MURRAY AND TRETTEL, INCORPORATED

November 2, 2011

ComEd
Lincoln Centre Two
Two Lincoln Centre
Oakbrook Terrace, Illinois 60181

Re: Detailed Report for Weather Event July 11, 2011

Introduction:

I, Thomas R. Piazza, Certified Consulting Meteorologist and President of Murray and Trettel, Inc. of Palatine, Illinois, have been asked by the Commonwealth Edison Company ("ComEd"), to provide a written report on the Weather Pattern and associated Severe Weather Event that occurred in Northern Illinois on July 11, 2011.

In the process of formulating my conclusions and opinions expressed in this report, I have examined the weather data reports, images and maps, documents and other information and reports listed in Appendix A.

Executive Summary:

The intent of this report is to describe, in a meteorological context, the weather events and their severity that occurred across ComEd's territory in Northern Illinois on July 11, 2011.

A rapidly moving line of severe thunderstorms moved out of Iowa into ComEd's service territory just after sunrise and then moved at speeds of 60-65 mph across the territory. It produced the following severe weather:

1. Damaging winds…numerous reports of 60-80+ mph
2. Intense lightning…over 18,000 strokes in 2.5 hours
3. Brief torrential rains

It had all the characteristics of a Derecho. A Derecho is a widespread and long lived windstorm that is associated with a band of rapidly moving showers or thunderstorms. This band of showers and thunderstorms is usually curved in shape (these bowed lines are called bow echoes). This Derecho reached the Mississippi River about 0600 hours on July 11, then rapidly swept across and affected all of ComEd's service territory north of Interstate 80 ("I-80"), including all of Southern Wisconsin. It reached the Chicago Metropolitan area about 0800 hours on July 11th and was east of the area by 0900 hours. It only slightly decreased in intensity by the time it reached Ohio around 1100 hours on July 11th. This Derecho continued all the way to the East Coast by late in the day on July 11th.

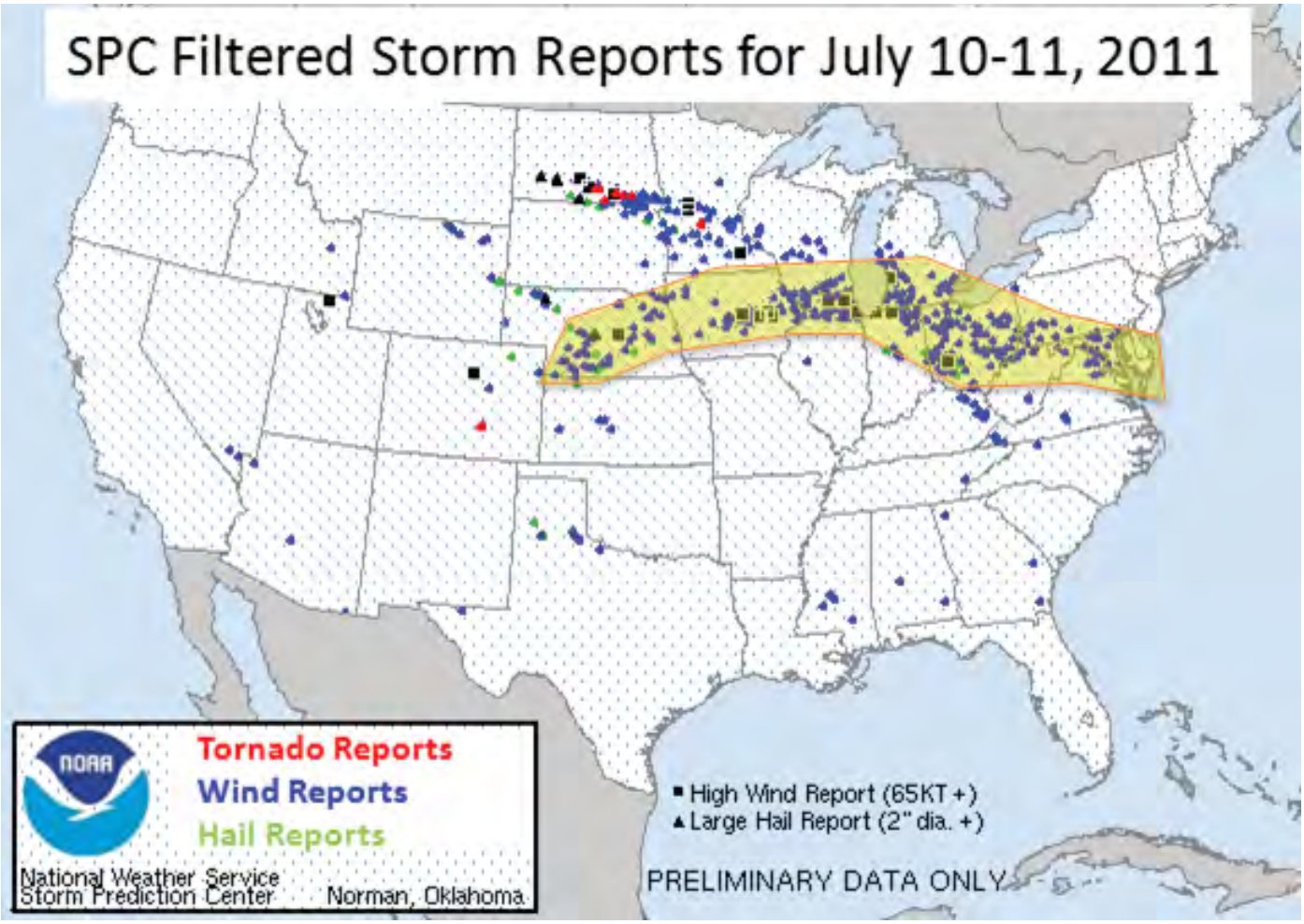


Image 1 Path of July 10-11, 2011 Derecho (courtesy National Weather Service)

The most intense part of this Derecho moved across two sections of Northern Illinois. One moved eastward across Jo Daviess, Winnebago, Boone, McHenry into Lake and Northern Cook Counties. Another part moved near I-88 from Whiteside to Lee, Southern Dekalb and Kane then into Dupage and Central Cook Counties.

Over 100 mph wind gusts were reported in Iowa and numerous reports of wind gusts of 50-80 mph were reported elsewhere across Iowa and Northern Illinois, including 72 mph at Mundelein, Burbank and Evergreen Park. O'Hare Airport officially recorded a wind gust of 63 mph at 804 hours, while 75 mph was recorded at Midway Airport at 0814. Further south winds reached 65 mph in Plainfield.

Considering the severity of the winds, short time frame of the event, and the geographic area of coverage, I would rank this Derecho as the worst severe weather event to affect ComEd's territory in over fifteen (15) years.

Severe Weather Event on July 11, 2011:

Background and Supporting Information

Radar images are from the National Weather Service Doppler Radar Sites in Davenport, IA ("KDVN") and Romeoville, IL ("KLOT").

All wind speed reports that are indicated with a +, e.g., 70+ mph, are estimated wind speeds made by this author that are based upon the measured speeds with associated damage descriptions for that particular event, and the guidelines outlined in, A Recommendation for an Enhanced Fujita Scale.

Lightning count information shown on the radar images represent the total number of lightning strokes in the previous fifteen (15) minute timeframe, unless otherwise noted. E.g., on the image labeled "approximately 2000 hours", the lightning count is the total number of strokes from 1945 to 1959 hours inclusive.

The outage and severe weather reports plotted on the radar images follow the same guideline as the lightning counts noted in the above paragraph.

All times are Central Daylight Time ("CDT") unless otherwise noted.

The severe weather event of July 11, 2011 can be classified as a Derecho, a widespread and long lived windstorm that is associated with a band of rapidly moving showers or thunderstorms. This band of showers and thunderstorms is usually curved in shape (these bowed lines are called bow echoes). A Derecho can be associated with a single bow echo or multiple bow echoes. The bow echoes may vary in scale and may die out and redevelop during the life of the Derecho. In addition, winds can be enhanced on a smaller scale by embedded cells within the line of storms.

There are three types of Derechos[1], which are serial, progressive and the hybrid. A hybrid Derecho has a combination of the characteristics of the progressive and the serial. The severe weather event on July 11, 2011 most closely resembles the progressive Derecho[2]. This type of Derecho can be associated with a relatively short line of showers and thunderstorms, typically 40 miles to 250 miles in length, which at times may take the shape of a single bow echo or several short bow echoes. In some cases, the width of the progressive Derecho and its associated bow echo system can remain relatively narrow.

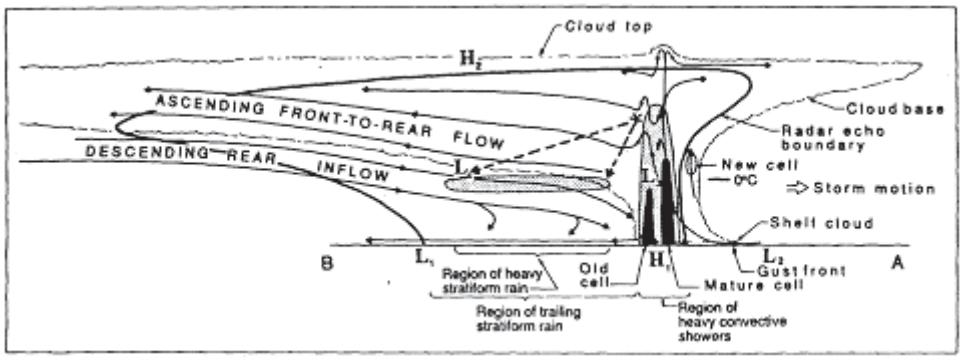
Winds in a Derecho must meet the National Weather Service criterion for severe wind gusts (greater than 57 mph) at most points along the Derecho's path. (See attachment 1 for reported and estimated wind speeds and damage) In stronger Derecho events, winds can exceed 100 mph. The winds associated with Derechos are not constant and may vary considerably along the Derecho path, sometimes being below severe limits (57 mph or less) and sometimes being very strong (from 75 mph to greater than 100 mph)[3].The stronger winds embedded within the general Derecho path are called downbursts and they are often in clusters.

The Derecho that occurred on July 11th had one bow echo associated with it while it moved across Illinois and Southern Wisconsin.

The formation of a bow echo requires a strong elevated rear inflow jet stream at mid levels. Early in the morning on July 11th, a mid level jet of 40 to 60 knots (40 to 69 mph) existed over North Iowa, Northern Illinois and Wisconsin. (See attachment B, 700 mb chart dated 12 GMT July 11, 2011) **When this jet stream enters**

[1] About Derechos, Types of Derechos, Robert H. Johns and Jeffery S. Evans, Storm Prediction Center.
[2] About Derechos, Types of Derechos, Robert H. Johns and Jeffery S. Evans, Storm Prediction Center.
[3] About Derechos, Strength and Variation of Derecho Winds, Robert H. Johns and Jeffery S. Evans, Storm Prediction Center.

the rear of the line of storms, it descends and spreads along the surface of the earth generating strong straight-line winds. This happens generally where the jet is perpendicular to the line. This rear mid-level jet inflow, in many cases, can be detected by radar within a bowed line of convective storms as an area of weaker echoes, or echo free area that is adjacent to strong line segments on either side. Depending on the various atmospheric and topographic characteristics, the wind strength may vary considerably at ground level while the line of storms advances and evolves.



(Figure 1 from Houze et al. 1989)

Figure 1 Thunderstorm cross section diagram

The maximum convective wind gusts associated with the individual cells in a Bow echo line of severe storms generally only last a few minutes and may only have a path of a few hundred yards to a few miles. As the individual cells move forward, several downbursts over the life of that cell may reach the ground, thus resulting in a pulsating characteristic of the severe wind gusts that affect the ground environment. In addition, as the line of storms moves forward, cells may weaken with new stronger cells developing along the leading edge of the outflow from the preceding cells. Since the spatial scales of most convective cells are on the order of 10 kilometers, the size of the outflow during the time of maximum horizontal wind gusts is only a few kilometers.[4] The characteristics of Derechos, bows and downbursts as described above, explain why in a severe convective event, such as occurred on July 11, 2011, the severest damage would be concentrated in localized areas. Maximum wind gusts would vary greatly.

Meteorological Situation

Leading up to this event, Northern Illinois saw two days (July 9th and 10th) with temperatures in the lower 90's and dew points near 70 degrees. In the early morning of July 11th, temperatures were near 80 degrees with dew points in the lower 70's, indicating the atmosphere was "energized." A cold front extended from Lake Superior to Western Wisconsin to low pressure over North Central Iowa with the cold front trailing southwest.

In the afternoon prior to this event, strong thunderstorms developed over North Dakota extending into Northern South Dakota. At night, as the storms advanced into Minnesota, they congealed into a southeastward moving mesoscale convective complex (mcs). .

In the upper atmosphere a low pressure system was situated over Hudson Bay, Canada while another low pressure system was located just west of British Columbia, Canada. A high pressure system was located over the Southeast States. Between the two systems was a jet stream that originated from the Northern Rockies

[4] Extreme Convective Windstorms: Current Understanding and Research, 1994, Charles A. Doswell III, National Severe Storms Laboratory, Norman, Oklahoma

across North Dakota and into Wisconsin and the Great Lakes. The huge difference in atmospheric pressure between these systems created a strong middle to low level jet extending from the Northern Rockies eastward into Wisconsin and Northern Illinois. The orientation of this jet stream is important because as it came across the Rockies into the Plains it allowed very warm dry air to be transported into Iowa and Northern Illinois in the lower layer of the atmosphere. The low pressure off of Southwest Canada kicked out a shortwave trough, which on the morning of July 11th was over Minnesota and Northern Iowa. At 0700 hours that morning, a weather balloon was launched from Davenport, Iowa. Data retrieved from the balloon indicated the atmosphere, while moist at the low levels, was dry at the mid layers. Therefore, there was greater evaporative cooling of the downburst of rain filled air which creates a greater temperature differential with the surrounding air. This cooler downburst then accelerates its downward speed to the ground producing stronger downburst winds at the surface.

Chronology of events

On July 10th,thunderstorms developed southwest along the cold front and by midnight formed an extensive line from Western Wisconsin into Northwestern Iowa and Northeast Nebraska all the way into Northwestern Kansas. Early in the morning on July 11th, the storms in Iowa developed into a squall line with some bowing of the line, an indication of very strong winds. It had all the characteristics of a Derecho. As it moved through North Central Iowa, it produced wind gusts in excess of 100 mph and cause widespread damage. The image below depicts the path across Iowa.

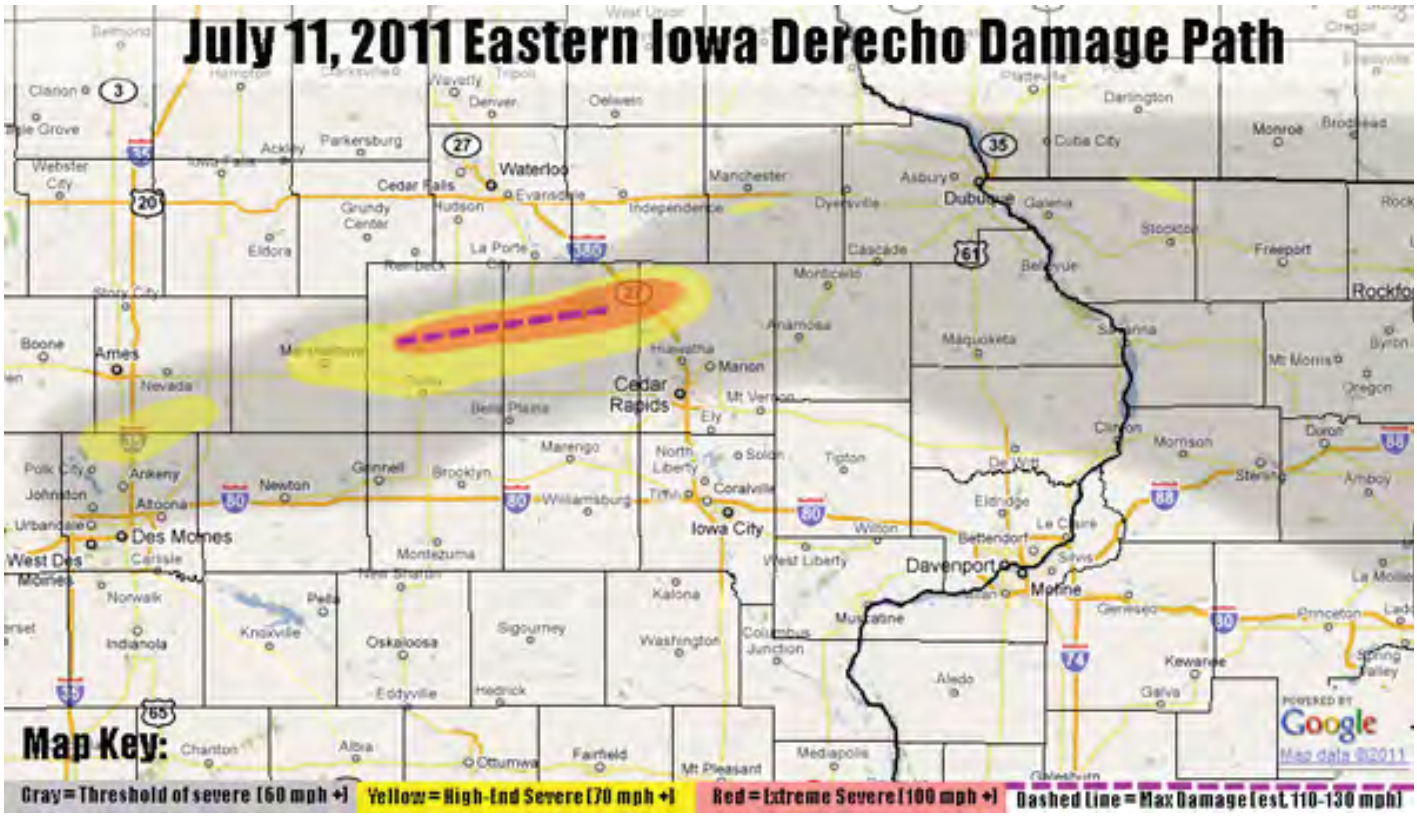


Image 2 Derecho Winds across Iowa on July 10-11, 2011
(Courtesy National Weather Service Davenport, Iowa)

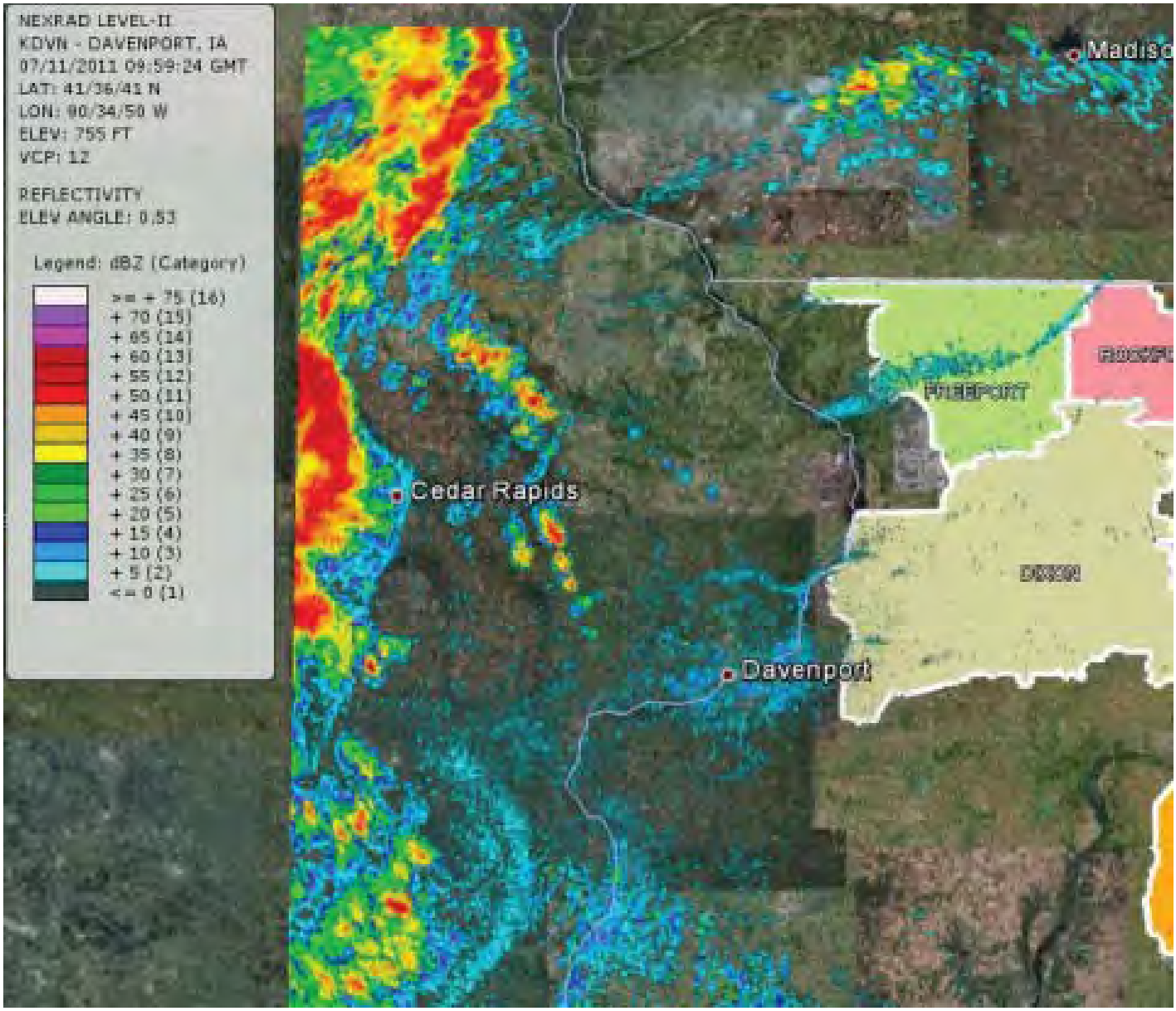


Image 3 KDVN NEXRAD base reflectivity on July 11, 2011 at 0500 hours
Derecho firsts appears on KDVN's radar

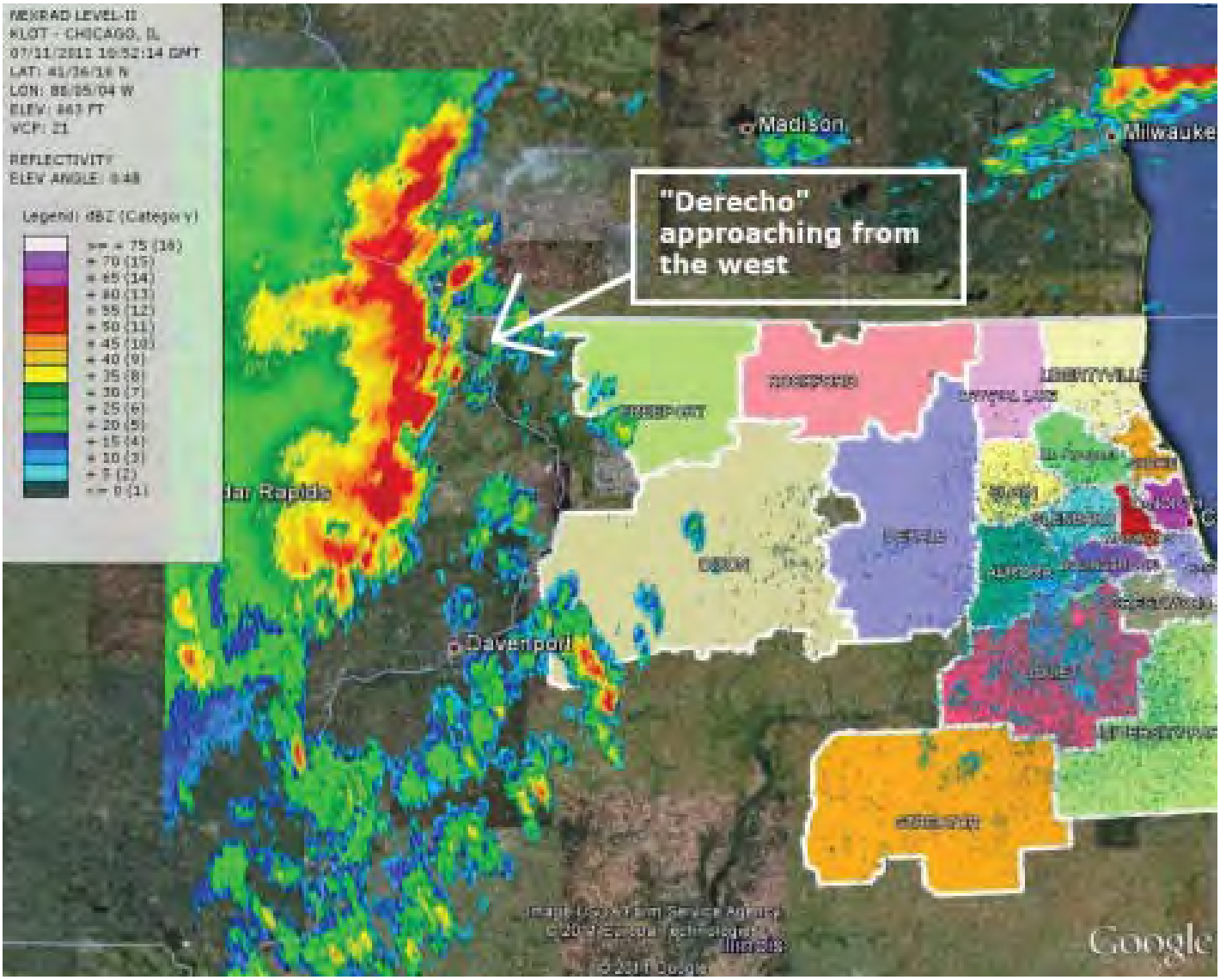


Image 4 KDVN NEXRAD base reflectivity on July 11, 2011 at 0530 hours

This Derecho would reach the Mississippi River about 0600 hours, then rapidly sweep across and affect all of ComEd's service territory north of I-80, including all of Southern Wisconsin. It reached the Chicago Metropolitan area about 0800 hours and was east of the area by 0900 hours. It only slightly decreased in intensity by the time it reached Ohio around 1100 hours on July 11th. This Derecho continued all the way to the East Coast by late in the day. Numerous reports of wind gusts of 50-80 mph were reported across Northern Illinois, including 80 mph in Rockford, 72 mph in Mundelein, Burbank and Evergreen Park. Officially at O'Hare Airport at 0804 hours a wind gust of 63 mph was recorded, while 75 mph was recorded at Midway Airport at 0814 hours. Further south winds reached 65 mph in Plainfield.

The following images show the progression of the Derecho across ComEd's service territory:

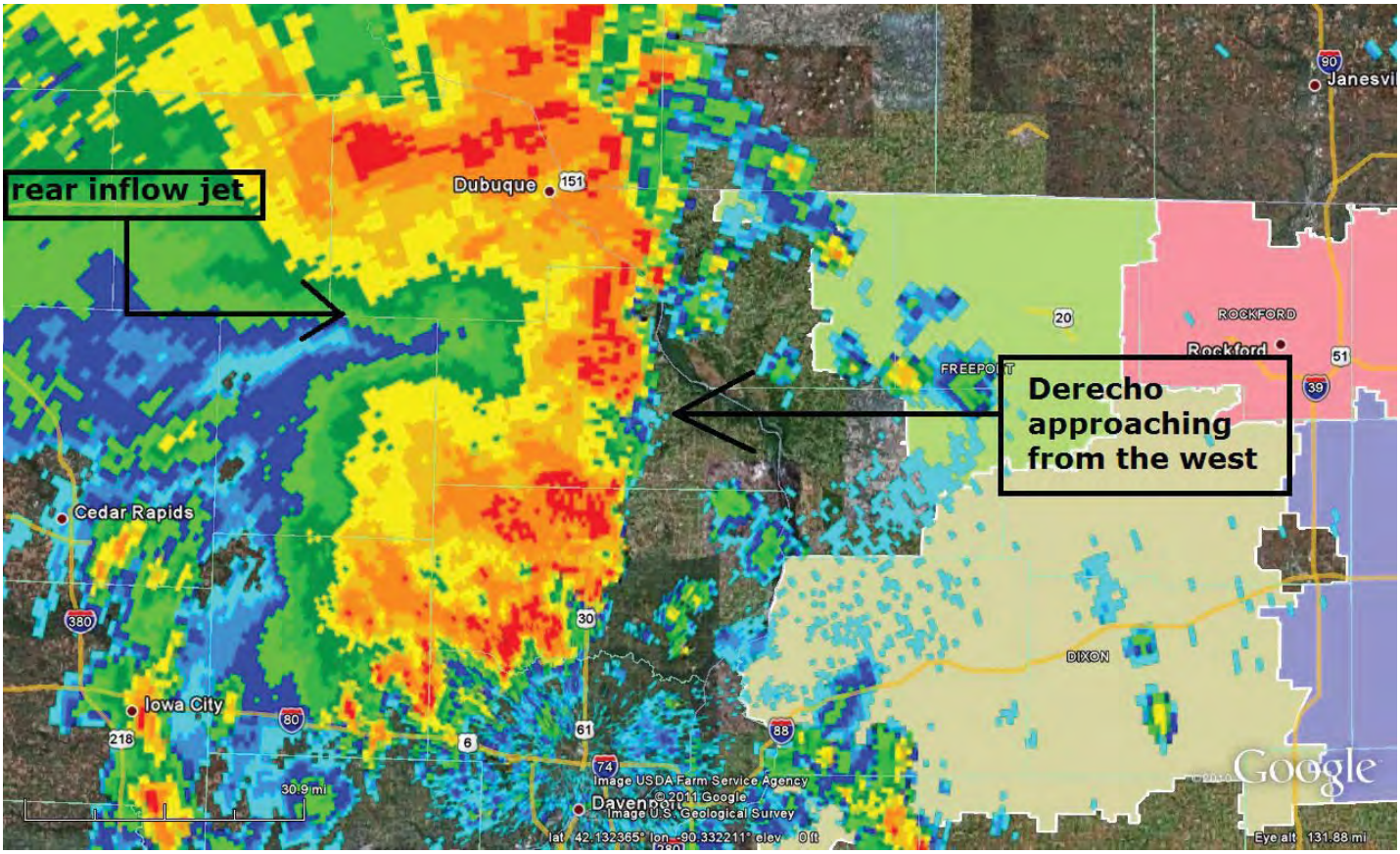


Image 5 KDVN NEXRAD base reflectivity on July 11, 2011 at 0600 hours

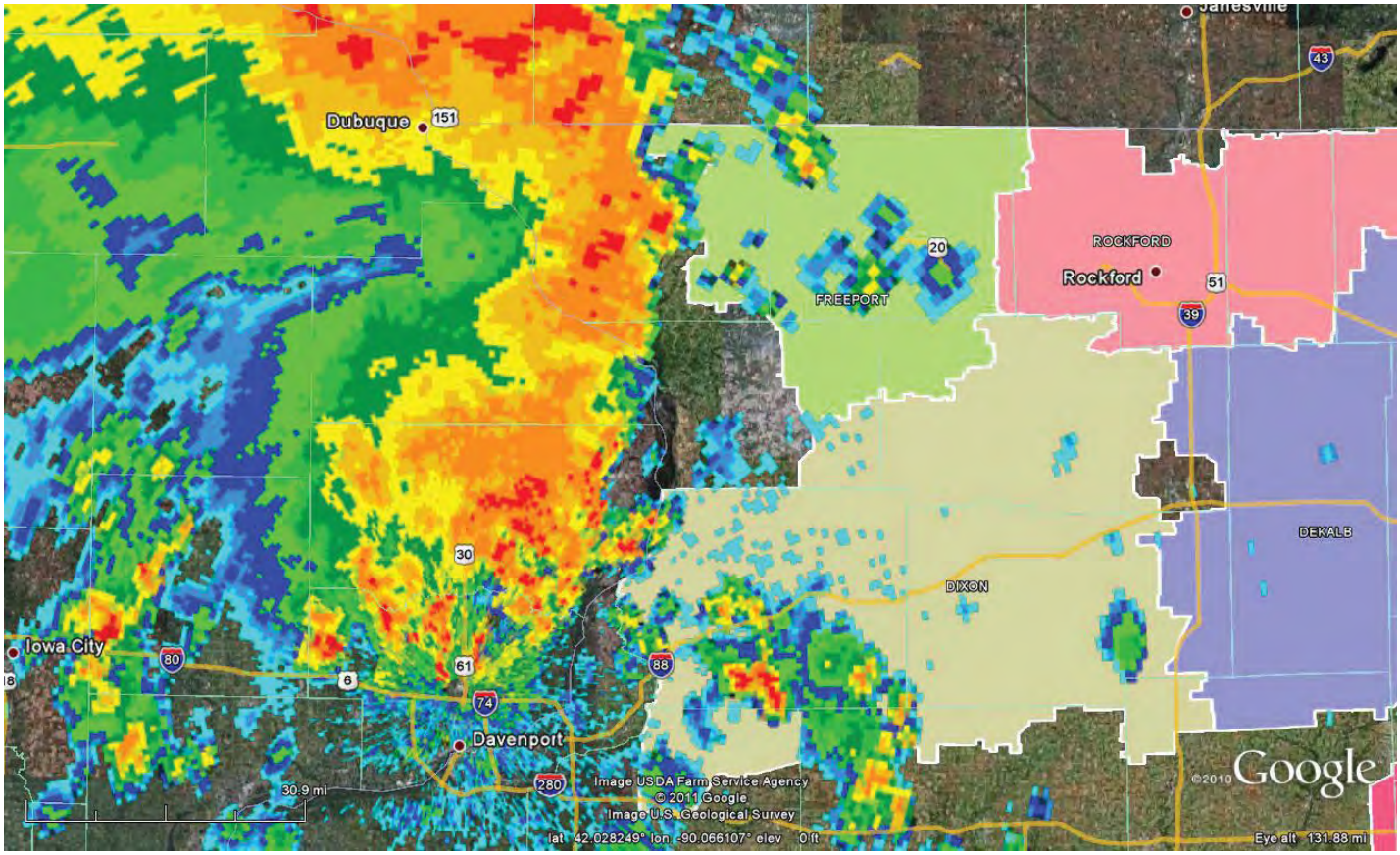


Image 6 KDVN NEXRAD base reflectivity on July 11, 2011 at 0615 hours

Total ComEd Customers Who Lost Power (Cumulative)	Customers Restored (Cumulative)	Customers Still Without Power
0	0	0

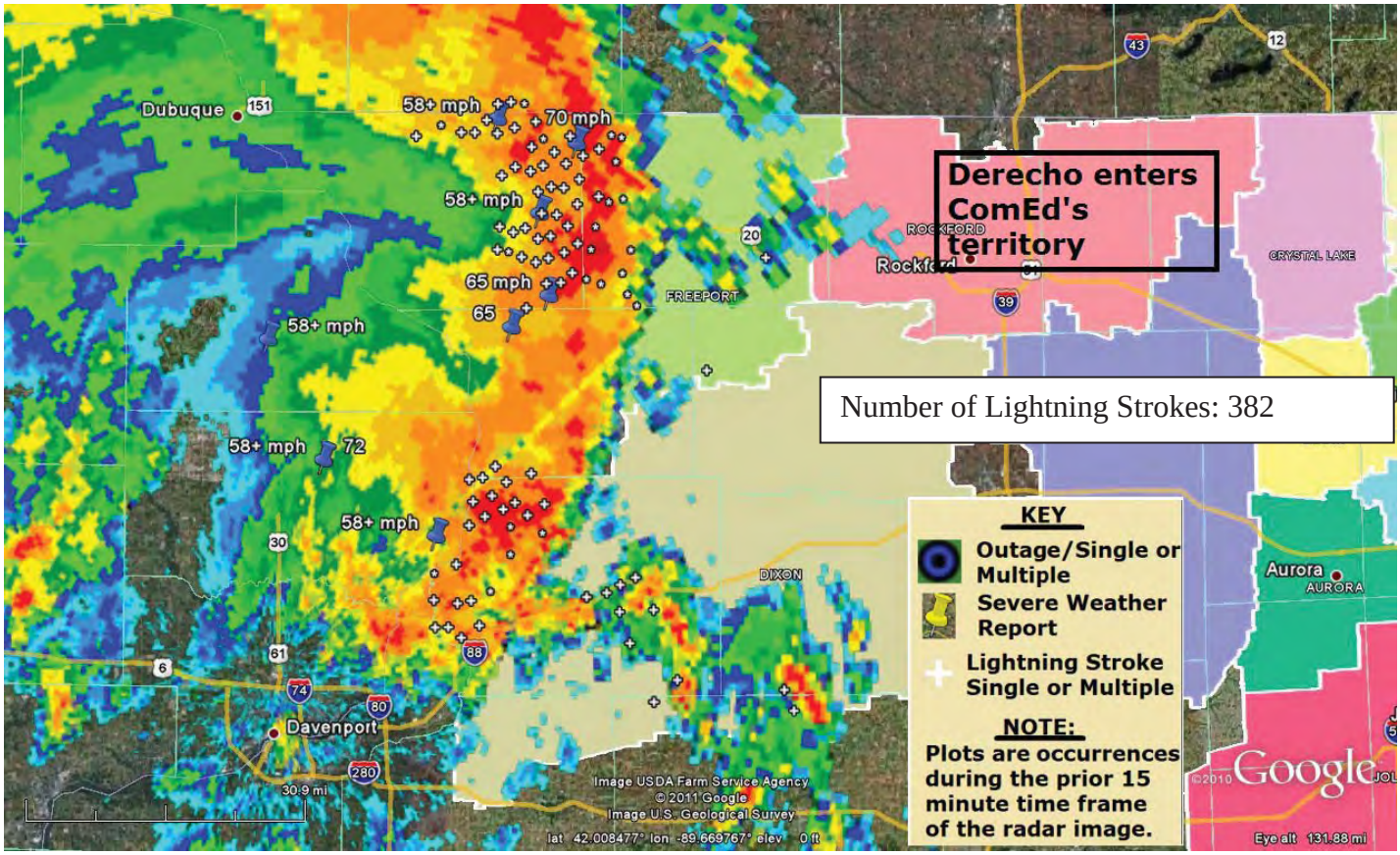


Image 7 KDVN NEXRAD base reflectivity on July 11, 2011 at 0630 hours

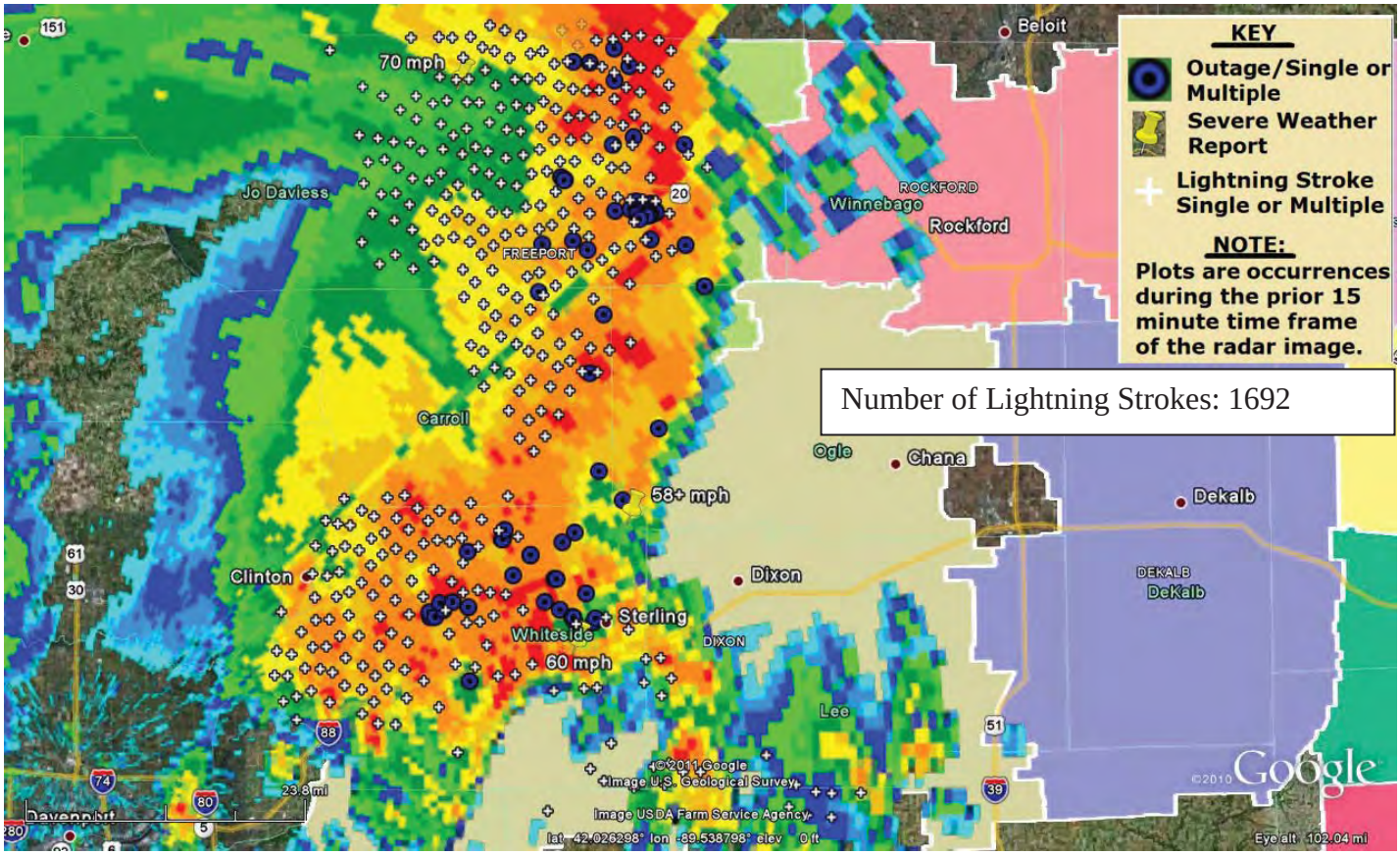


Image 8 KDVN NEXRAD base reflectivity on July 11, 2011 at 0645 hours

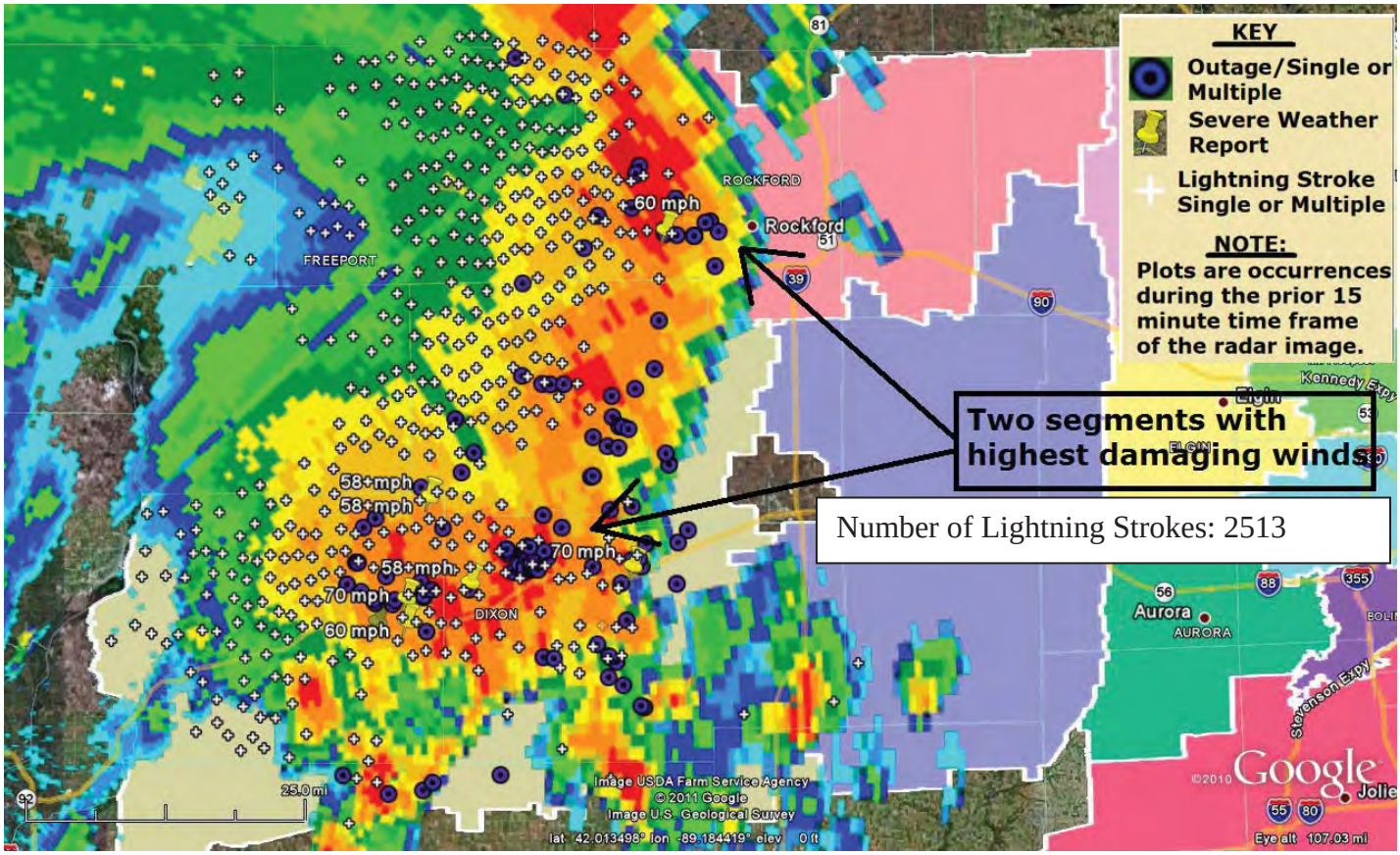


Image 9 KDVN NEXRAD base reflectivity on July 11, 2011 at 0700 hours

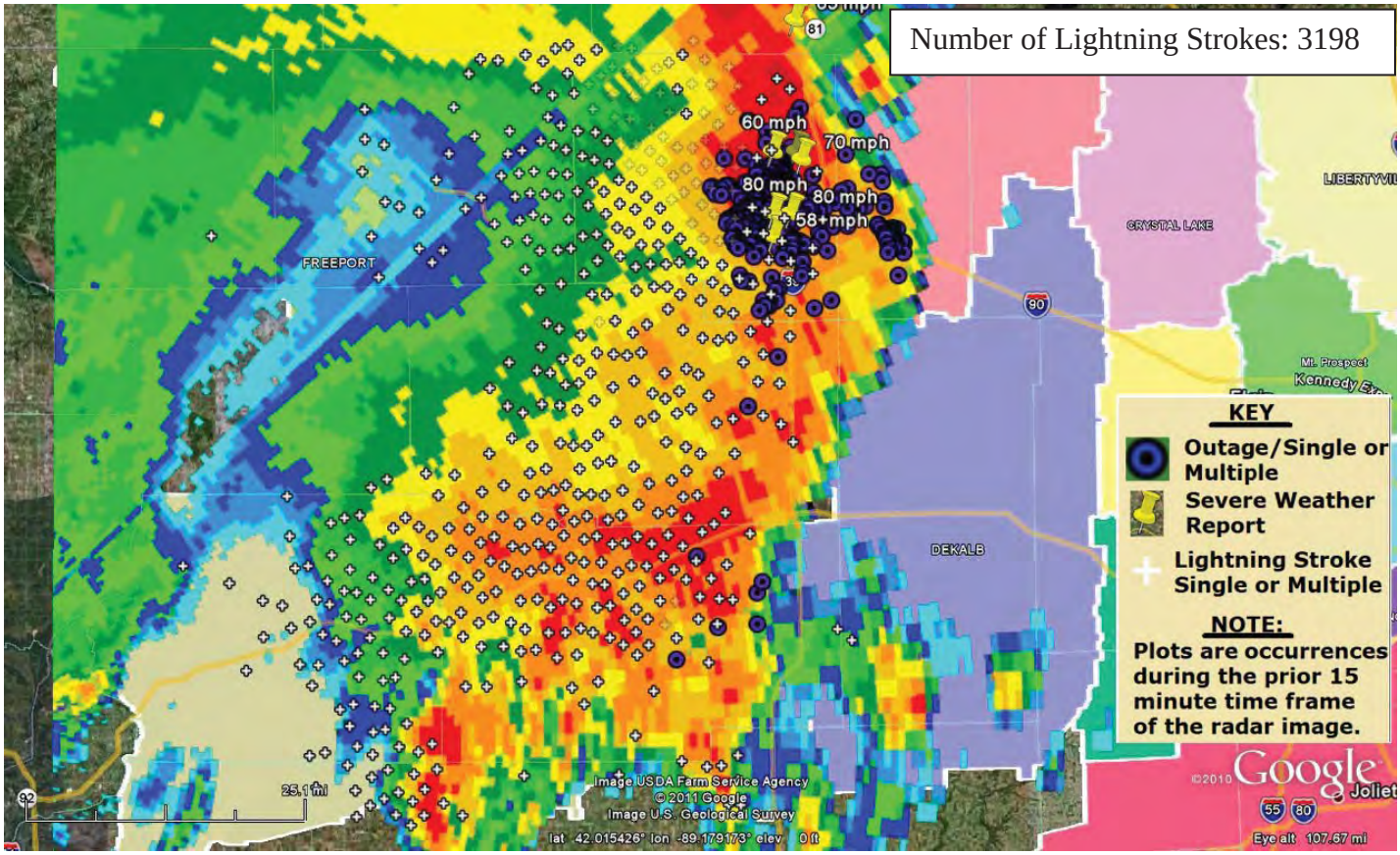


Image 10 KDVN NEXRAD base reflectivity on July 11, 2011 at 0715 hours

Total ComEd Customers Who Lost Power (Cumulative)	Customers Restored (Cumulative)	Customers Still Without Power
40,738	2,211	38,527

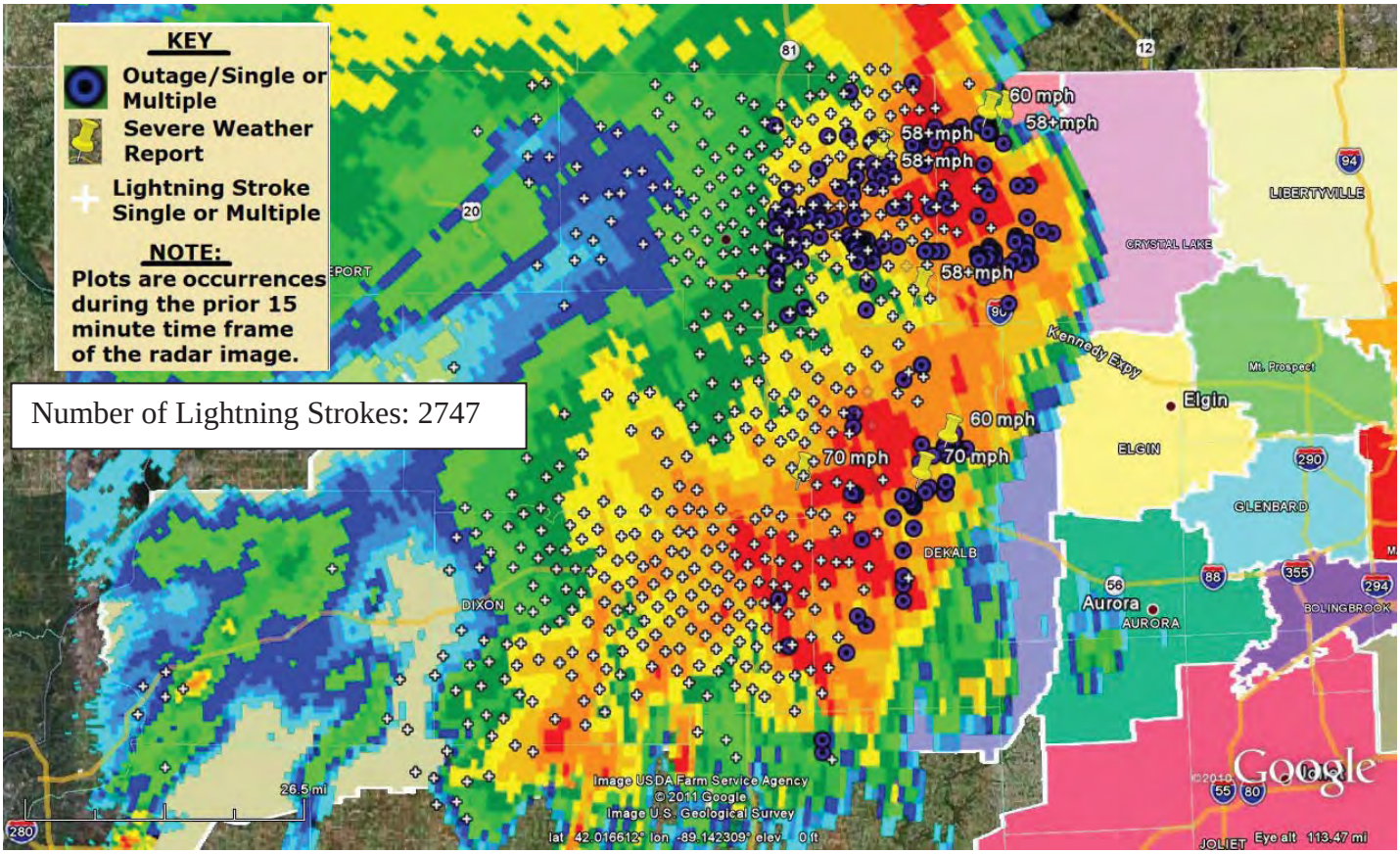


Image 11 KDVN NEXRAD base reflectivity on July 11, 2011 at 0730 hours

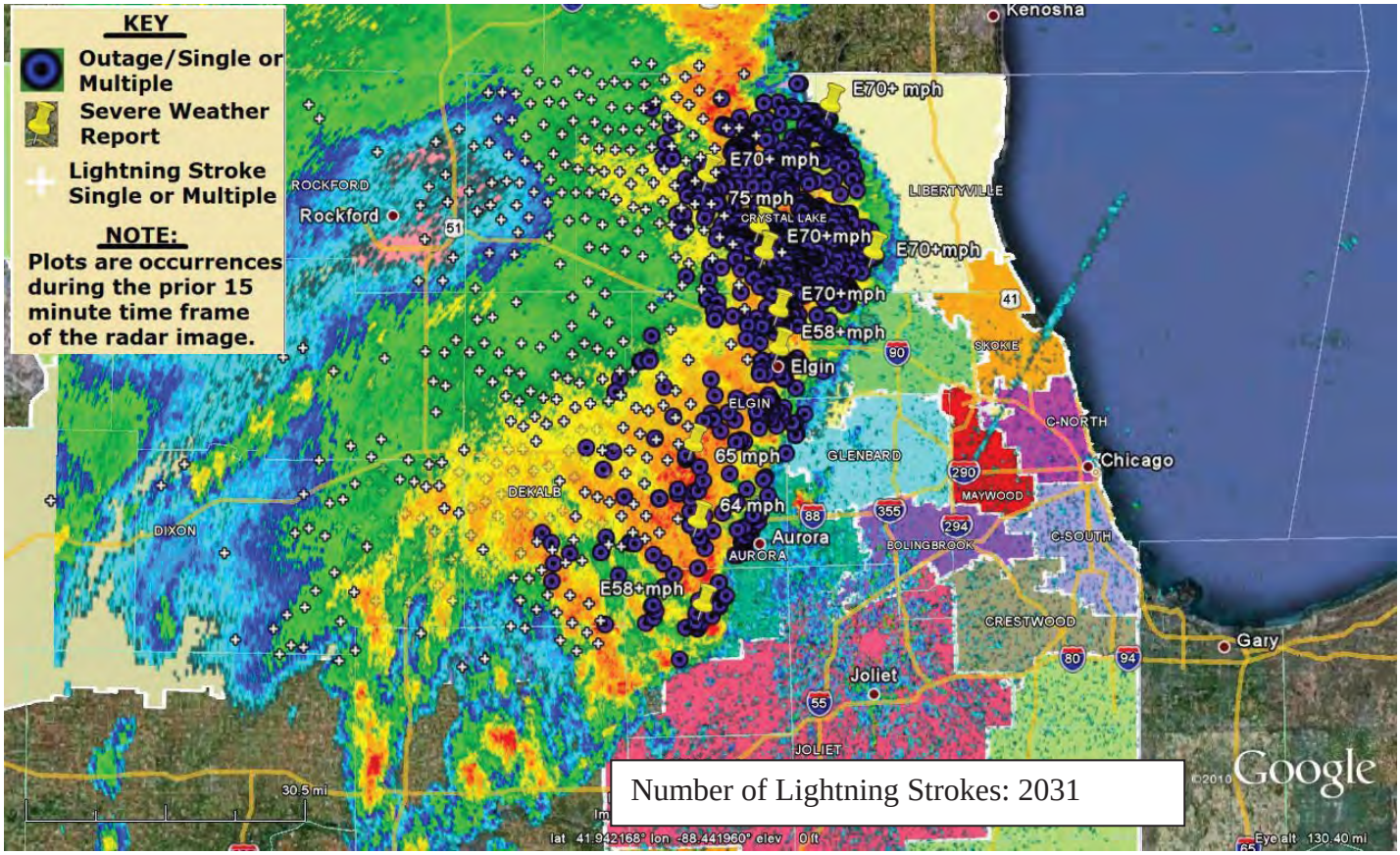


Image 12 KLOT NEXRAD base reflectivity on July 11, 2011 at 0745 hours