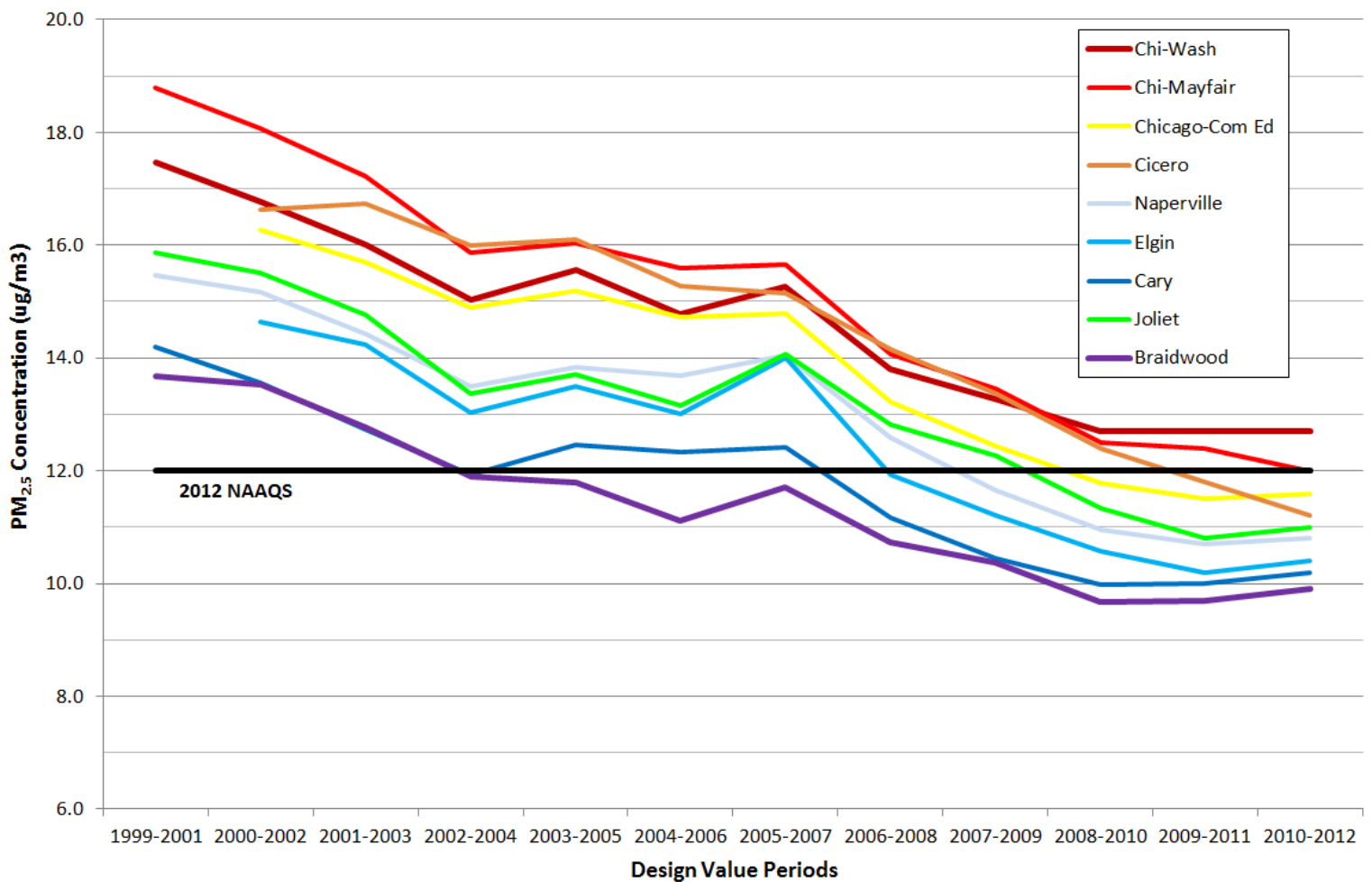
5 Designation Factors

(Weight of Evidence Approach)



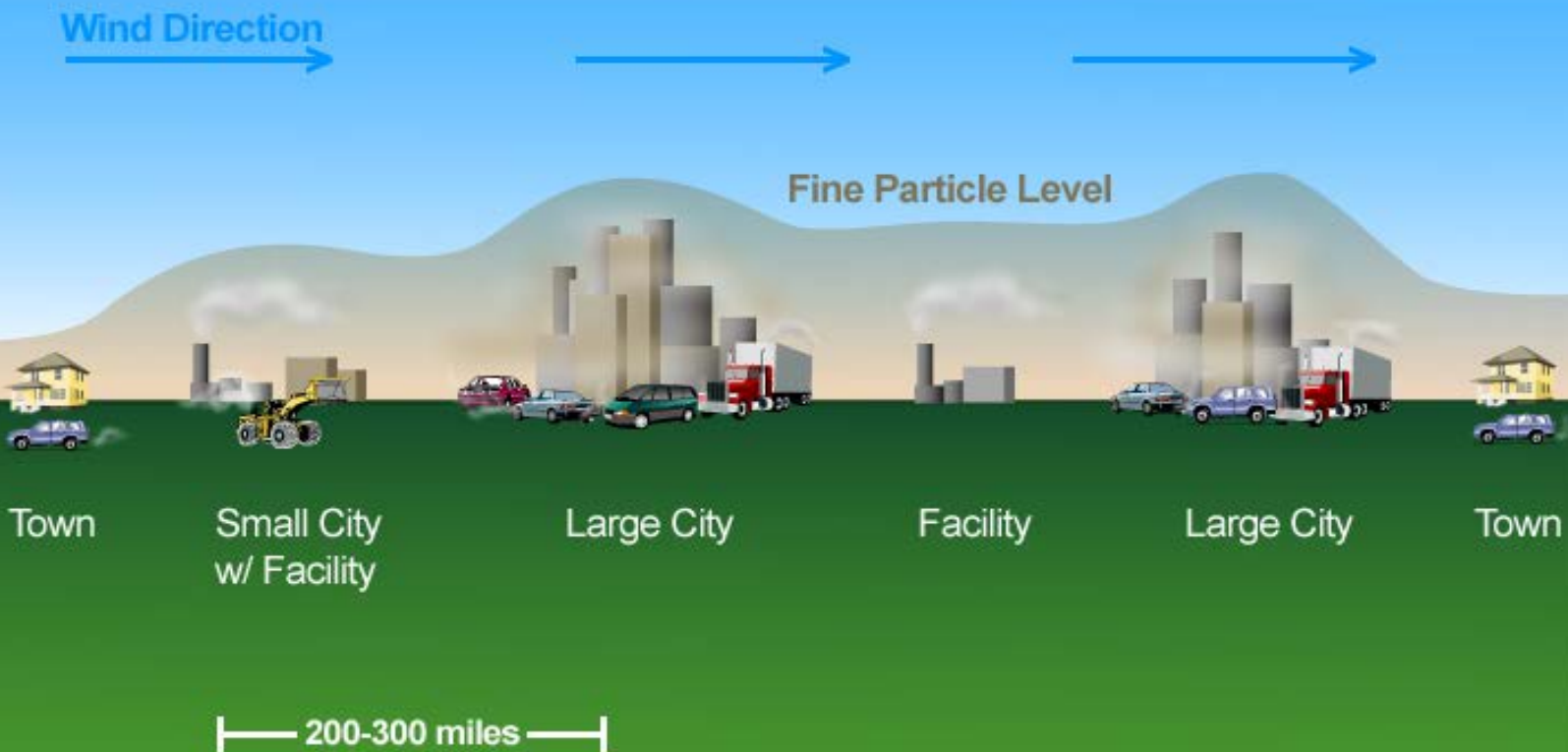
PM2.5 Trends by Monitor

Chicago Area Annual PM_{2.5} Design Value Trends (1999-2012)



Fine Particle Concentrations are Affected by Nearby Sources and Transported Emissions

Particles may be transported long distances and impact large numbers of people



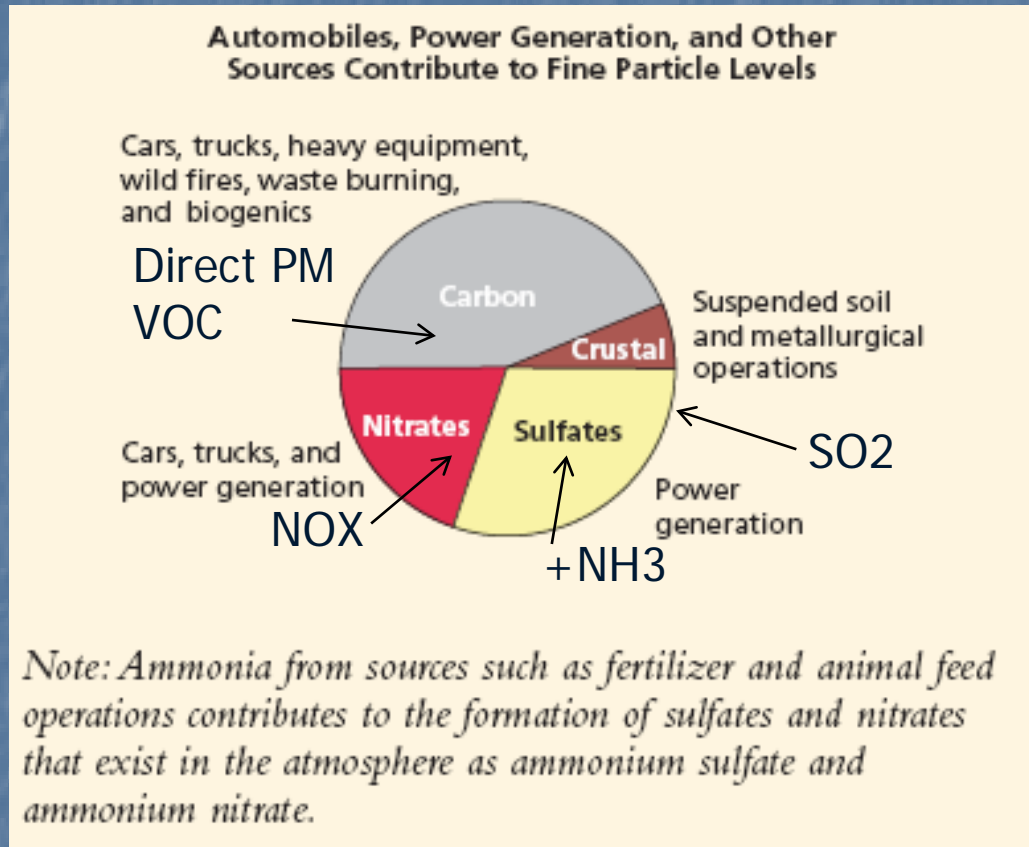
Analytical Challenge in the Designations Process:

- Identifying the nearby areas and sources that contribute to PM_{2.5} violations

What is the composition of PM2.5 and where does it come from?

Major Components

- Ammonium Sulfate
- Ammonium Nitrate
- Organic
- Carbonaceous Mass
- Elemental Carbon
- Crustal Material



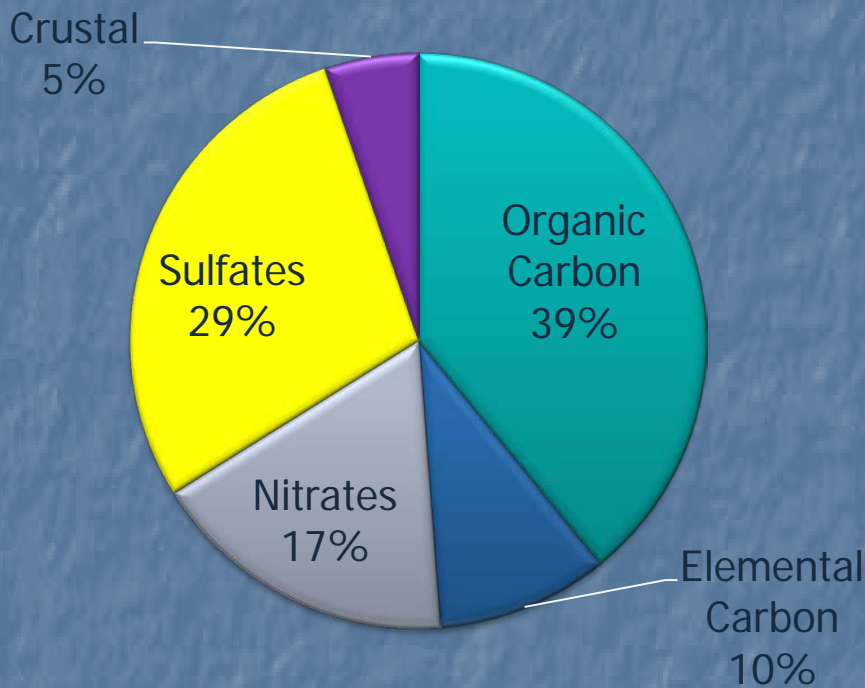
From: *The Particle Pollution Report: Current Understanding of Air Quality and Emissions through 2003*

The chemistry is complicated and particle formation is dependent on other pollutants and atmospheric conditions

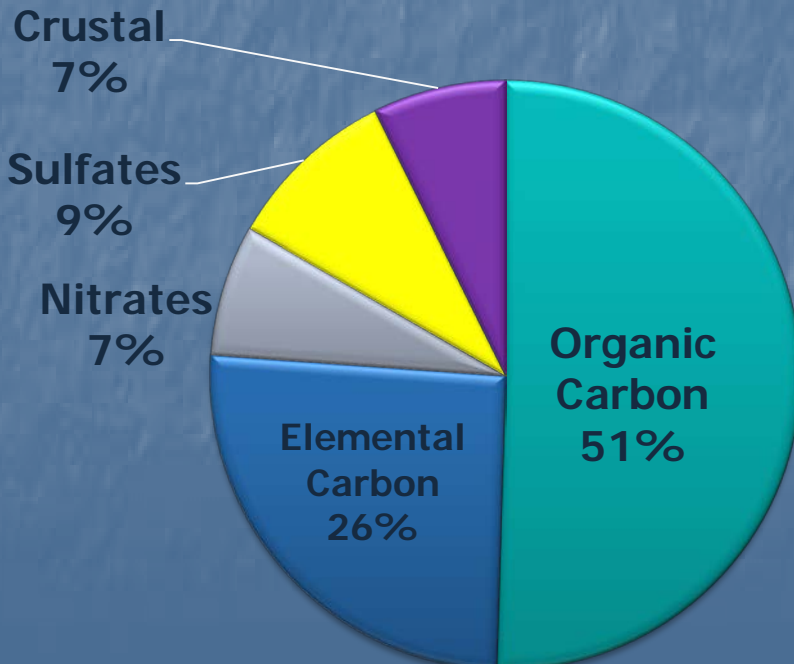
Urban Increment Analysis

Chicago Study Area – ComEd Monitor

Chicago PM2.5 Total Mass Annual (2010-2011)



Chicago PM2.5 Urban Increment Mass Annual (2010-2011)



- Goal is to estimate the local contribution to Urban PM2.5
- Total Mass = (Regional + Urban)
- Uses PM2.5 Compositional data
- PM2.5 Contributed by dominant nearby area emissions
- $\text{Urban PM2.5} - \text{Regional PM2.5} = \text{Background Concentrations}$

Emissions
&
Emissions
Related Data

Where are Emission Sources located?



Wood-Burning Stoves



Forest Fires



Heavy Duty Diesel Engines



Natural Sources

Particle pollution is a complex mixture derived from many sources



Cars and Trucks



Non-Road Vehicles



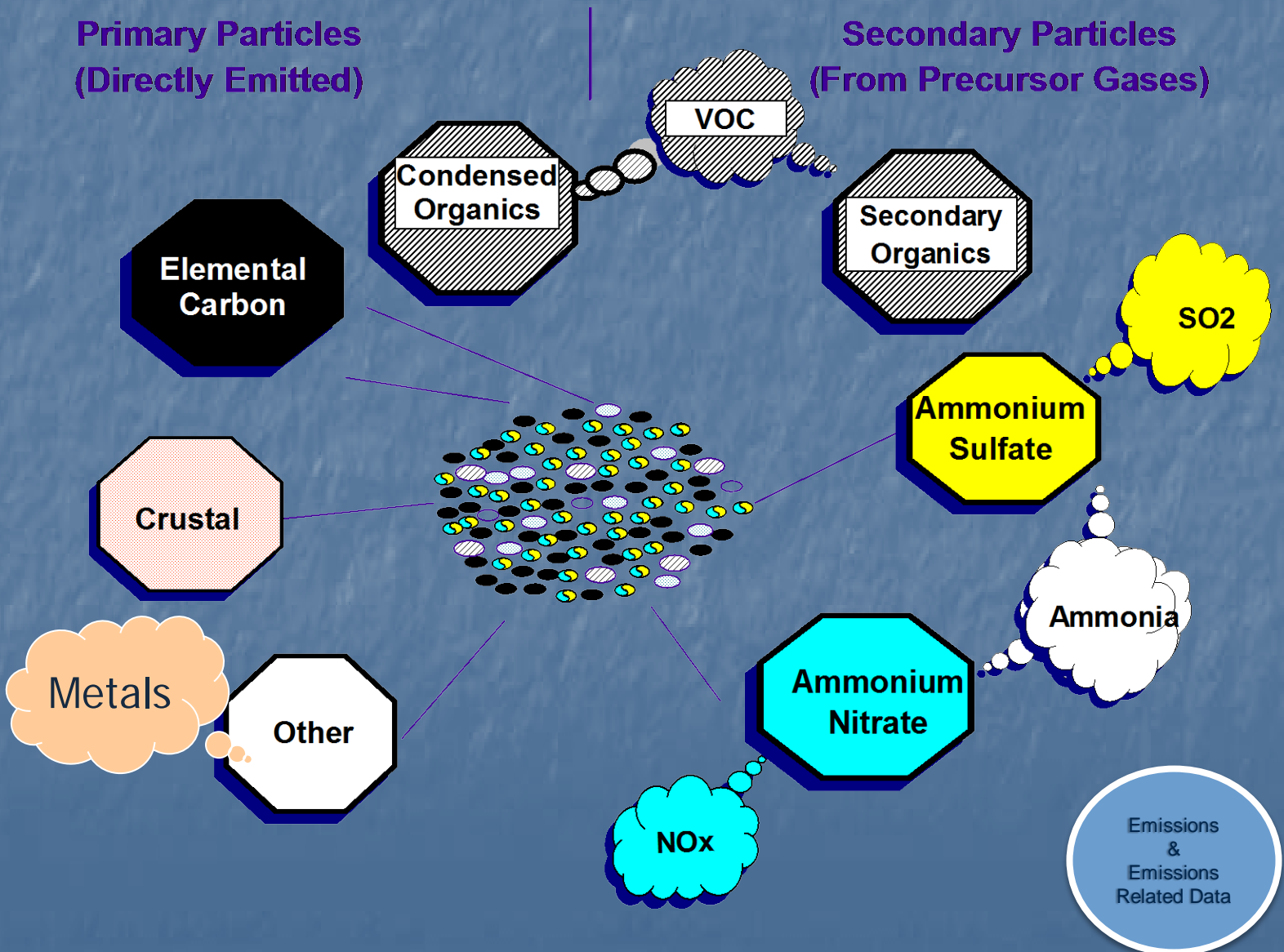
Leaf Burning



Industrial Sources

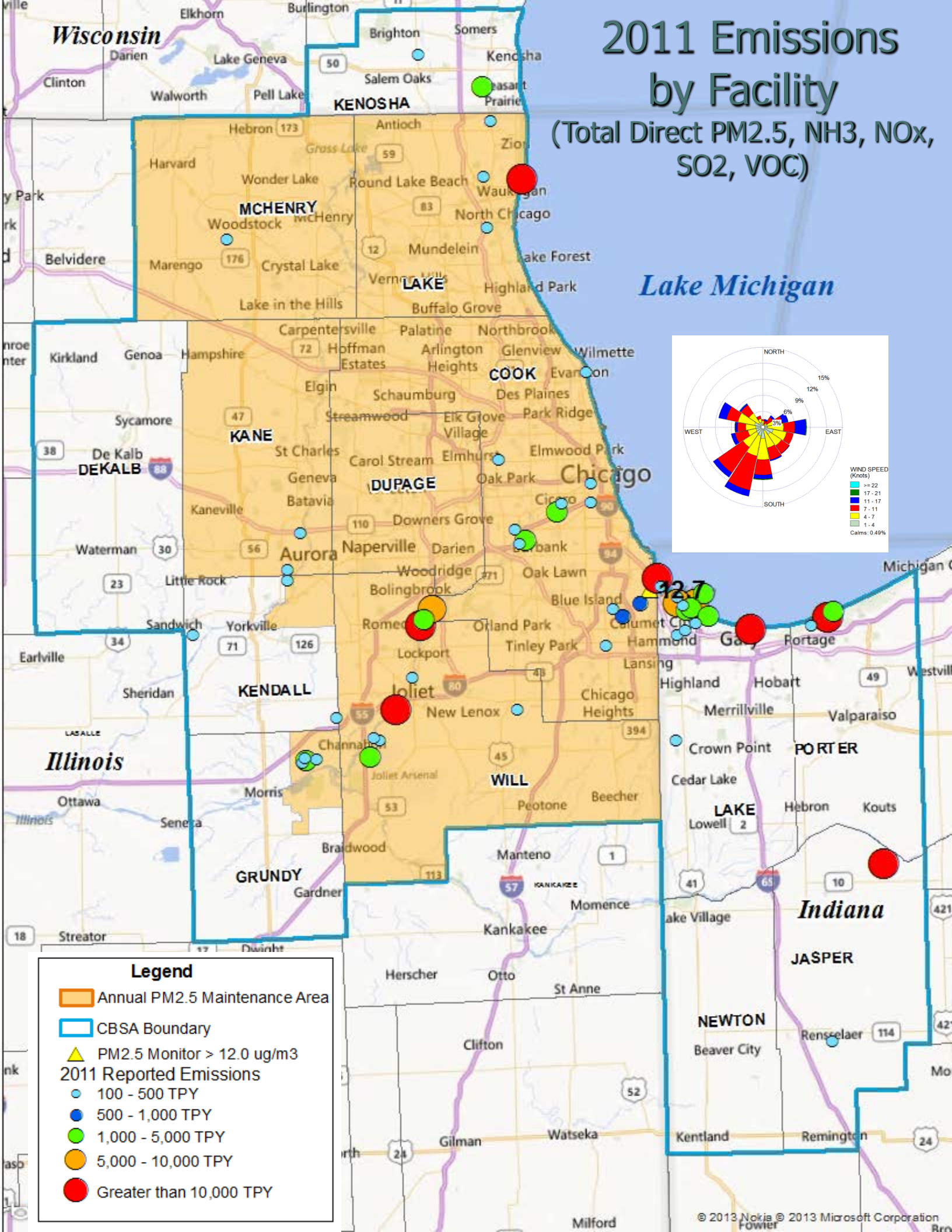
Emissions

- What are the emissions of Direct PM2.5 and Precursors from nearby contributing counties?
 - Precursor emissions include: NO_x, SO₂, VOC and NH₃ (2011 NEI Emissions)
 - PM2.5 in Ambient Air is a Complex Mixture

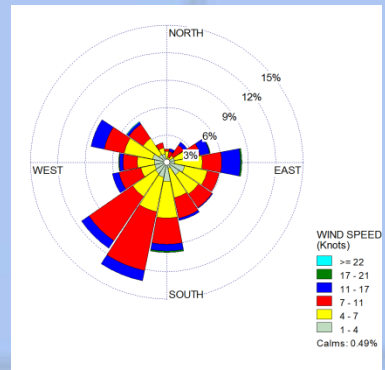


2011 Emissions by Facility

(Total Direct PM2.5, NH3, NOx, SO2, VOC)



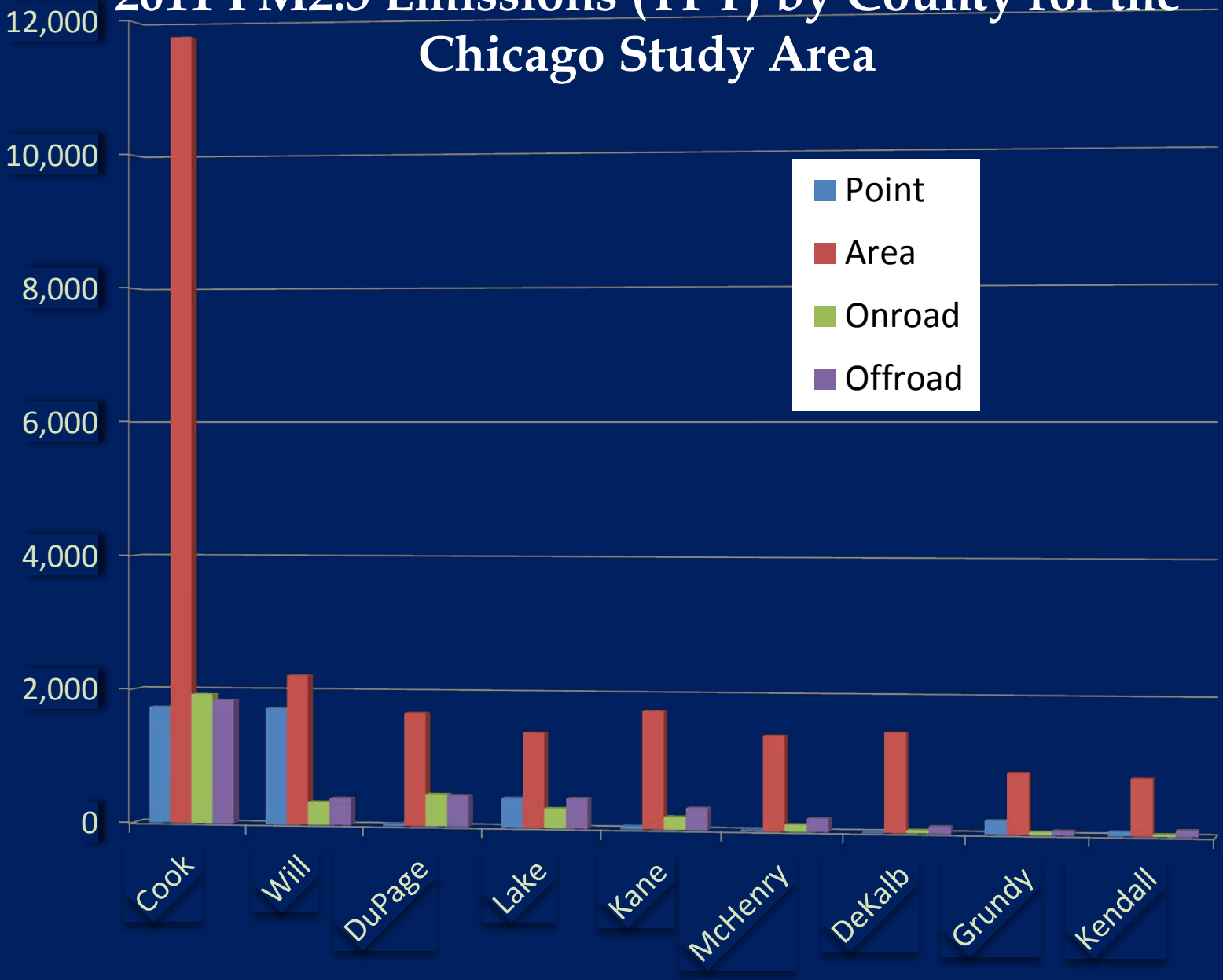
Lake Michigan



Legend

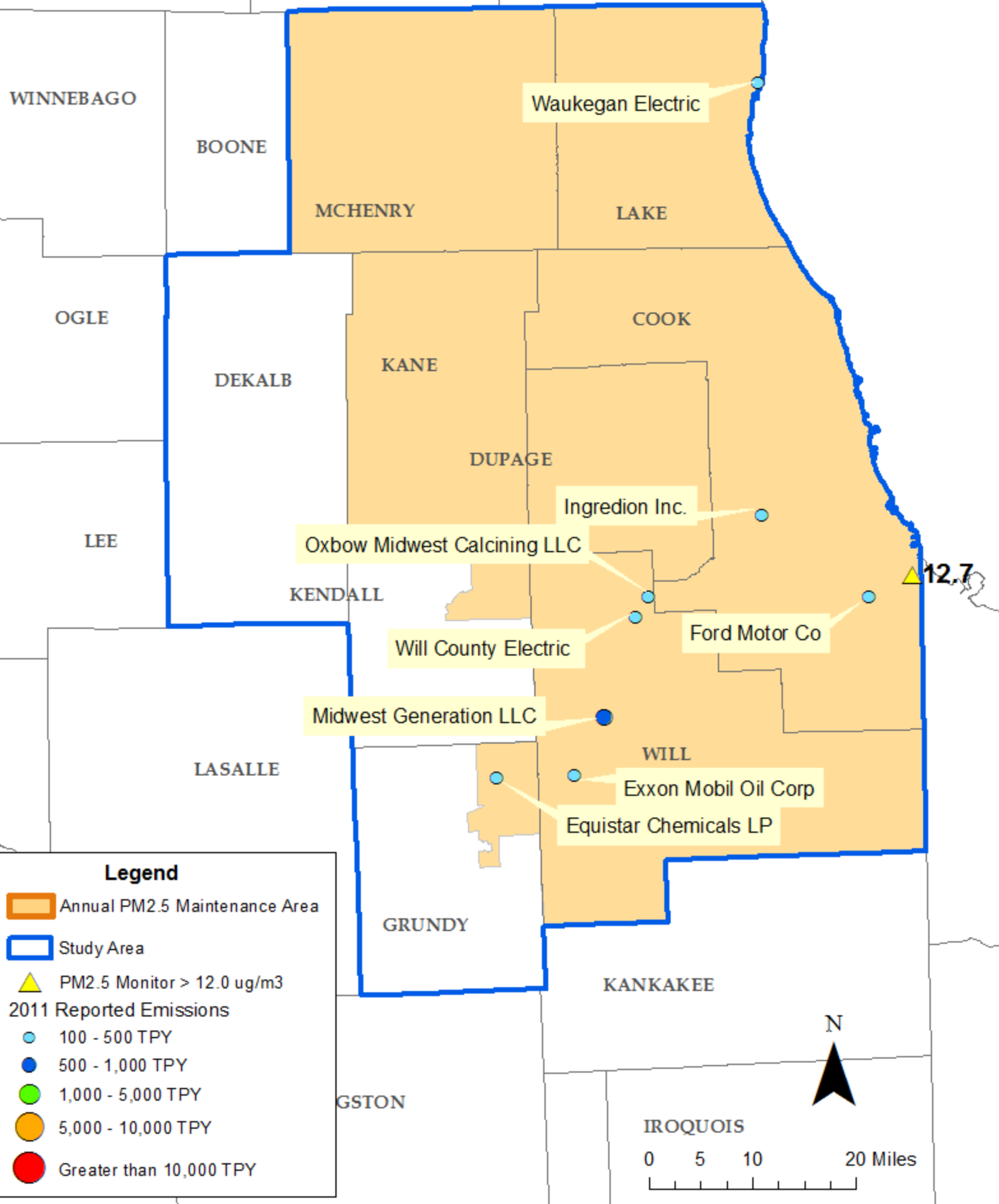
- Annual PM2.5 Maintenance Area
- CBSA Boundary
- PM2.5 Monitor > 12.0 ug/m3
- 2011 Reported Emissions**
- 100 - 500 TPY
- 500 - 1,000 TPY
- 1,000 - 5,000 TPY
- 5,000 - 10,000 TPY
- Greater than 10,000 TPY

2011 PM2.5 Emissions (TPY) by County for the Chicago Study Area

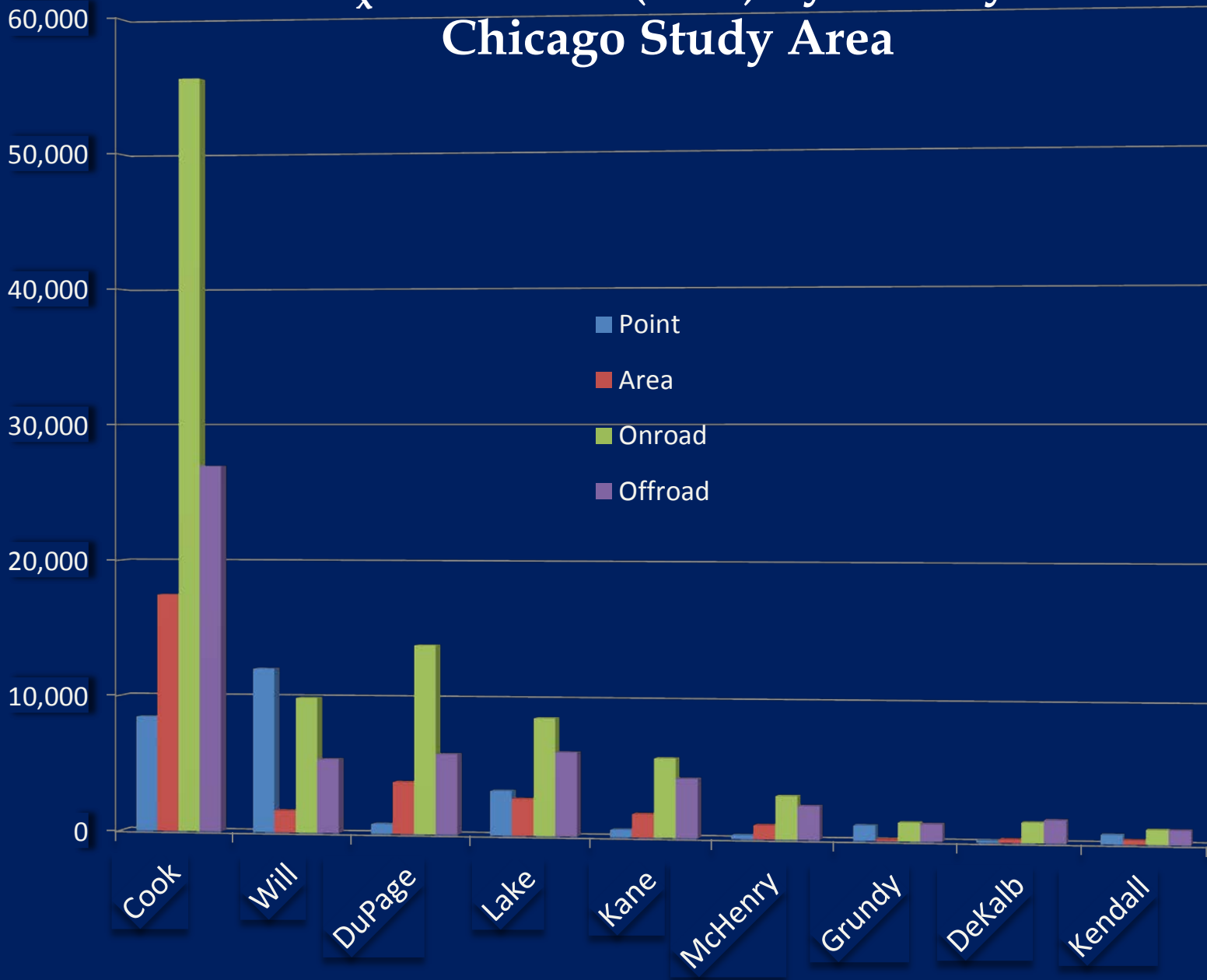


County	Point	Area	Onroad	Offroad	Total TPY
Cook	1,743.89	11,769.13	1,934.06	1,849.22	17,296.29
Will	1,735.00	2,228.48	342.26	404.71	4,710.46
DuPage	35.02	1,685.79	481.20	469.12	2,671.13
Lake	440.83	1,409.71	293.47	447.67	2,591.68
Kane	51.65	1,746.12	194.79	330.27	2,322.83
McHenry	16.77	1,406.65	103.58	200.78	1,727.77
DeKalb	15.18	1,470.27	48.23	108.20	1,641.88
Grundy	205.64	902.07	47.23	68.51	1,223.46
Kendall	68.01	841.90	35.12	99.79	1,044.81

Major Direct PM2.5 Point Sources

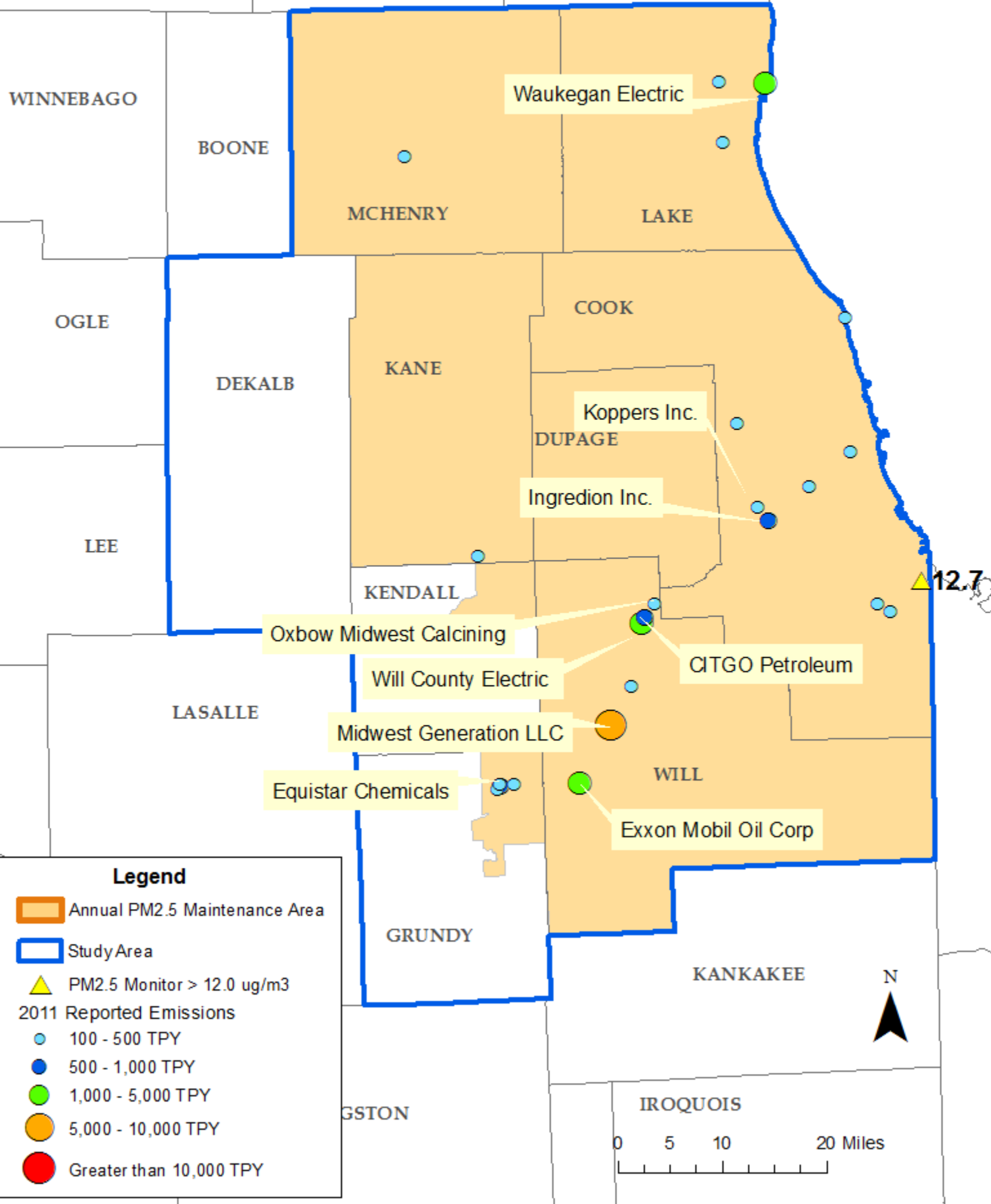


2011 NO_x Emissions (TPY) by County for the Chicago Study Area

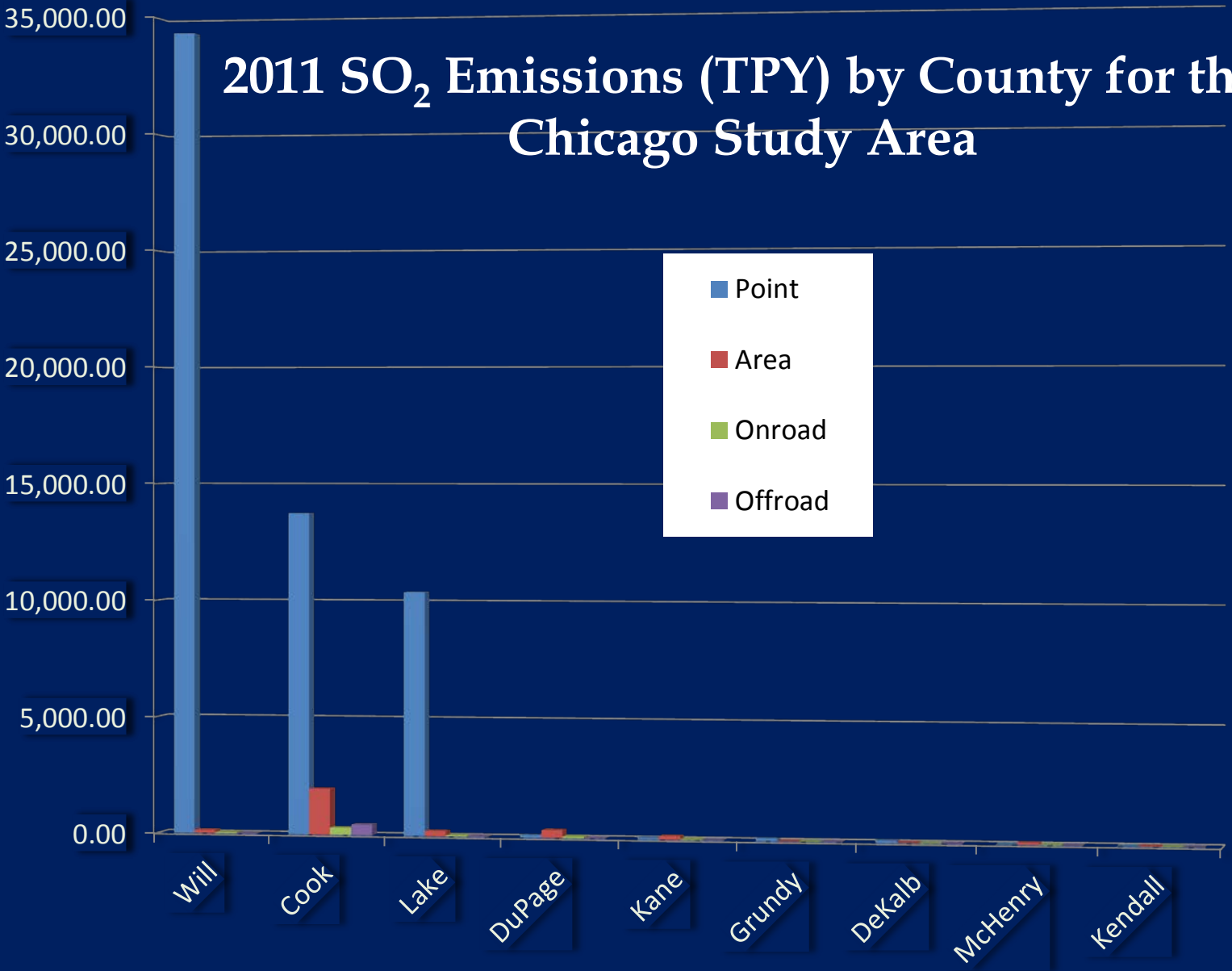


County	Point	Area	Onroad	Offroad	Total TPY
Cook	8,460.56	17,488.93	55,555.13	26,986.59	108,491.22
Will	12,064.39	1,625.83	9,936.91	5,447.06	29,074.20
DuPage	740.46	3,832.41	13,867.30	5,914.23	24,354.39
Lake	3,279.10	2,706.23	8,610.92	6,137.99	20,734.24
Kane	564.01	1,725.76	5,790.27	4,327.60	12,407.63
McHenry	288.67	1,033.07	3,161.54	2,465.88	6,949.17
Grundy	1,123.66	135.70	1,369.44	1,280.58	3,909.37
DeKalb	140.69	259.09	1,490.64	1,675.60	3,566.02
Kendall	695.29	319.95	1,078.86	1,064.27	3,158.37

Major NOx Point Sources

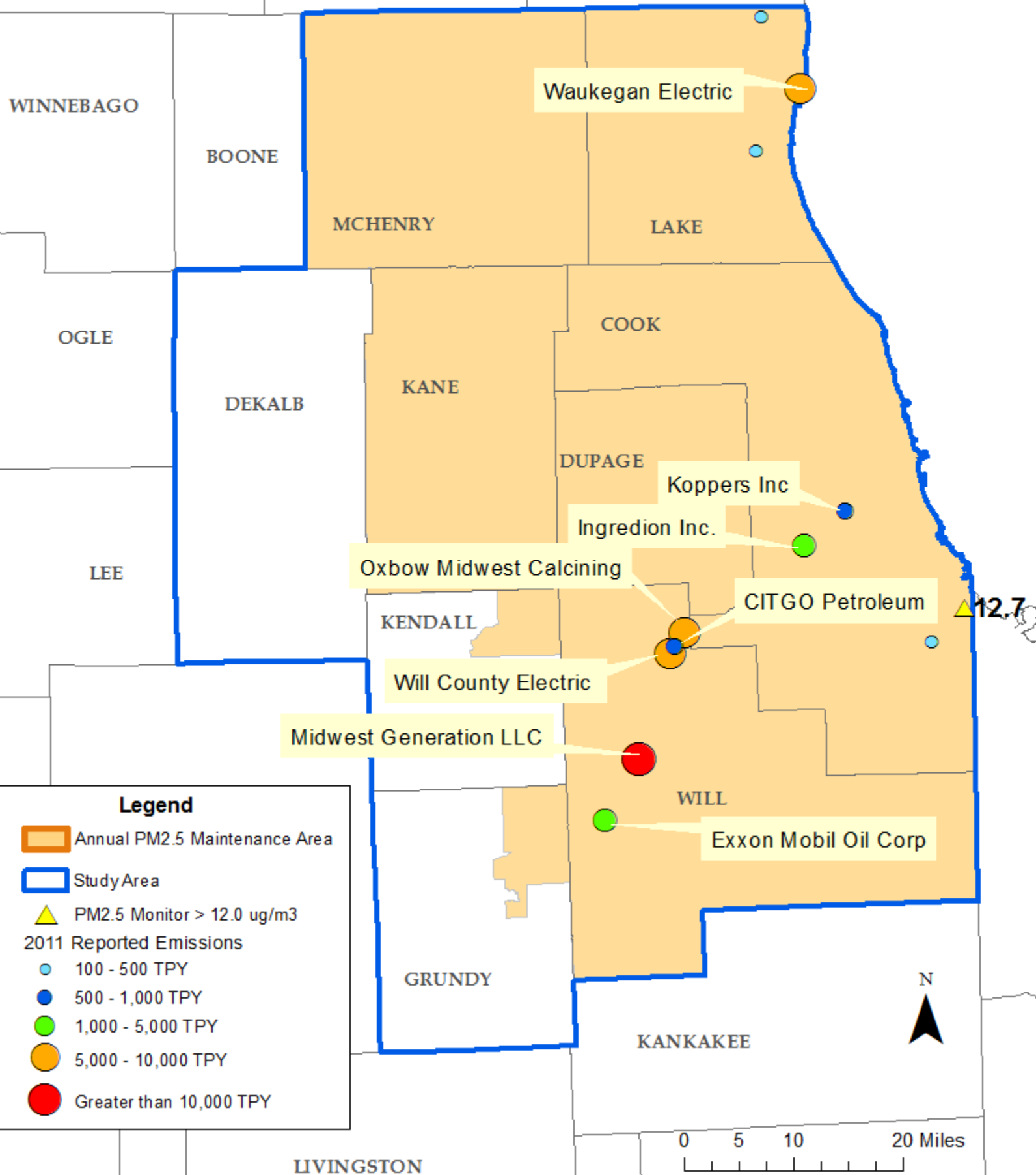


2011 SO₂ Emissions (TPY) by County for the Chicago Study Area

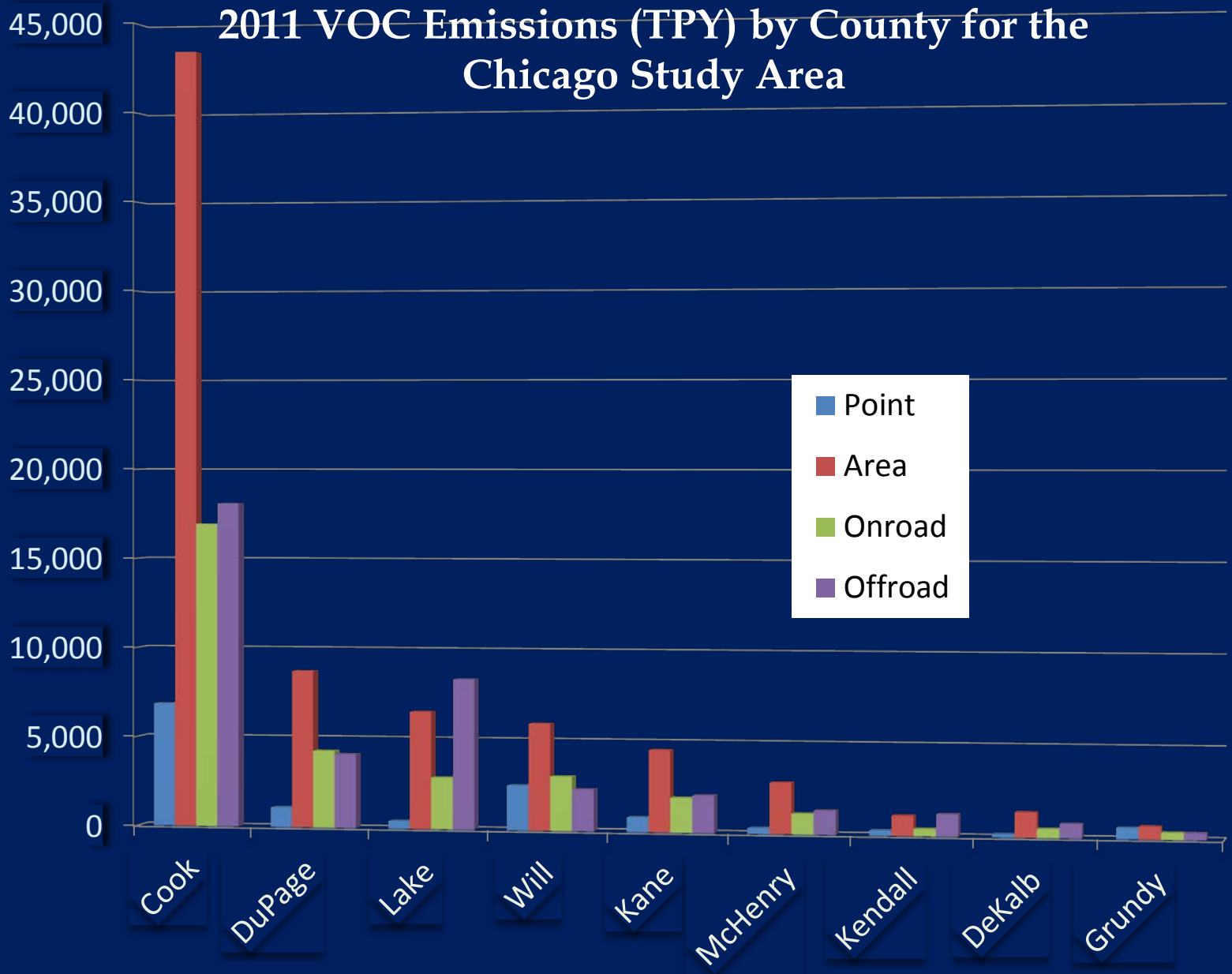


County	Point	Area	Onroad	Offroad	Total TPY
Will	34,355.57	144.75	55.32	24.73	34,580.37
Cook	13,755.87	1,971.47	317.21	463.15	16,507.69
Lake	10,399.29	233.12	53.71	42.46	10,728.58
DuPage	106.95	342.46	80.44	22.10	551.96
Kane	69.09	158.63	35.11	15.04	277.86
Grundy	106.14	12.78	7.03	22.36	148.31
DeKalb	90.25	30.01	8.87	10.23	139.36
McHenry	5.86	91.55	20.63	6.04	124.10
Kendall	12.82	27.97	7.47	3.61	51.87

Major SO₂ Point Sources

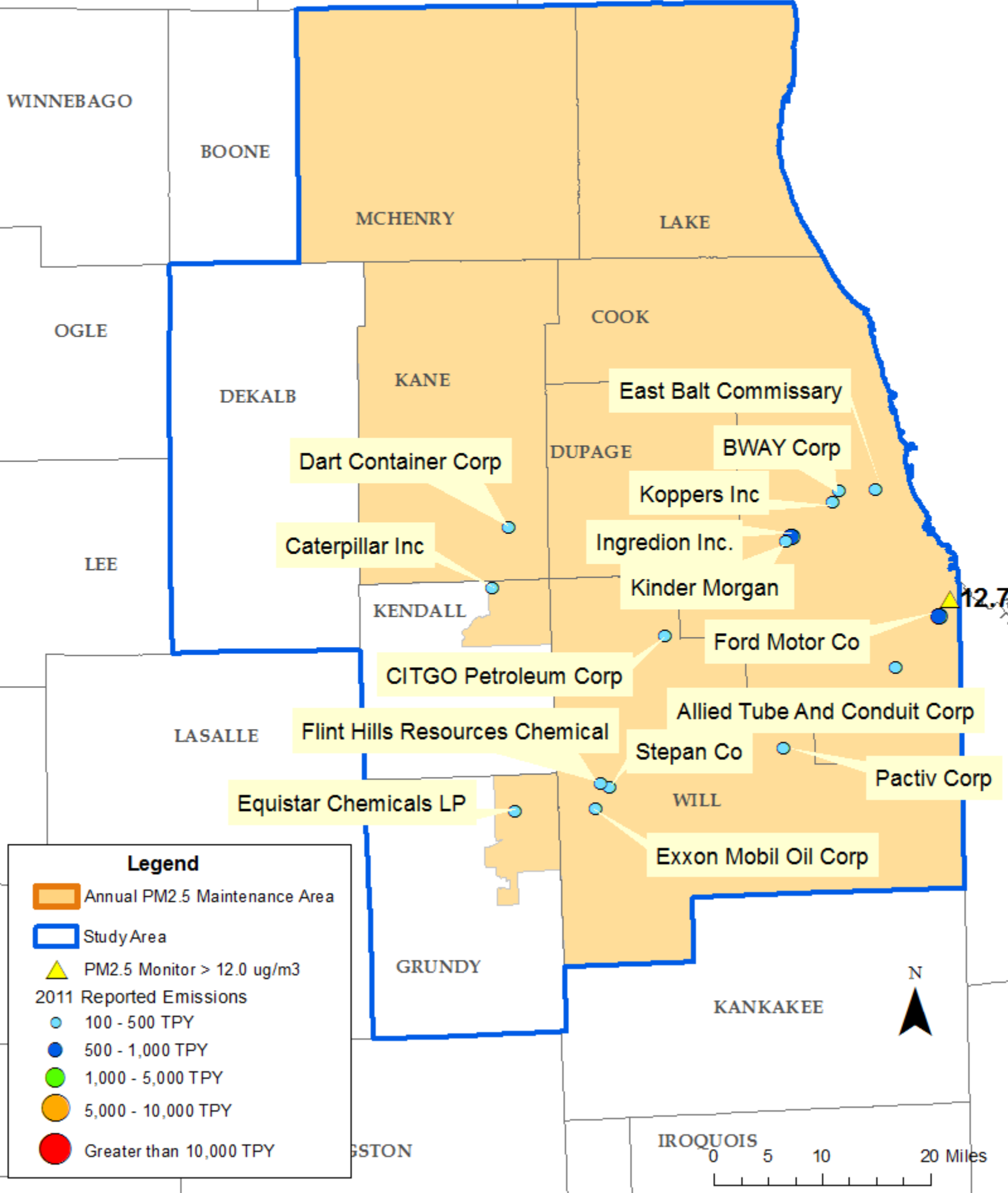


2011 VOC Emissions (TPY) by County for the Chicago Study Area

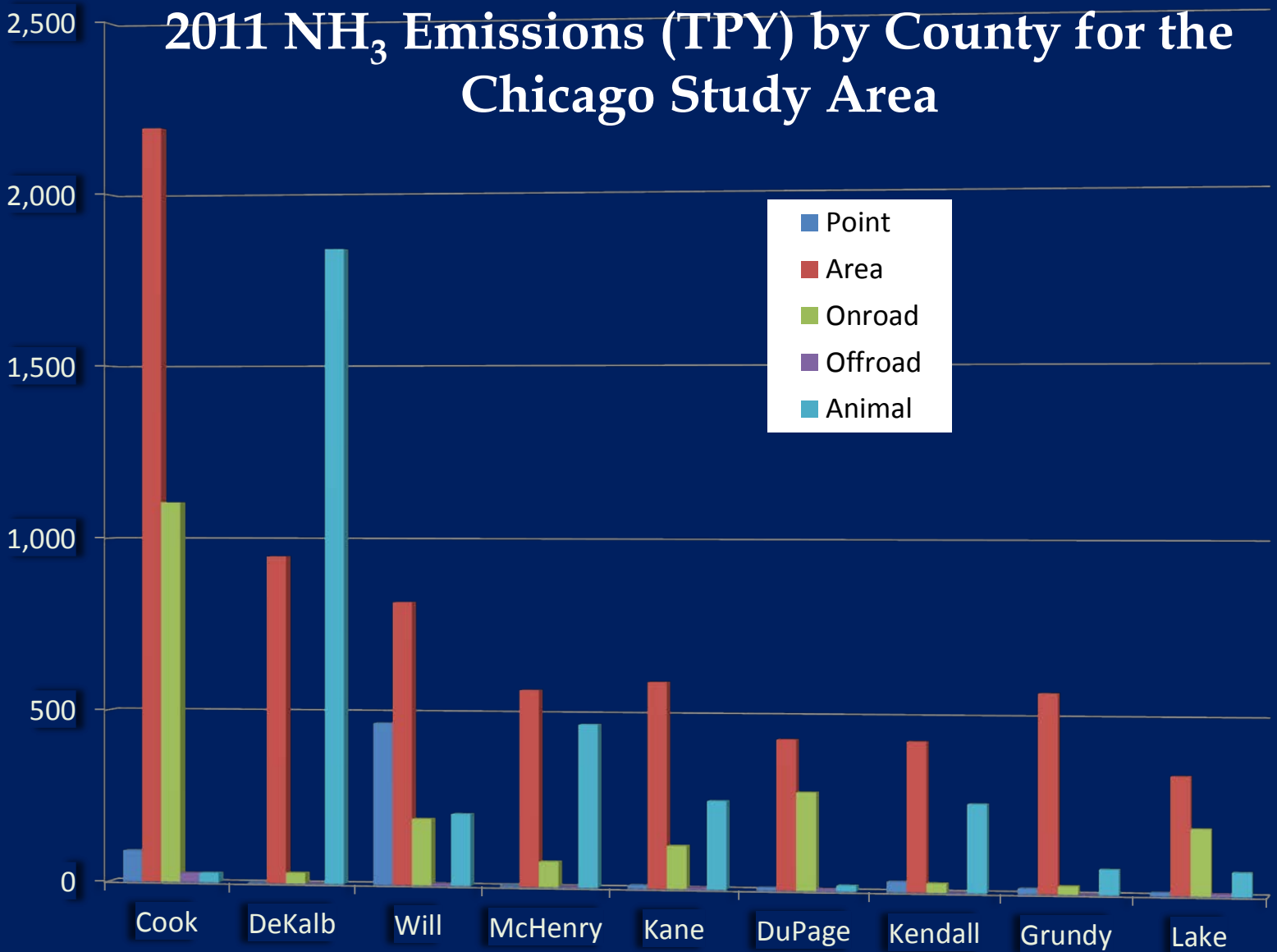


County	Point	Area	Onroad	Offroad	Total TPY
Cook	6,870.21	43,433.11	16,946.52	18,110.61	85,360.44
DuPage	1,115.51	8,749.86	4,300.47	4,125.90	18,291.74
Lake	445.49	6,532.99	2,886.29	8,360.71	18,225.48
Will	2,510.15	5,945.78	3,026.23	2,326.88	13,809.04
Kane	834.68	4,559.20	1,935.77	2,082.71	9,412.35
McHenry	336.06	2,845.07	1,150.48	1,343.94	5,675.54
Kendall	302.04	1,122.74	407.79	1,230.12	3,062.68
DeKalb	188.86	1,393.00	503.26	794.68	2,879.80
Grundy	626.53	715.83	393.92	389.48	2,125.75

Major VOC Point Sources

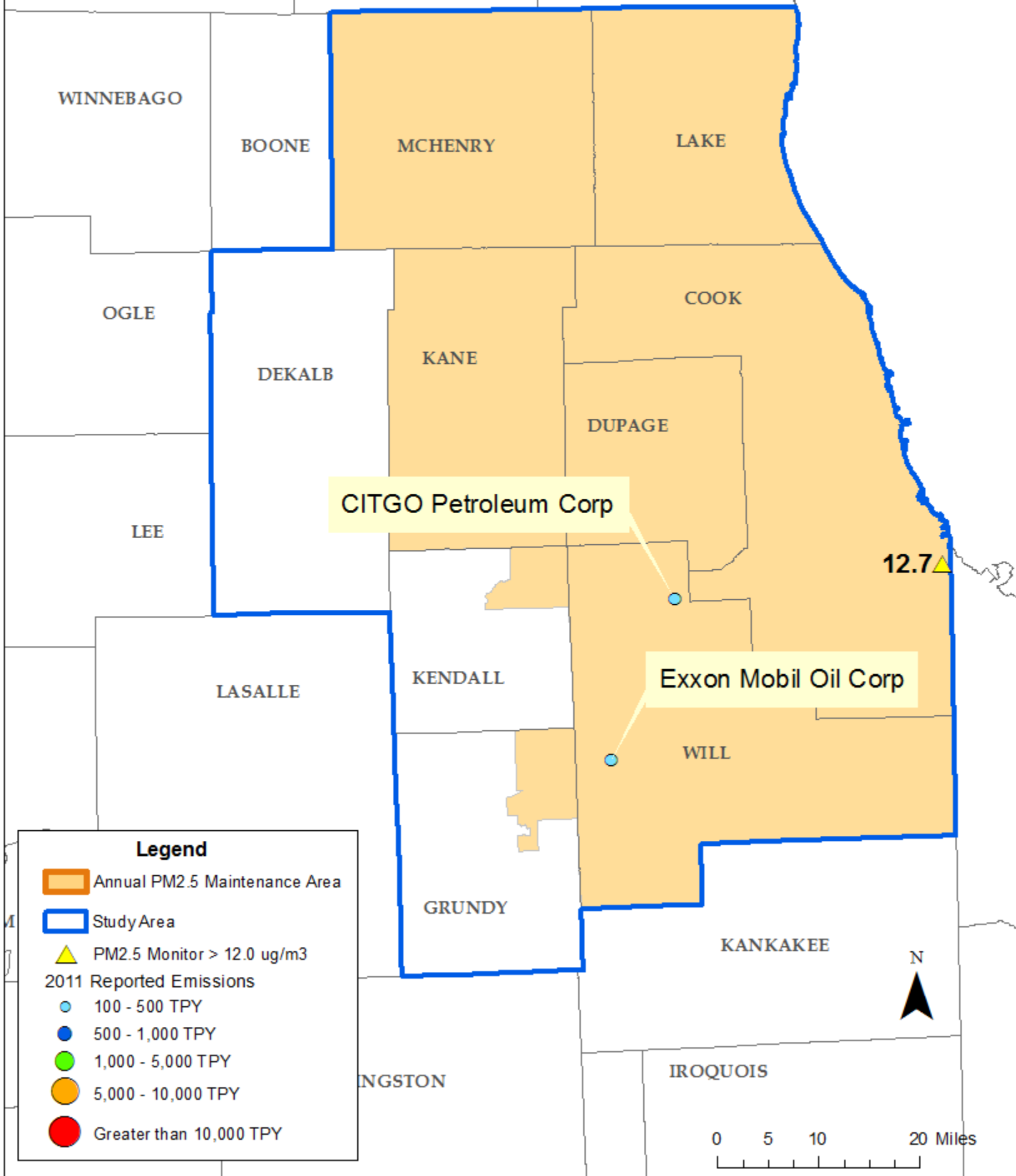


2011 NH₃ Emissions (TPY) by County for the Chicago Study Area



County	Point	Area	Onroad	Offroad	Animal	Total TPY
Cook	91.08	2,193.46	1,105.33	27.40	28.02	3,445.30
DeKalb	1.57	948.79	31.39	1.42	1,838.13	2,821.29
Will	468.35	817.69	192.34	6.02	208.02	1,692.42
McHenry	3.28	566.33	73.77	2.92	469.13	1,115.43
Kane	10.29	592.26	123.95	4.87	253.86	985.24
DuPage	8.46	431.31	281.09	7.19	17.35	745.40
Kendall	30.50	428.90	26.96	1.33	253.14	740.79
Grundy	16.58	568.39	24.12	0.95	72.59	682.62
Lake	10.02	337.22	190.02	7.88	68.74	613.89

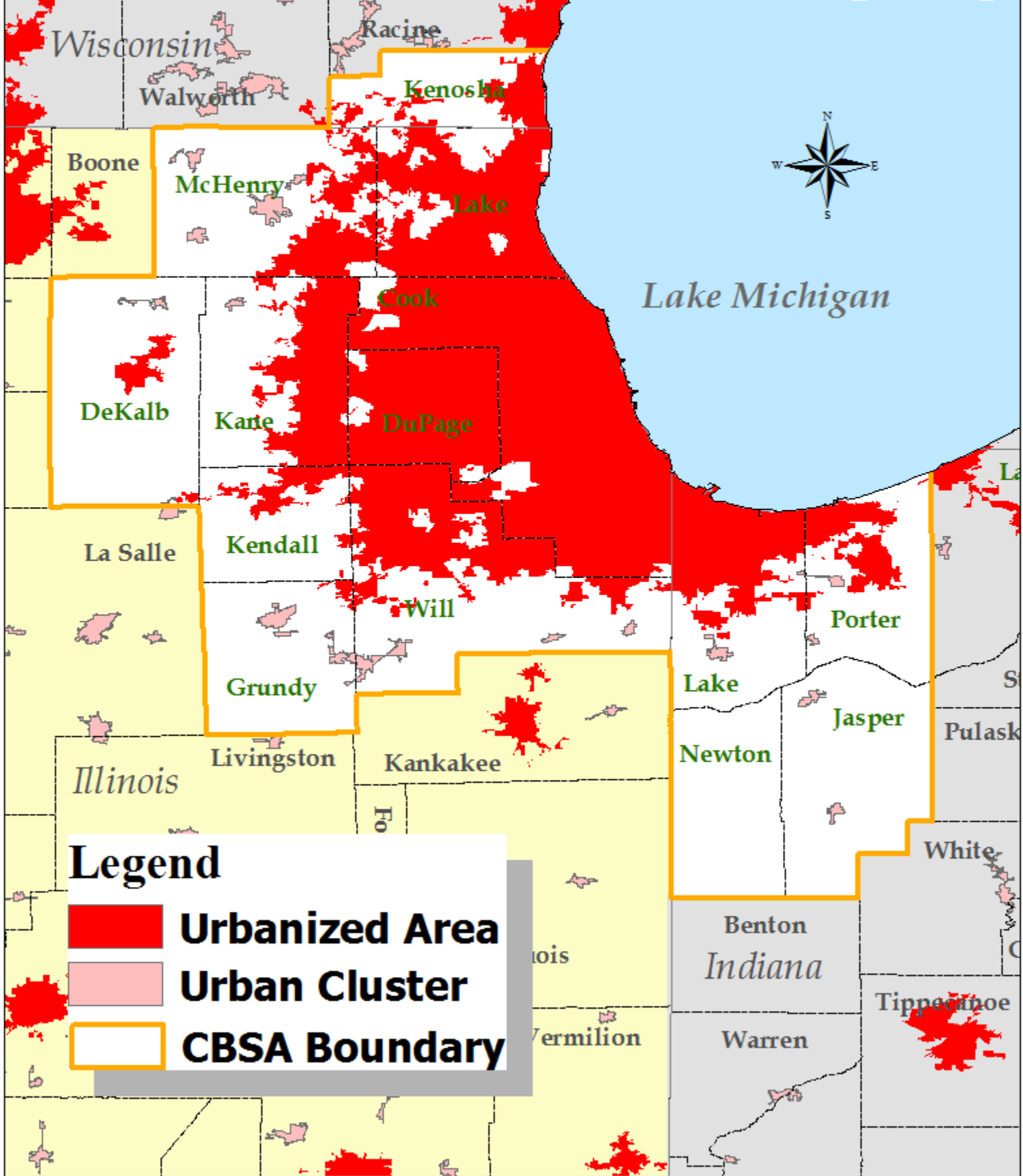
Major NH3 Point Sources



Emission Related Data

- What type of Area is it?
 - Large Metropolitan Area
 - How many counties make up the Study Area?
 - Metropolitan Statistical Area (MSA)
 - Core Based Statistical Area (CBSA)
 - How do the counties in the study area compare in terms of emissions related data
 - Population Density and Degree of Urbanization
 - Traffic and Commuting Patterns

Urban Areas within Chicago-Naperville-Elgin IL-IN-WI Core Based Statistical Area (CBSA)

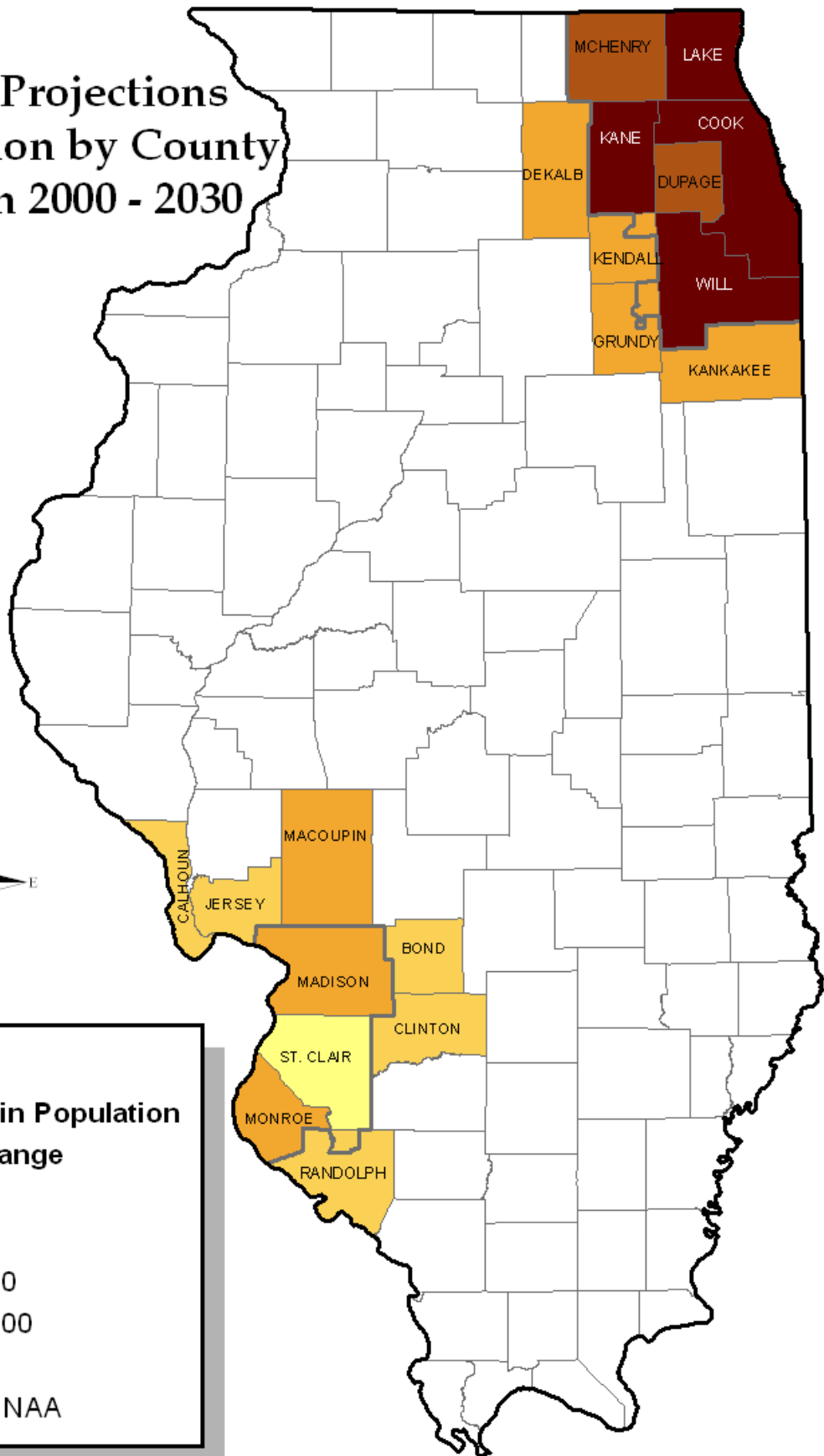


Population Statistics 2010/2012

State	County	2010 Population	Land Area (Sq. Miles)	Population Density (Persons per sq. mile)	Percent of CBSA	Cumulative Percent
IL	Cook	5,194,675	946	5491	54.9%	54.9%
IL	DuPage	916,924	334	2745	9.7%	64.6%
IL	Lake	703,462	448	1570	7.4%	72.0%
IL	Will	677,660	837	810	7.2%	79.2%
IL	Kane	515,269	520	991	5.4%	84.6%
IN	Lake	496,005	497	998	5.2%	89.9%
IL	McHenry	308,760	604	511	3.3%	93.1%
WI	Kenosha	166,426	273	610	1.8%	94.9%
IN	Porter	164,343	418	393	1.7%	96.6%
IL	Kendall	114,736	321	357	1.2%	97.9%
IL	DeKalb	105,160	634	166	1.1%	99.0%
IL	Grundy	50,063	420	119	0.5%	99.5%
IN	Jasper	33,478	560	60	0.4%	99.8%
IN	Newton	14,244	402	35	0.2%	100.0%

County	2012 Population	Land Area (Sq. Miles)	Population Density (Persons per sq. mile)	Percent of Study Area	Cumulative Percent	Rank
Cook	5,231,351	946	5,530	60.5%	60.5%	1
DuPage	927,987	334	2,778	10.7%	71.2%	2
Lake	702,120	448	1,567	8.1%	79.3%	3
Will	682,518	837	815	7.9%	87.2%	4
Kane	522,487	520	1,005	6.0%	93.3%	5
McHenry	308,145	604	510	3.6%	96.8%	6
Kendall	118,105	321	368	1.4%	98.2%	7
DeKalb	104,704	634	165	1.2%	99.4%	8
Grundy	50,281	420	120	0.6%	100.0%	9

Population Projections Total Population by County Change from 2000 - 2030



Legend

Projected Change in Population Net Population Change

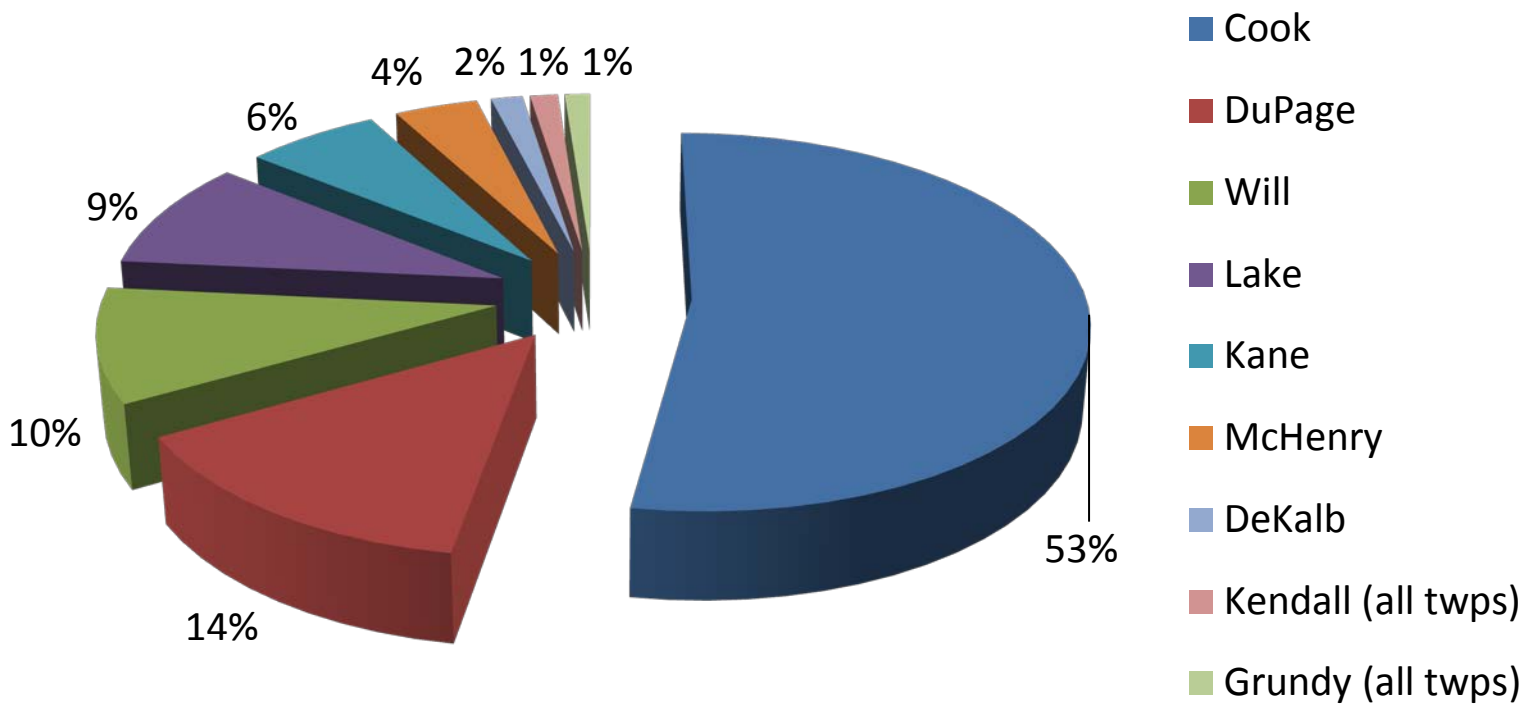
- Loss > 10,000
- 1 - 10,000
- 10,000 - 50,000
- 50,000 - 200,000
- > 200,000
- Annual PM2.5 NAA

Illinois Travel Statistics 2012

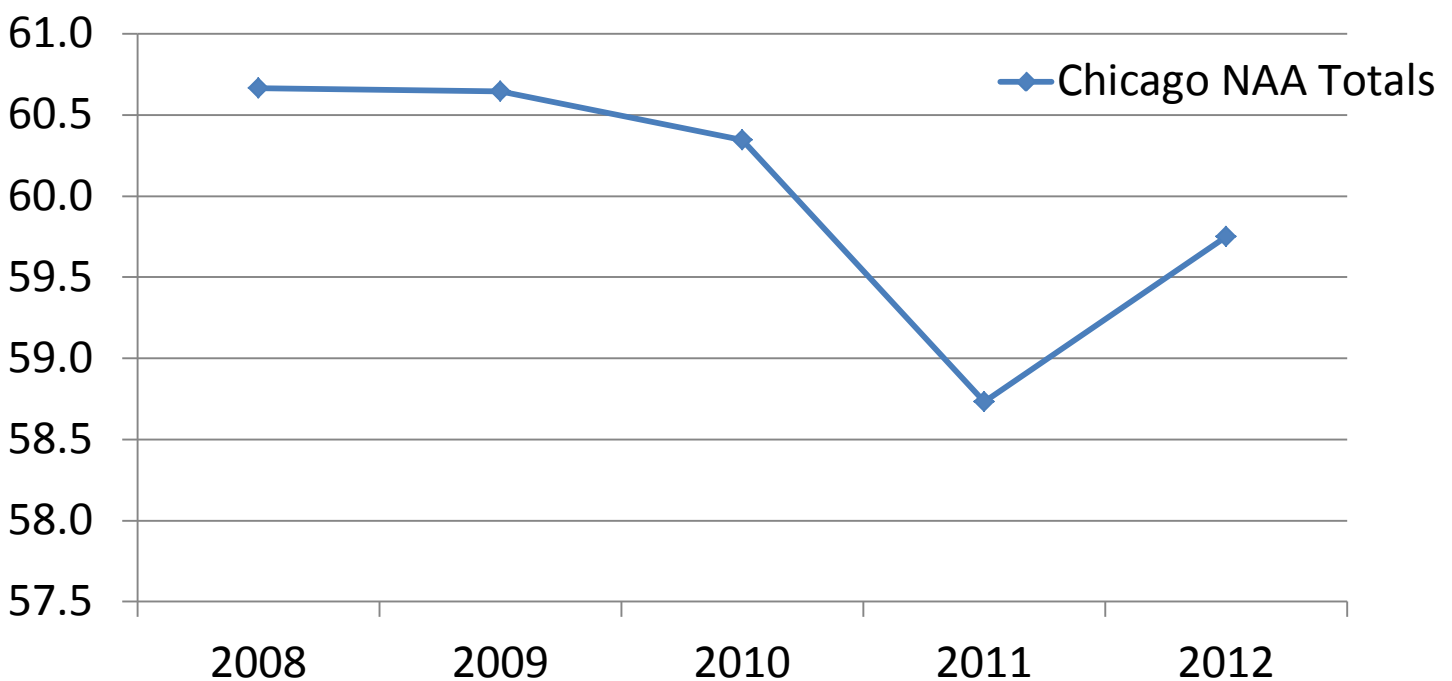
Chicago Study Area

Chicago Study Area	Annual Vehicle Miles Traveled (AVMT)
Cook	31,469,507,574
DuPage	8,424,261,955
Lake	5,836,451,375
Will	5,535,302,694
Kane	3,768,290,193
McHenry	2,341,490,195
DeKalb	888,587,200
Kendall	777,264,522
Oswego	279,815,228
Grundy	710,224,716
Aux Sable Township	152,698,314
Goose Lake Township	24,857,865

Percent by County - Annual VMT in the Chicago Study Area



Chicago NAA Totals (AVMT in Billions)

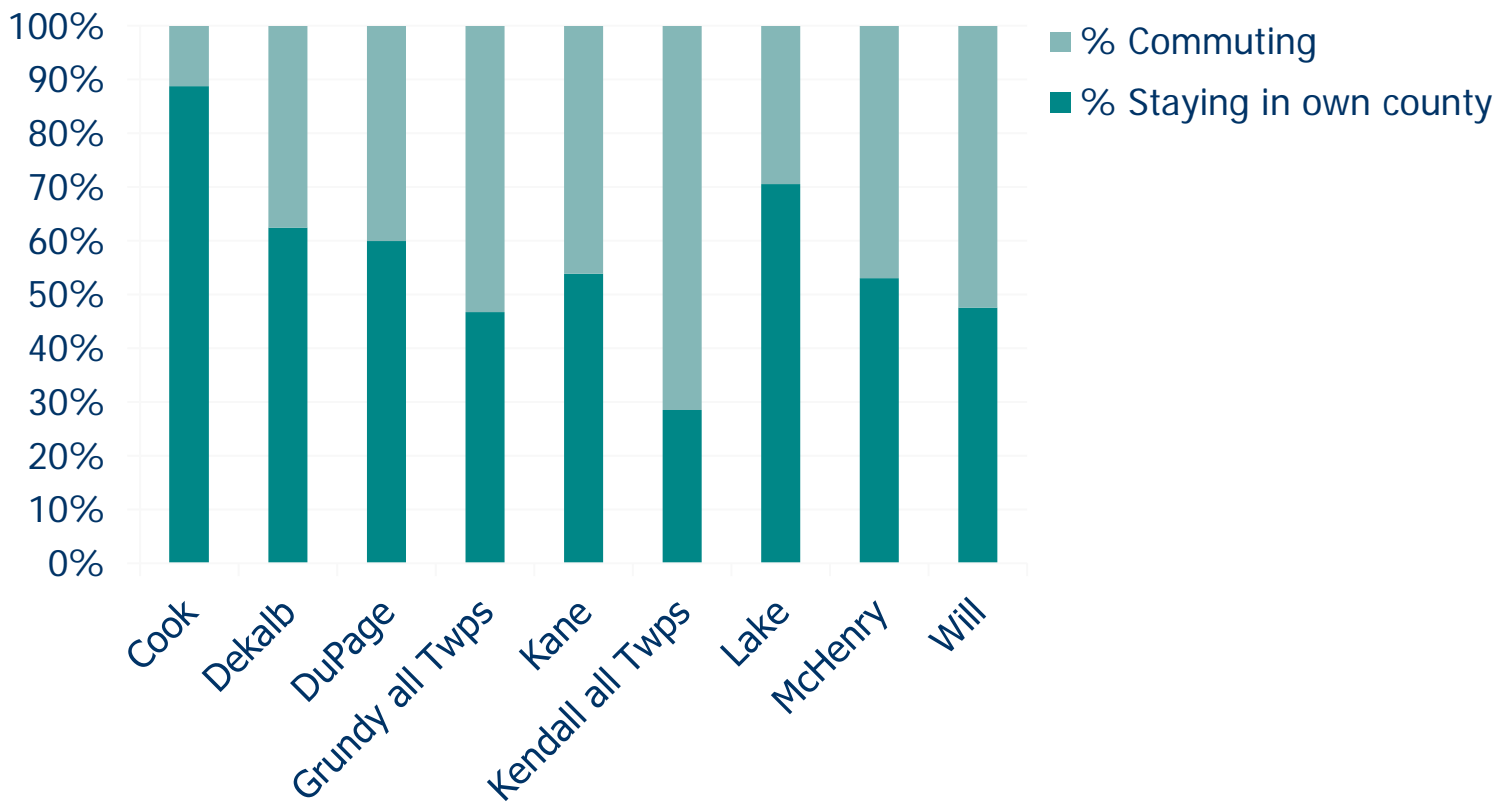


Residence County to Workplace Statistics

Chicago Study Area

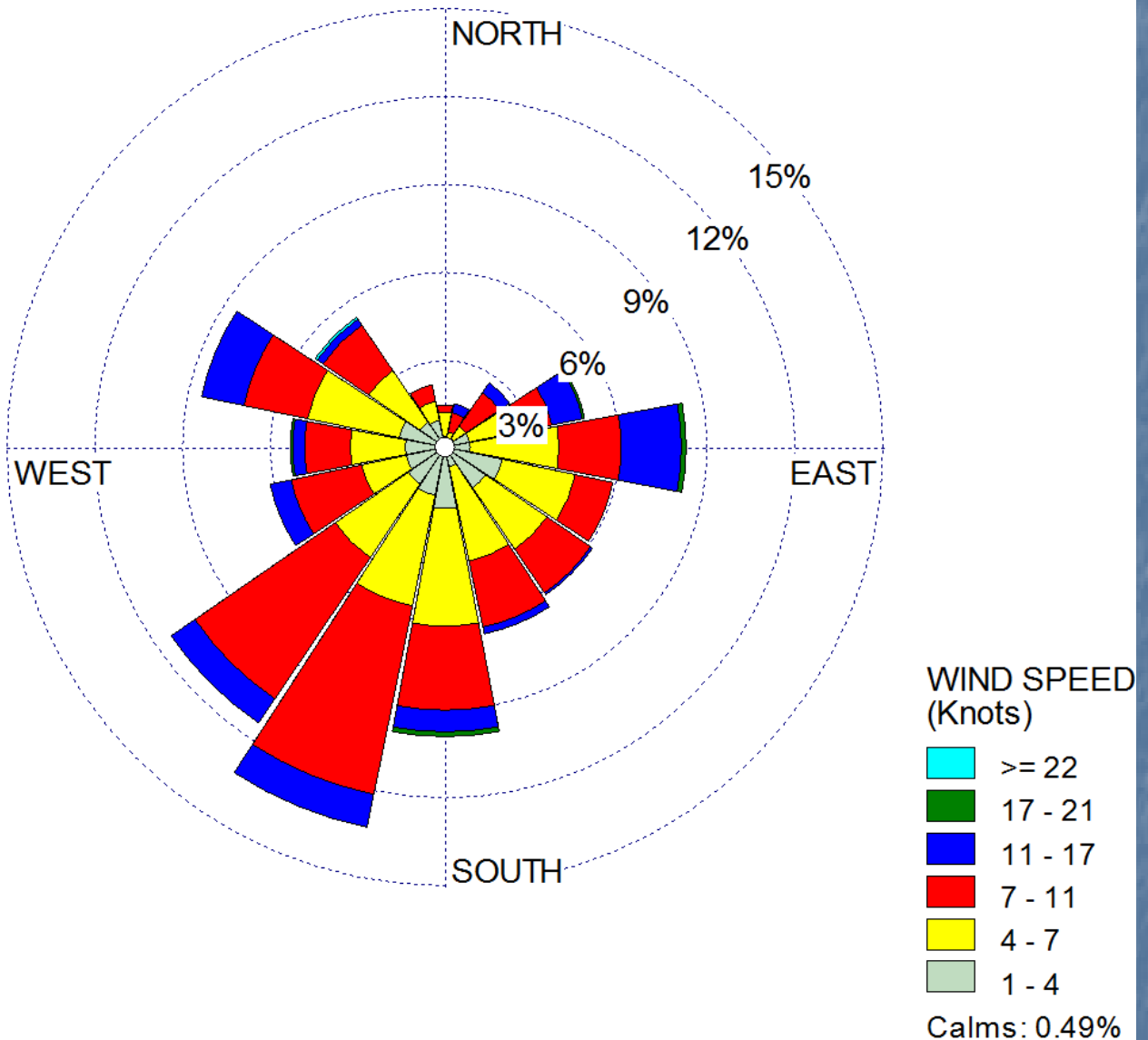
RESIDENCE COUNTY	% Staying in own County	% Commuting
Cook	88.8%	11.2%
Dekalb	62.5%	37.5%
DuPage	59.9%	40.1%
Grundy all Twps	46.8%	53.2%
Kane	54.0%	46.0%
Kendall all Twps	28.5%	71.5%
Lake	70.6%	29.4%
McHenry	53.1%	46.9%
Will	47.6%	52.4%

Total 2006-2010 Commuting Patterns within Chicago Study Area

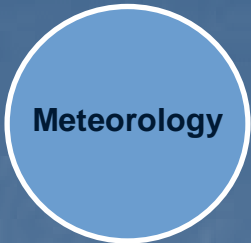


Chicago Study Area High Days Pollution Rose for Washington H.S. 2010 - 2012 Days > 15 ug/m3

Meteorology



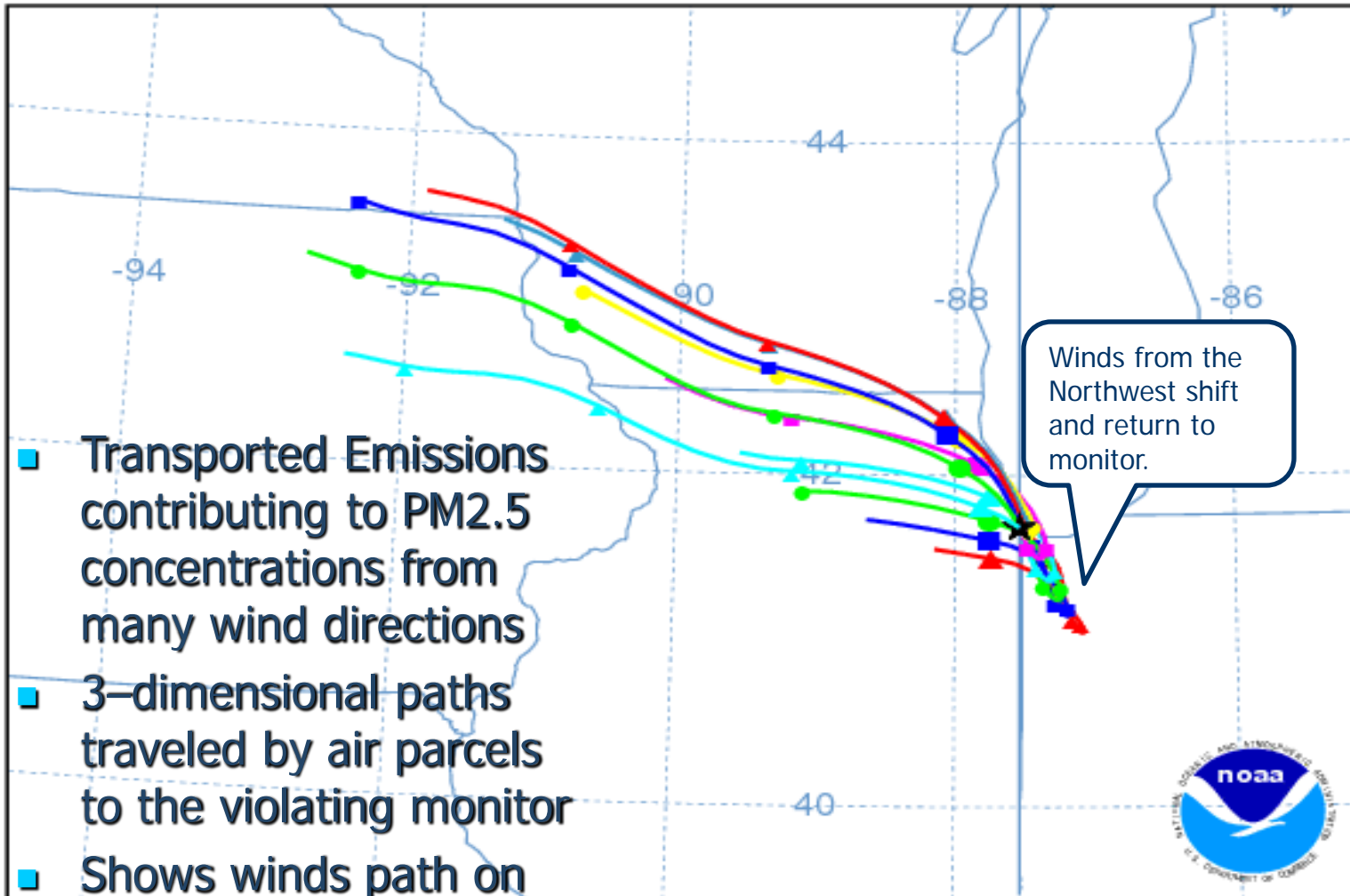
- Typical Wind Patterns
 - Percentage of time the wind blew from each direction on days when PM_{2.5} concentrations were > 15 ug/m³



HYSPLIT Trajectory Paths

NOAA HYSPLIT MODEL
Backward trajectories ending at 2200 UTC 01 Feb 10
EDAS Meteorological Data

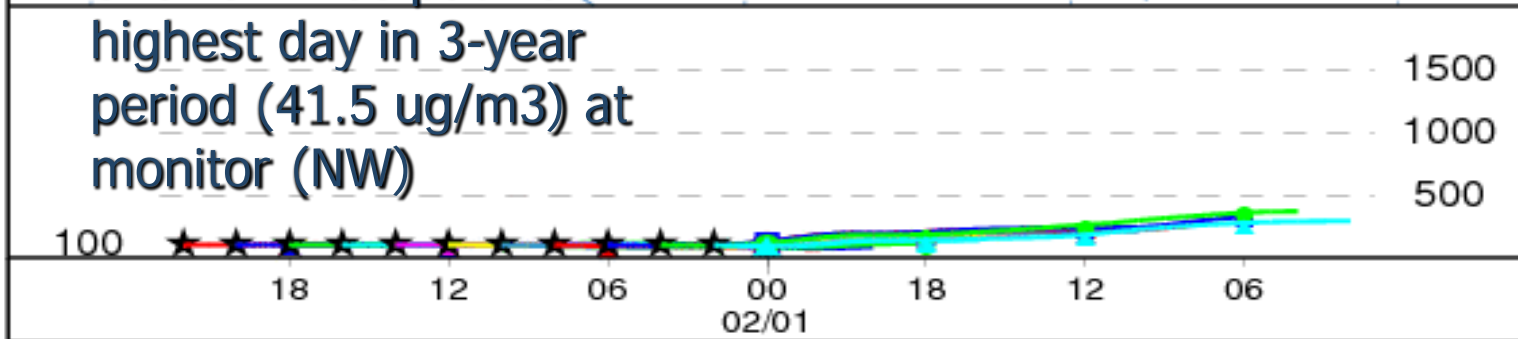
Source ★ at 41.69 N 87.54 W



- Transported Emissions contributing to PM2.5 concentrations from many wind directions
- 3-dimensional paths traveled by air parcels to the violating monitor
- Shows winds path on highest day in 3-year period (41.5 ug/m3) at monitor (NW)



Meters AGL



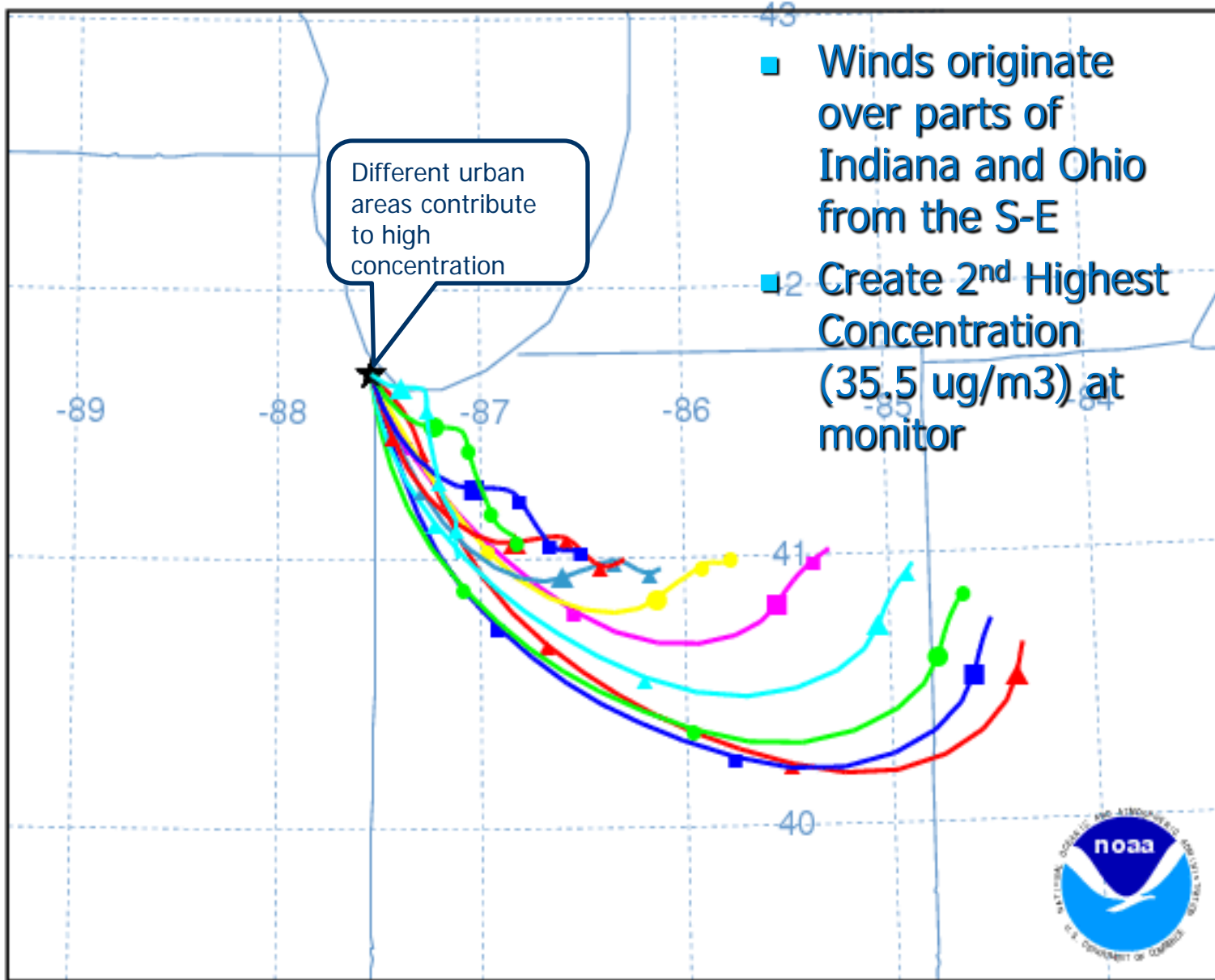
Job ID: 17413 Job Start: Wed Oct 2 21:03:12 UTC 2013
 Source 1 lat.: 41.687000 lon.: -87.539000 height: 100 m AGL

Trajectory Direction: Backward Duration: 24 hrs
 Vertical Motion Calculation Method: Model Vertical Velocity
 Meteorology: 0000Z 1 Feb 2010 - EDAS40

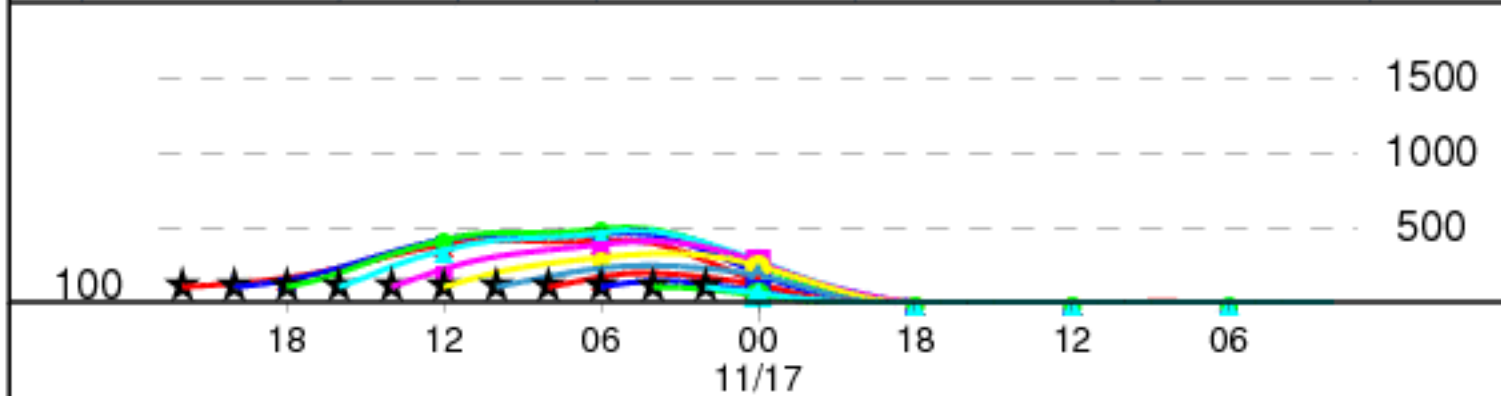
NOAA HYSPLIT MODEL

Backward trajectories ending at 2200 UTC 17 Nov 12 EDAS Meteorological Data

Source ★ at 41.69 N 87.54 W



Meters AGL



Job ID: 17436

Job Start: Wed Oct 2 21:06:18 UTC 2013

Source 1 lat.: 41.687000 lon.: -87.539000 height: 100 m AGL

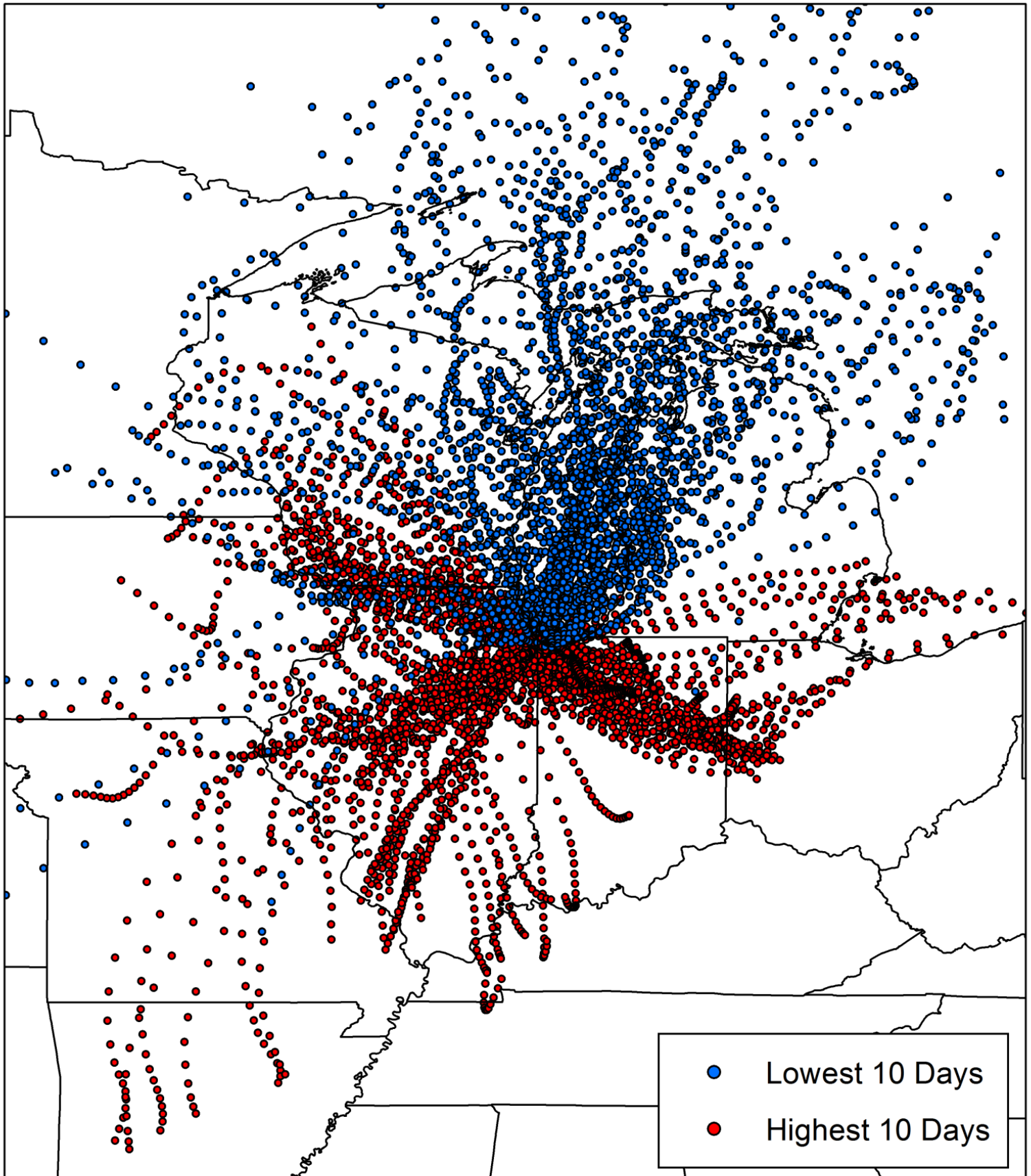
Trajectory Direction: Backward Duration: 24 hrs

Vertical Motion Calculation Method: Model Vertical Velocity

Meteorology: 0000Z 16 Nov 2012 - EDAS40

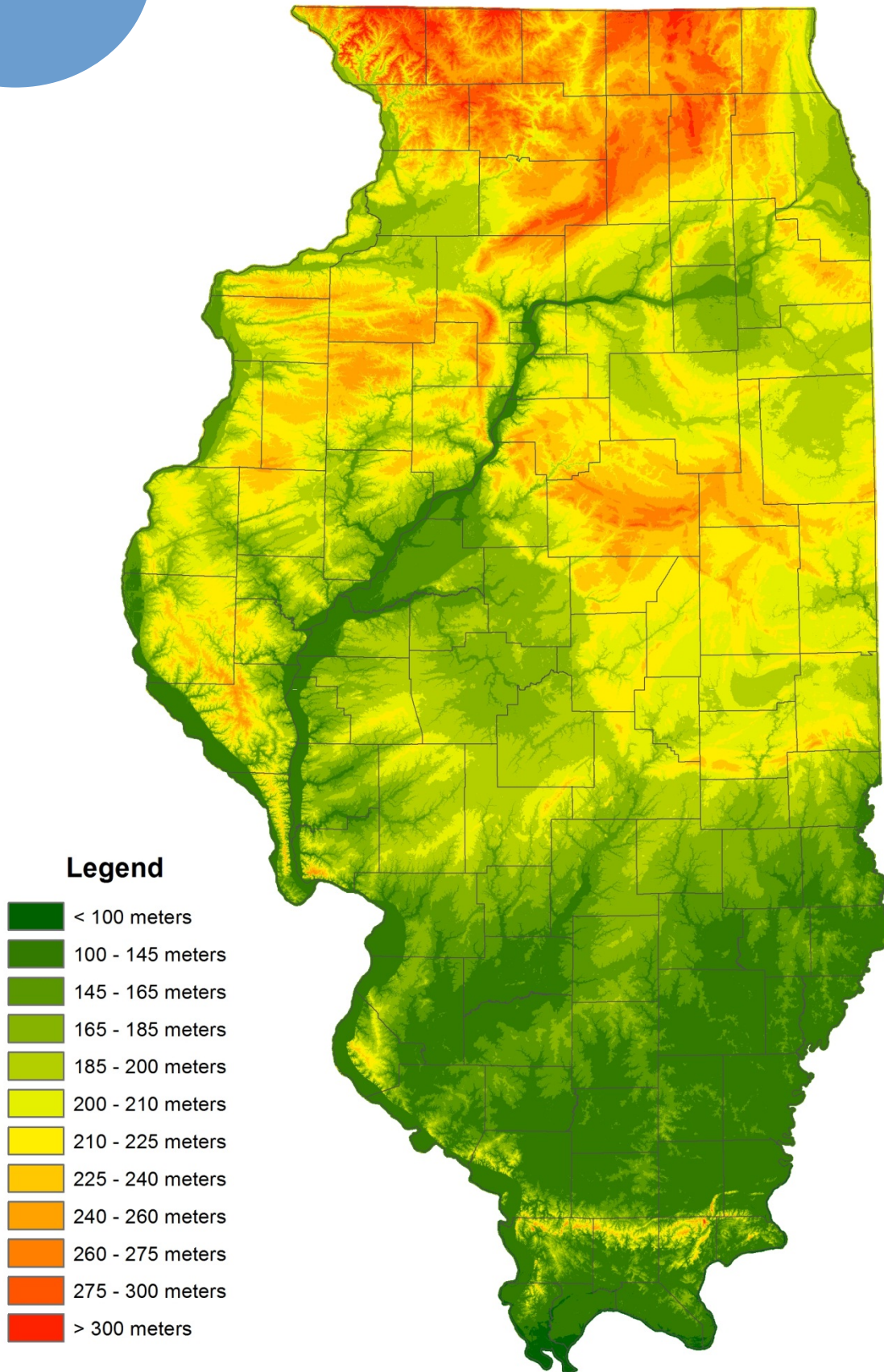
Chicago-Washington High School 2010-2012 HYSPLIT Trajectory End Points

Highest 10 Days versus Lowest 10 Days



Topography

Geography /
Topography



IEPA Recommendation

- **For Chicago, Illinois intends to propose the following counties/townships for the Annual PM2.5 NAA:**
 - Cook DuPage**
 - Kane Lake**
 - Will McHenry**
 - Kendall (Oswego)**
 - Grundy (Aux Sable & Goose Lake)**
- **For Metro-East, Illinois intends to propose the same NAA Annual PM2.5 boundary:**
 - Madison**
 - Monroe Randolph (Baldwin twp)**
 - St. Clair**
- **All Other Counties:**
 - Attainment/Unclassifiable**