

Widespread Wind Damage and Flooding, June 20-22, 2013

Summary, Discussion and Analysis

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This report summarizes and describes the damaging, high-impact thunderstorm events over Minnesota the Twin Cities Metropolitan Area, June 20-22, 2014

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Overview

Two distinct rounds of storms—one in the late night and early morning hours of June 20-21, and one in the late afternoon, evening, and overnight hours of June 21-22—produced widespread damage from winds and flooding, resulting in a Presidential Disaster Declaration for numerous Minnesota counties. The event produced over 500,000 simultaneous and 600,000 total power outages, along with extensive tree, road and bridge damage. The saturated ground following the first event contributed to the severity of tree damage caused by the second round of storms, particularly in Hennepin County.

Snapshot

Overall	Two rounds of storms producing heavy wind damage from wind and flash-flooding
Winds	Generally 50-70 mph, but duration and soil conditions led to massive tree mortality
Rainfall/flooding	1-hr rainfall rates exceeded 100-year thresholds over central and eastern Hennepin County; some areas exceeded threshold for 24-hour rainfall
Impacts	<ul style="list-style-type: none"> • Widespread and record-breaking power outages • High tree mortality • Flash flooding • Infrastructural damage • Nearly \$6 million in damages and losses in Hennepin County; \$17.8 million statewide
Frequency/Recurrence	<ul style="list-style-type: none"> • Wind speeds alone: approx every year within Hennepin County • Rainfall alone: approx every year • Combined Wind/rainfall: every 3-5 years • Geographical extent and magnitude of impacts: every 30-50 years <p>→ <i>Damage was far more extensive and severe than would have been expected from wind speeds alone</i></p>
Considerations and Recommendations	Despite producing winds that were at or just above “entry-level severe,” this system produced some of the most significant and widespread wind damage in the recorded history of Hennepin county. The duration of strong winds was unusually long, the ground was very wet and soft, and these two factors combined to produce ideal tree-uprooting conditions. Thus, this event makes a strong case for not relying too heavily on one variable (i.e., wind speed) to predict and prepare for high-impact weather events.

Event Synopsis

Meteorological Conditions

A classical late spring/early summer pattern established itself over the Upper Midwest, with a nearly stationary warm front over southern Minnesota, separating very warm and unstable air to the south from cooler air to the north. A weak but large low pressure area remained anchored on the high plains of Colorado and western Nebraska, with numerous smaller impulses emanating from this system (see fig 1). Winds aloft over the region were relatively strong and generally blowing from the west and northwest.

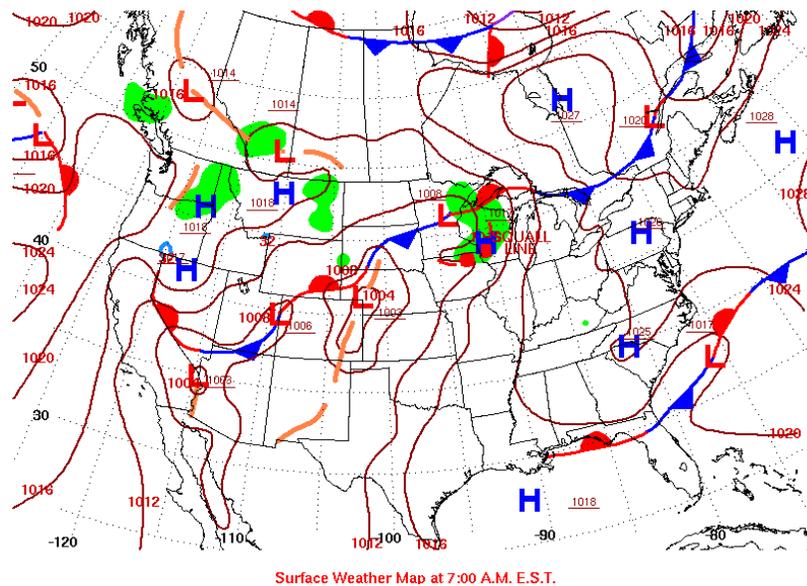


Figure 1. Daily Weather Map from the morning of June 21, 2013¹

The combination of warm, moist air in proximity to strong winds aloft, produced two distinct rounds of severe thunderstorms that affected Hennepin County (see fig 2). The first began in North Dakota and northwest Minnesota during the late afternoon evening of June 20th, and struck the Twin Cities Metropolitan Area between 2:30 and 5 AM on the 21st, with scattered wind damage and intense rainfall. The second round began in southwestern South Dakota in the mid/late morning hours of the 21st, and struck the Twin Cities area in the early evening, with even more severe wind damage and flooding than the first round produced.

The two events occurred within 24 hours of each other, developed in the same general weather pattern, had overlapping impact footprints, and worked together—in that the first event made the second appear more “severe.” They are therefore both covered in this report.

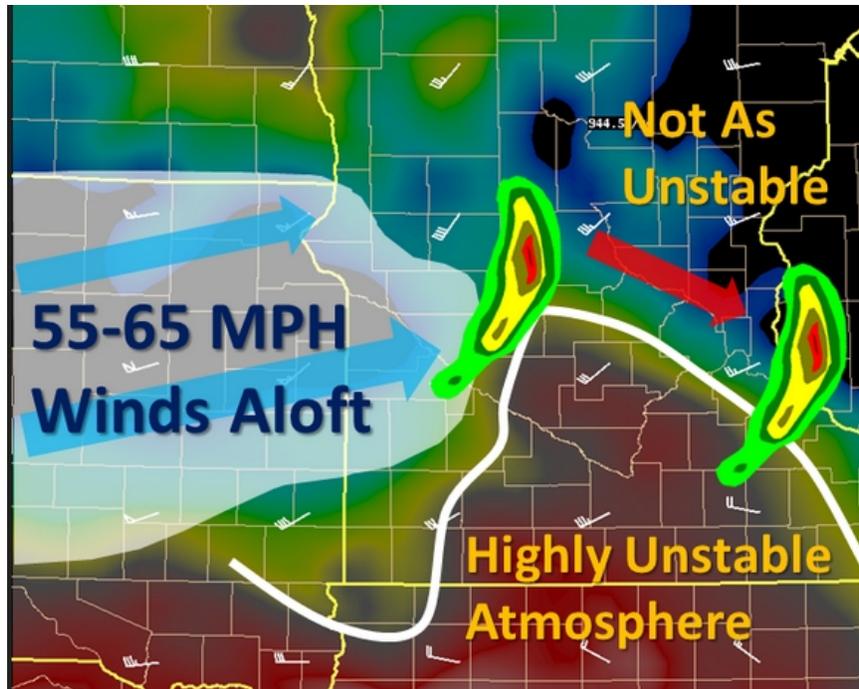


Figure 2. General meteorological setup, modified from Chanhassen NWS office event summary page.ⁱⁱ

Event #1

June 20, late afternoon through evening

As warm and humid air surged up through southern Minnesota (MSP reached a high of 91), intense thunderstorms developed in the vicinity of a disturbance in North Dakota, near a warm-cool boundary, and within a region of strong winds aloft and strong wind shear. The Storm Prediction Center had outlooked a Slight Risk of severe weather over the entire region; the 2000 Z/ 3 PM CDT outlook on the 20th indicated an initial risk for tornadoes and large hail in North Dakota, giving way to a heightened risk for non-tornadic, straight-line winds after dark as the storms moved east and southeast (fig 3).

Initial storms were distinctly supercellular, producing primarily large hail in North Dakota and northwestern Minnesota (see fig 4). The storms regenerated and moved west-to-east, generally parallel to the warm/cool boundary, remaining north of a line extending eastward from the North/South Dakota border through about midnight. Two small tornadoes were spawned during this time (in ND). Reports of non-tornadic wind damage began to increase after dark, especially in Minnesota, as the storms' forward motion increased and they began to produce persistent outflow. Significant damage to boats, docks, and lakeshore trees was reported on Otter Tail Lake and Battle Lake ⁱⁱⁱ.

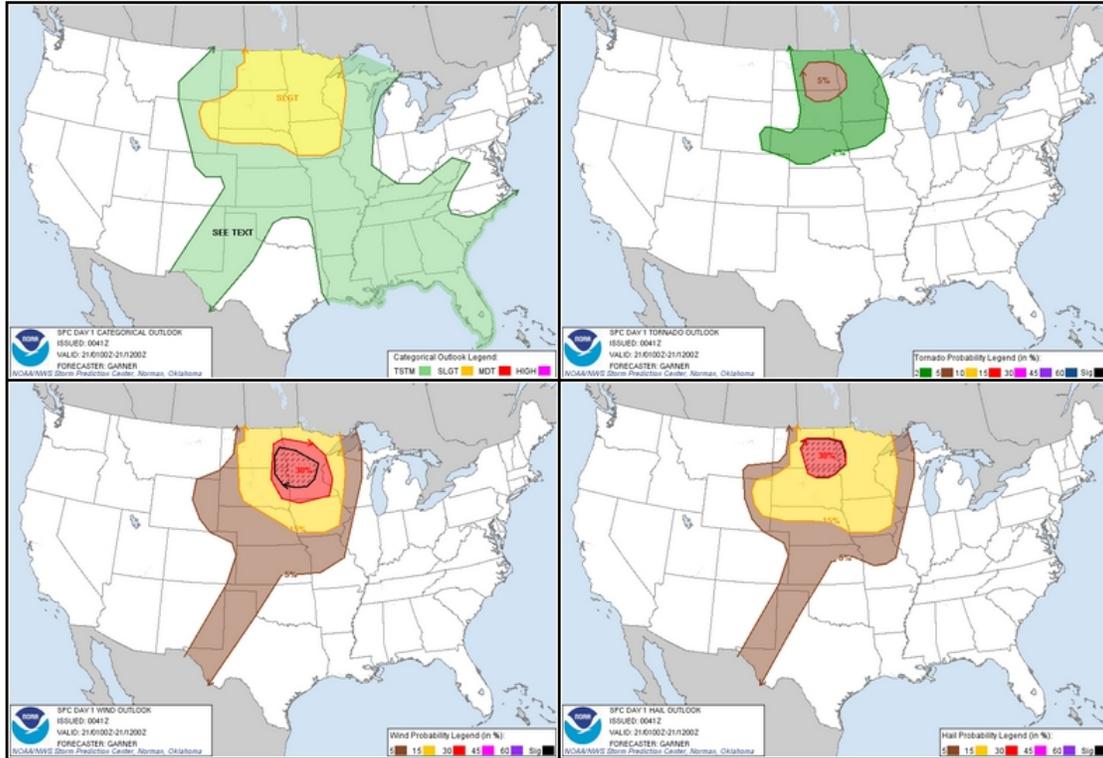


Figure 3 Convective outlook graphics from the Storm Prediction Center, valid 3 PM CDT June 20, to 7 AM CDT June 21, 2013. Images show: general severe weather risk (upper-left); risk of tornado within 25 miles of a point (upper-right); risk of 58+ mph winds within 25 miles of a point (lower-left); risk of 1" hail within 25 miles (lower right). Black encircled hatching indicates area with 10% or greater probability of hurricane-force (75 mph) winds or 2" hail.^{iv}

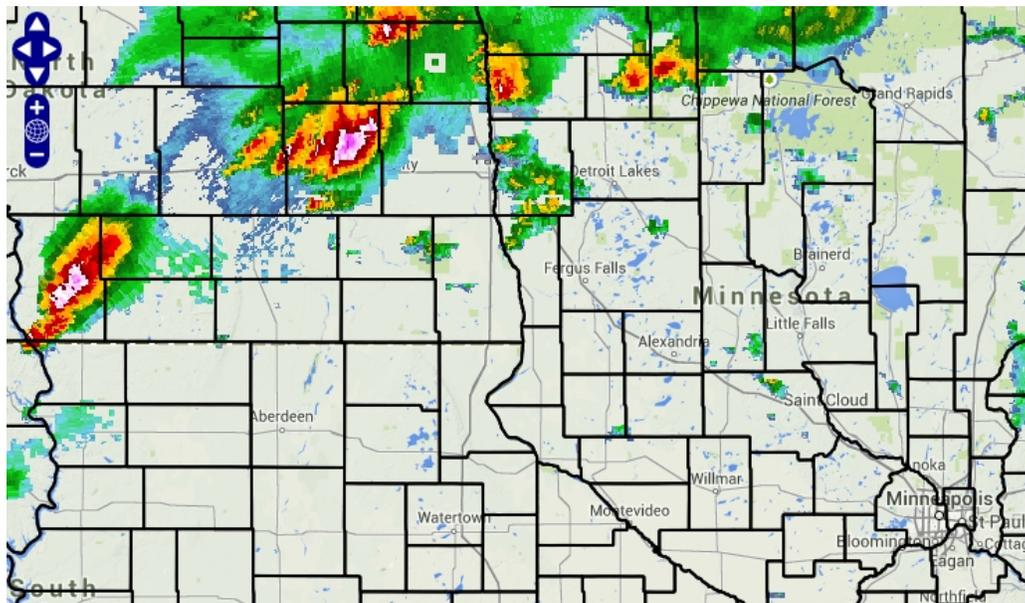


Figure 4. Composite radar image from 7:20 PM CDT, showing the signature, discrete appearance of supercellular thunderstorms over North Dakota and northwestern Minnesota..

June 21, late overnight and early morning

By midnight, the storms had largely lost their supercellular characteristics, and had begun to congeal into a larger convective system. Thus, the primary severe weather hazard became strong winds. In addition, as a large system with numerous embedded strong thunderstorm cells, widespread flash-flooding was becoming a concern as well.

As the storms organized into linear formations, they also began “diving” towards the higher instability available within the warm and moist airmass to the south. As such, the motion of the storms shifted from eastward, to east-southeastward, to southeastward over the next several hours.

The frequency and coverage of wind damage reports increased, first in west-central Minnesota, where numerous trees were uprooted or snapped in Stevens, Pope and Douglas counties. Shortly after midnight, airport and MnDOT anemometers deployed in west-central Minnesota began recording severe-level wind gusts as well. A gust of 68 mph was recorded at the Morris municipal airport, and at approximately 1:30 AM, the Benson airport recorded the strongest wind gust of the first event, at 85 mph. Concurrent borderline severe thunderstorms were developing in Carver and Scott counties, in the southwestern Twin Cities Metropolitan Area—out in front of the main area of storms (see fig 5)

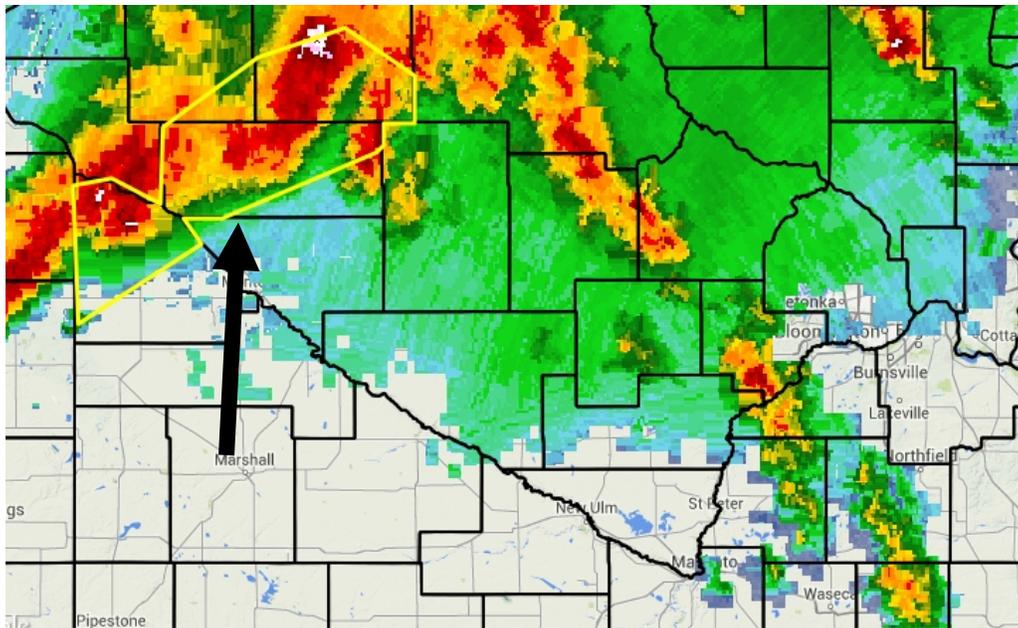


Figure 5. Radar from 1:30 AM CDT on June 20th. Arrow points to peak of the bow echo associated with 85 mph wind gusts measured in Benson. Yellow polygon denotes outline of one severe thunderstorm warning in effect at that time.

The leading band of storms lifted northeastward through the Twin Cities, producing small hail and heavy rainfall, while the main band of storms surged southeastward, traveling from west of St. Cloud and Litchfield, through Wright County and into central Hennepin County, in the space of one hour (see fig 6.). The coverage of wind damage and strong wind reports expanded accordingly, with recorded gusts over 60 and even 70 mph observed in Stearns, Meeker, McLeod, and Wright Counties. Apart from

tree damage, some secondary damage to structures was reported, and in Buffalo, the rodeo grounds across from the airport received damage to its seating area and other equipment.

The storms continued into the Twin Cities Area, producing intense rainfall rates and downed limbs and trees from winds measured or estimated between 50 and 60 mph. Secondary and structural damage was not particularly common. The storms had left the Twin Cities area by sunrise. Flash flooding was most prevalent in the northern part of the metropolitan area, where the storms persisted longer, and especially over parts of central and northern Minnesota, where the storm motion had been slower initially (fig 7). However, the intense rainfall rates over Hennepin County and the central part of the Twin Cities area were enough to overwhelm local drainage capacities, leading to minor flooding and many reports of standing water on roads.

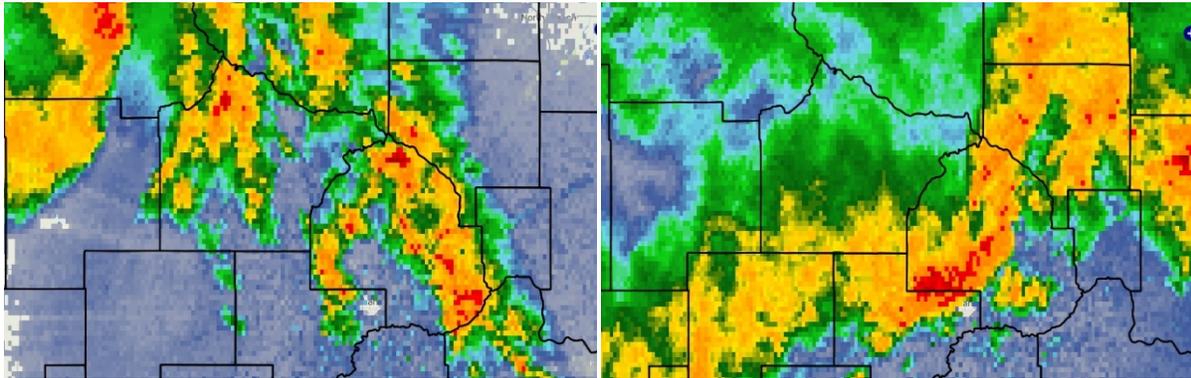


Fig. 6. Twin Cities Radar at 2:28 (left) and 3:28 AM (right). The line of storms traveled up to 70 miles in that one-hour period.

Minnesota: Current 1-Day Observed Precipitation
Valid at 6/21/2013 1200 UTC- Created 6/21/13 15:53 UTC

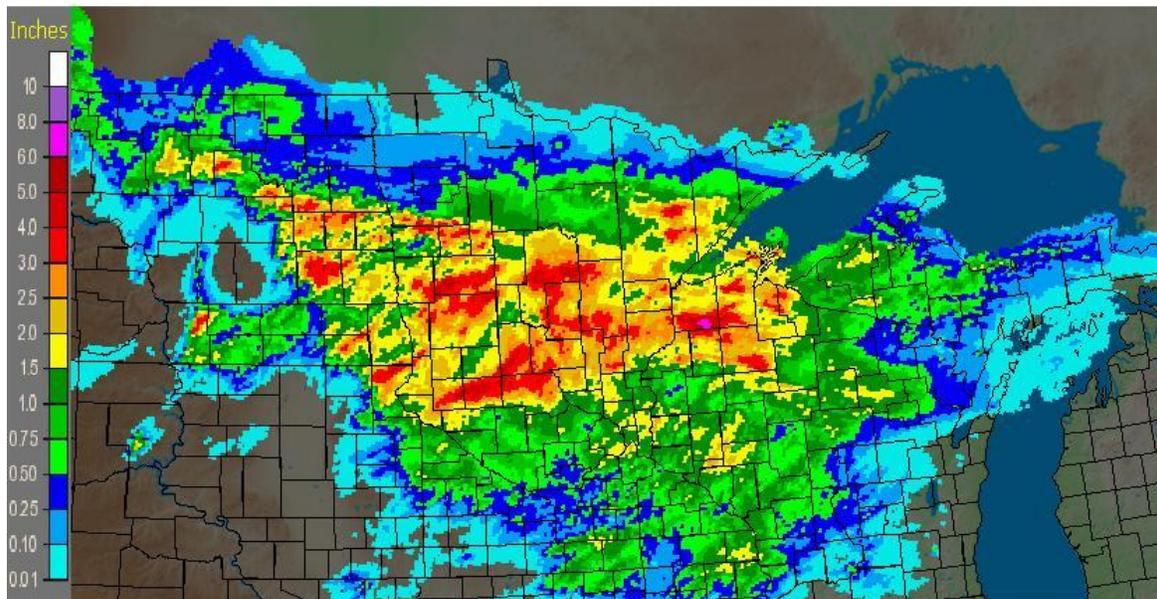


Figure 7. Rainfall totals estimated by radar from June 20 into the morning of June 21, 2013. Storm totals were greatest where storm motions were slow and/or where storm cell regeneration occurred.

As noted in Storm Data (reference iv), persistent 40-60 mph winds developed in the wake of the thunderstorms and produced additional minor damage over central Minnesota. Ultimately, the first round of storms led to an extensive swath of severe weather reports, oriented northwest-to-southeast in accordance with the storm motion (fig 8). The report of 85 mph winds in Benson was the only report in excess of hurricane-force, and the majority of damage was measured or estimated to be from winds in the 50-60 knot, or 58-70 mph range (fig 9). At one point, Xcel Energy reported 133,000 outages.^v

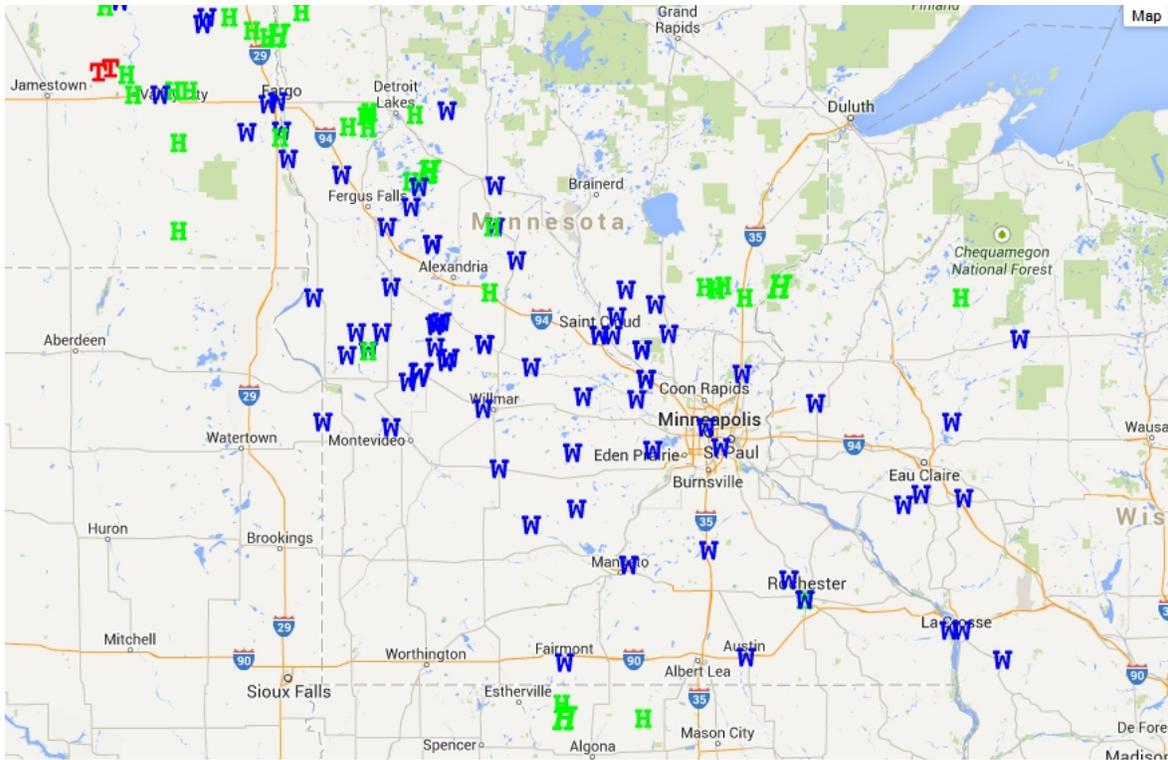


Figure 8. Reports of severe weather for through 7 AM CDT, June 21. Storms generally progressed southeastward. Note tendency for storms to produce hail or even tornadoes early in lifecycle. T=tornado, H= Hail, W= Winds.

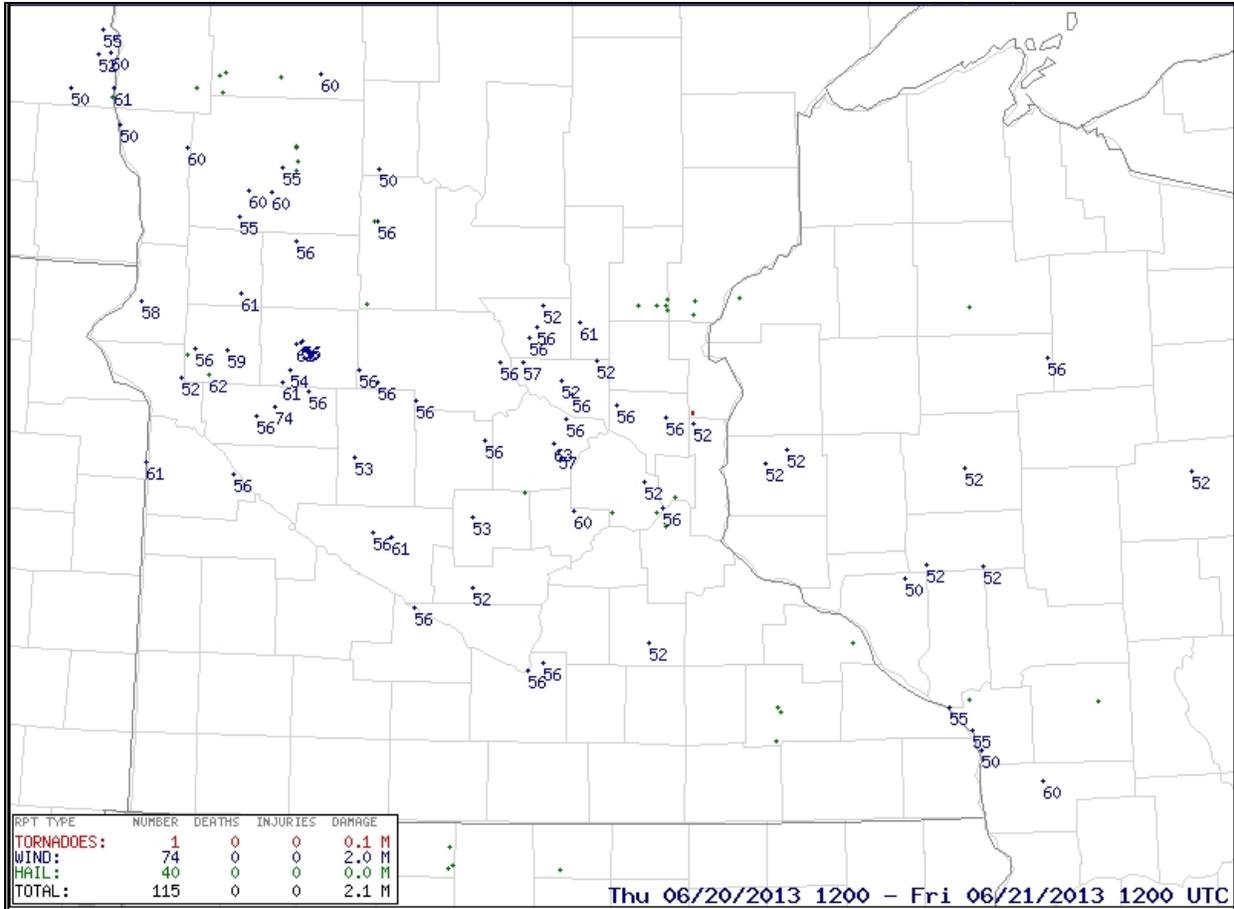


Figure 9. Wind reports in knots, ending 7 AM CDT (1200 UTC) on June 21, 2013. 1 knot = 1.15 mph. Retrieved from Storm Prediction Center Severe Plot 3 tool^{vi}

Event #2

General Timeline	
Time (CDT)	Description
7 – 9 AM	Isolated, intense storm forms southwest of Rapid City, SD
9 AM – 2 PM	SD storm intensifies; numerous reports of hail and damaging winds in central and southwestern through central SD. Some significant.
2 – 5 PM	Storms reach peak intensity in eastern SD and western MN; several tornadoes, winds up to 90 mph, hail to softball size, extensive damage, one fatality.
5-7 PM	Storm fractures, with northern segment dying west of St. Cloud, and southern segment weakening and contracting in Wright county. Storm severity <i>appears</i> to be waning
7-9 PM	Storm re-intensifies and crosses Twin Cities, causing massive power outages and tree/powerline damage along with flash-flooding.
9PM – 1 AM	Additional storms throughout southern and central MN with some hail and winds, and especially heavy rainfall exacerbating flood conditions.

7 – 9AM

As the first event exited Minnesota and was losing its strong-wind producing capabilities, the second one began. By 7 AM, an isolated thunderstorm had formed out in extreme southwestern South Dakota. Initially, this storm was not considered to pose a sustained severe weather threat. However, at 9:10 AM CDT, this storm, along with others developing in its vicinity, prompted a Severe Thunderstorm Watch severe (see fig 10). The main threats were damaging winds and hail.

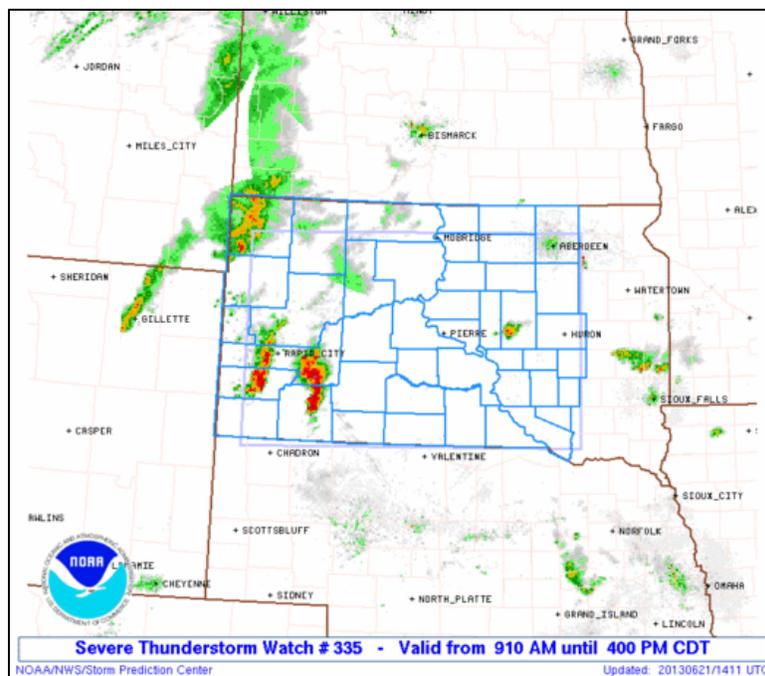


Figure 10. First Severe Thunderstorm Watch issued by Storm Prediction Center for second event. The initial cell is the shown east and south of Rapid City (or just below the lettering).

9 AM – 2 PM

The initial cell maintained itself throughout the morning and proceeded east-northeastward across south-central South Dakota. Reports of 1-2" hail were common, with isolated reports of tennis ball and even baseball and softball-sized hail south of Rapid City. By 9:30 AM CDT the storm was beginning to produce isolated reports of wind damage, and by just after 10 AM, the storm complex became a sustained damaging wind-producer, with numerous reports and estimates of 60-75 mph winds in and around the Murdo, SD area.

As the cell moved into more deeply unstable air, it further intensified, and new storms began developing out ahead of it. With the chance for surface-based rotating updrafts somewhat high, the Storm Prediction Center issues a Tornado Watch for eastern South Dakota and southwestern and central Minnesota, extending right up to Wright and Carver counties (fig 11). This watch lined up with the Storm Prediction Center's highest outlook probabilities for the day (fig 12).

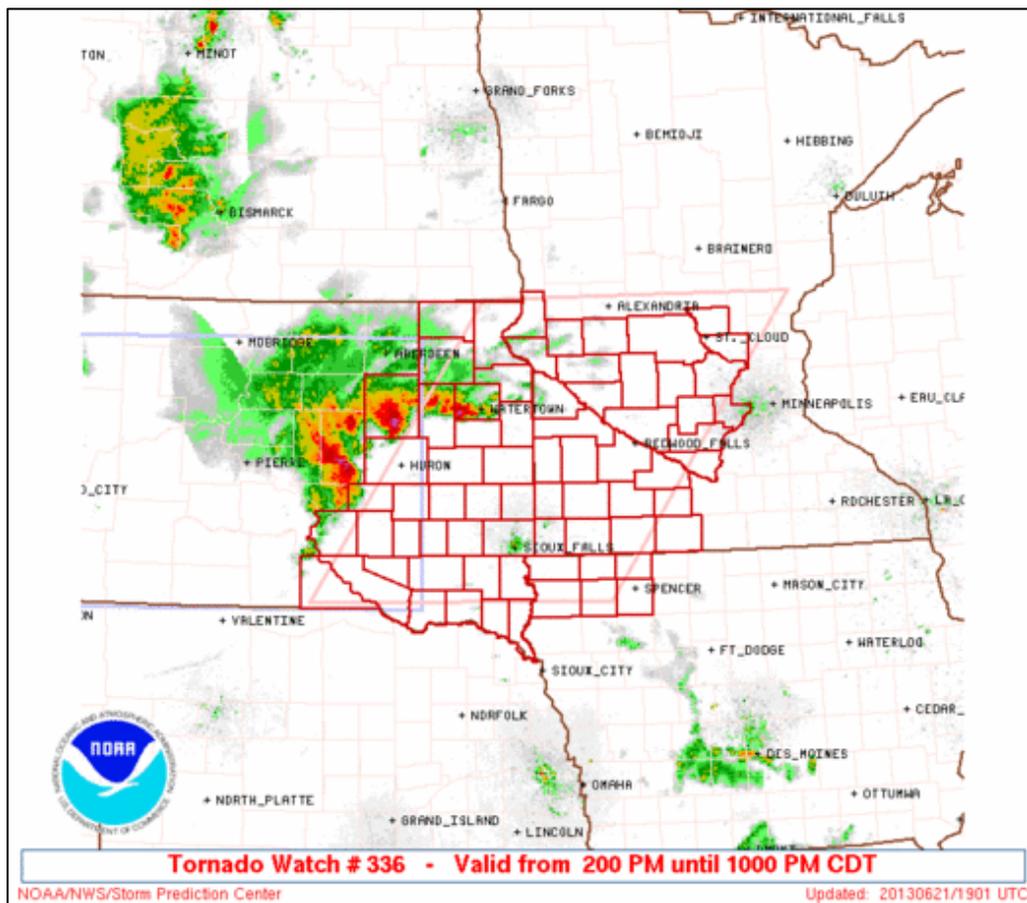


Figure 11. Tornado watch covering greatest risk area and expected duration of event. Note arc of other intense storms developing east of main/initial cell.

2- 5 PM

In terms of magnitude and breadth of severity, the storms entered their peak between 2 and 5 PM CDT. During this period, several tornadoes, generally low on the EF-scale, were reported in South Dakota, with one in Minnesota; additional baseball and softball-sized hail reports were received and confirmed via damage surveys by the NWS Aberdeen office; and non-tornadic wind gusts frequently exceeded 75 mph, with NWS Aberdeen and Sioux Falls estimating some up to 90 mph. An 87 mph wind gust was measured in the vicinity of Huron, and damage was particularly severe there, on Lake Poinsett (see fig 13), in Watertown and in Milbank. A woman was killed and her husband seriously injured when their house on Lake Poinsett was destroyed. Many of the affected counties in South Dakota received Presidential Disaster declarations.

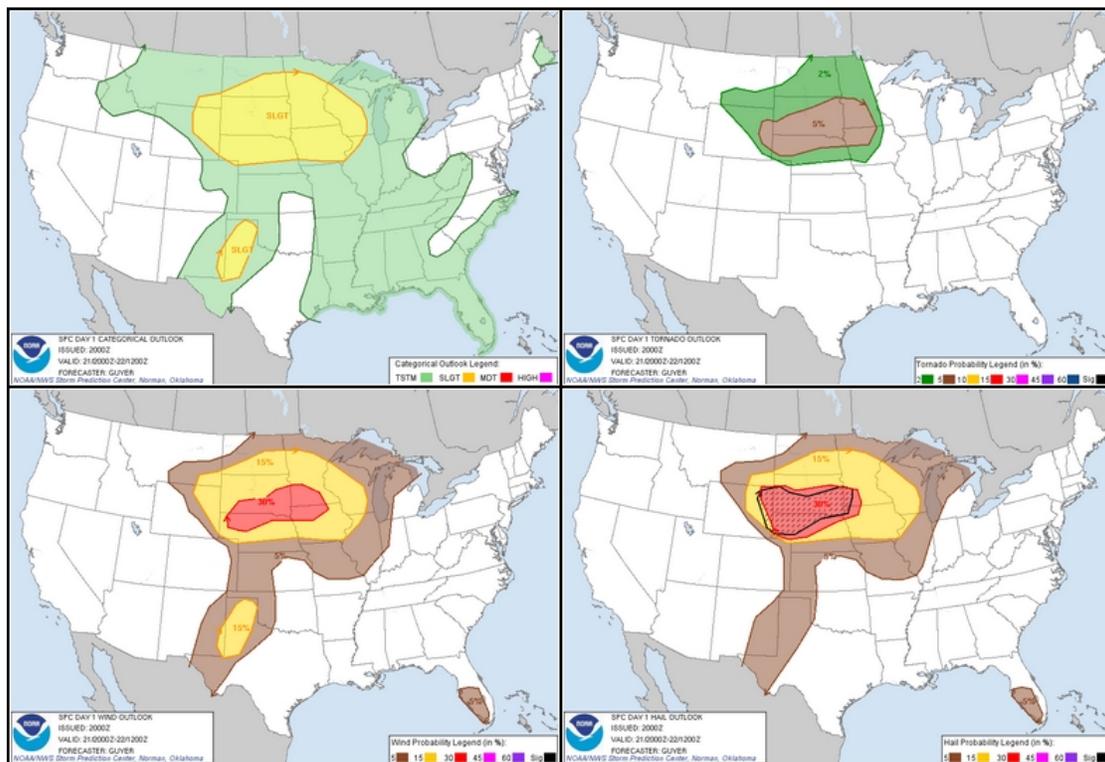


Figure 12. As in Fig 3, but, valid 3 PM CDT June 21, to 7 AM CDT June 22, 2013. Images show: general severe weather risk (upper-left); risk of tornado (upper-right); risk of 58+ mph winds (lower-left); risk of 1" hail (lower right).



Figure 13. Extreme wind damage to Lake Poinsett cabin, courtesy of NWS Aberdeen.ⁱⁱⁱ

The supercellular and tornadic storms that had developed (and can be seen in fig 11) were eventually subsumed by the powerful and fast-moving initial thunderstorm cell. The storm took on a distinct “bowing” appearance as it approached the South Dakota Minnesota border, and entered Minnesota around 4:30 PM CDT (fig 14).

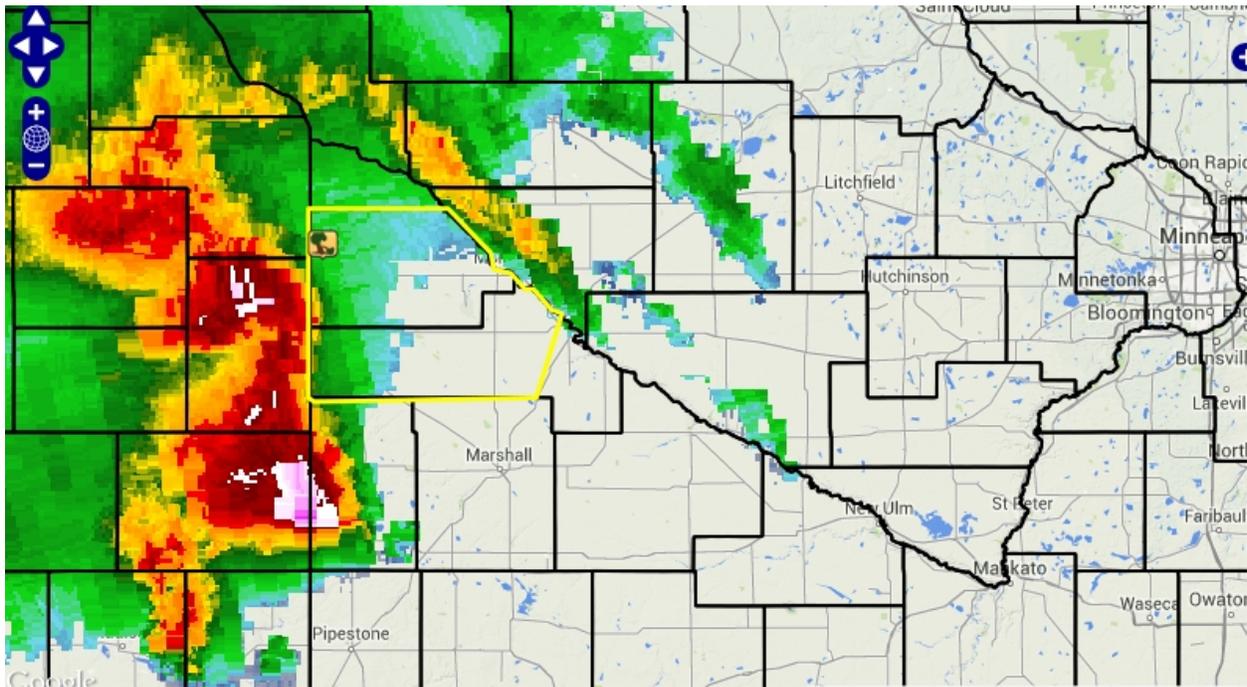


Figure 14. Composite radar Image from 4:25 PM CDT, showing, large, intense bowing thunderstorm complex entering far western Minnesota. Yellow polygon shows outline of one of the active Severe Thunderstorm Warnings for that cell (other warnings were in effect). Note size of complex relative to Hennepin County.

Extreme winds were reported in far western Minnesota, with measured and estimated gusts between 65 and 80 mph common. Extensive damage was reported in Ortonville and Madison. The forward speed of the storm was close to 60 mph by 5 PM. Given the rapid movement, and the transition of the threat towards primarily straight-line winds, the Storm Prediction Center issued a Severe Thunderstorm Watch for eastern Minnesota and western Wisconsin, well in advance of the storms (fig 15).

5-7 PM

After about 5 PM CDT, no further 75 mph+ wind reports were received. The storm contracted and weakened substantially between 5:30 and 6:30 PM. The primary wind damage swath, which had begun in southwestern South Dakota, and stretched east-northeastward through Watertown, South Dakota and into Minnesota, terminated just west of St. Cloud, as the northern extent of the primary cell collapsed (see fig 16). The southern extent of the cell produced winds of 50-65 mph and spotty damage in central Minnesota. It is this storm, in an apparently degraded state, that entered the far western Metro Area around 7:00 PM.

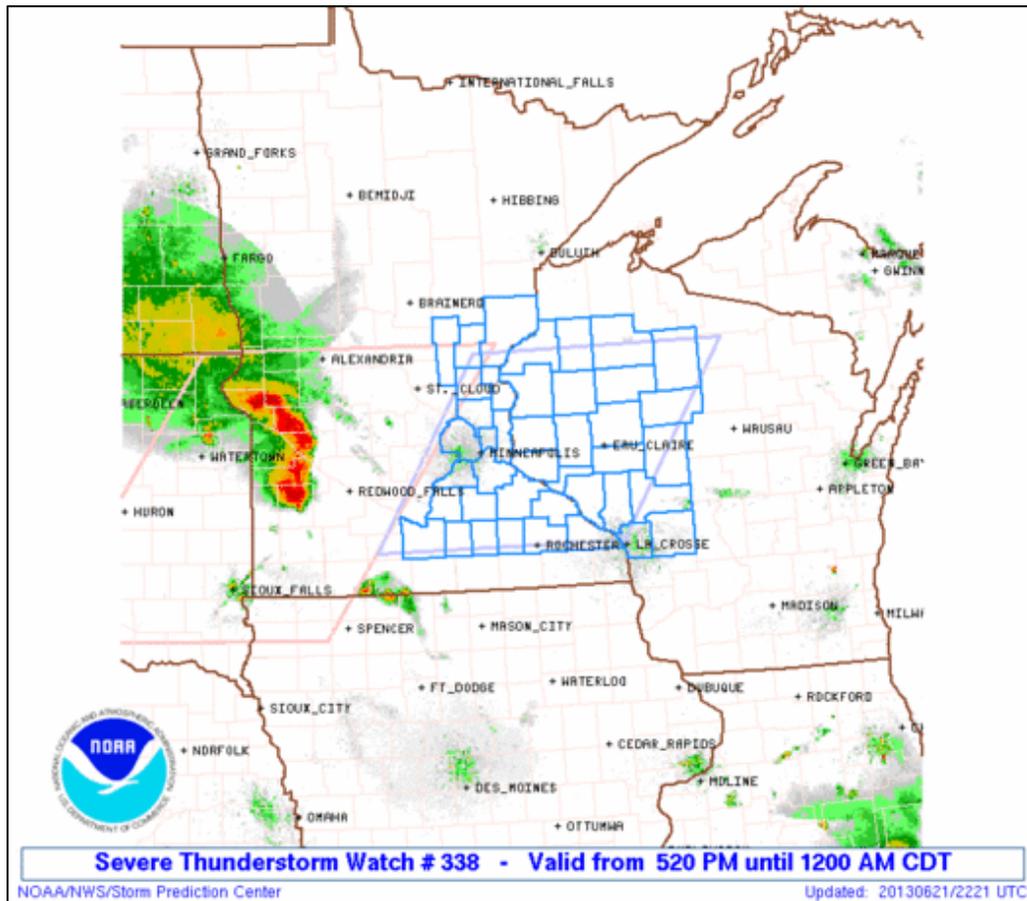


Figure 15. Severe Thunderstorm Watch issued well in advance of the main storm, which was moving at 60 mph.

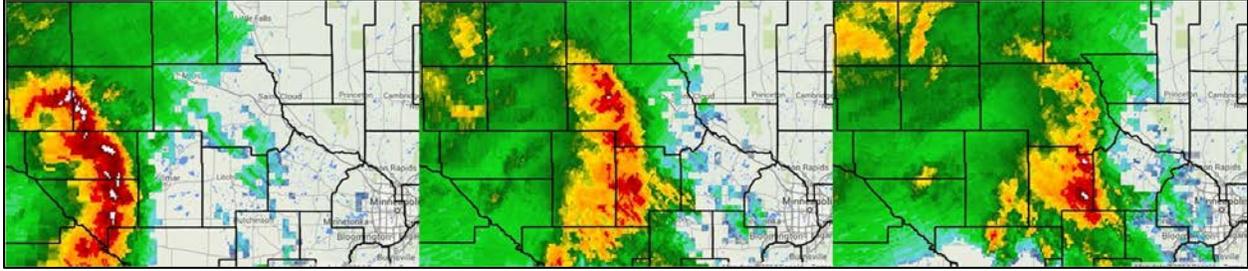


Figure 16. Composite radar from 5:30, 6:30 and 6:50 PM CDT, as storm contracts and weakens in central MN. Note change in storm size relative to Hennepin County.

7-9 PM

Despite an apparent collapse of a major cell within the storm complex, the thunderstorm over Wright and McLeod counties was still producing widespread, borderline severe winds. In addition, it was producing very intense rains—commonly 2 inches in under an hour.

The storm re-intensified slightly, entering northern Carver county at 7 PM, and western Hennepin by 7:15 PM. This strengthening increased the winds, the rainfall rates, and the duration of the storm at many places, and between 7:15 and 9:00 PM, 50-70 mph winds and extreme rainfall rates overspread the Twin Cities area, resulting in flash-flooding and some of the most widespread wind damage in the area's history. By the end of the event, several thousand trees had been uprooted or snapped, and Xcel Energy reported over half a million customers without power.

The wind-driven rain was so intense and so widespread, that few reports, other than those from sensors, were received in real-time; the ongoing damage was masked by the storm itself, and its true magnitude and coverage were not understood until after the storm had passed, especially in the coming days.

The breadth and magnitude of damage are beyond what would normally be observed from 50-70 mph winds, which would typically produce isolated pockets of downed limbs and trees. This damage, however, was nearly continuous across hundreds of square miles reaching into the core of the Twin Cities area. The extent of the wind damage was likely aided by the following factors:

1. **Duration of high winds.** Whereas as many thunderstorm wind events occur on the leading edge of the squall-line, this event saw downburst winds embedded within the main precipitation area and lasting for 20-30 minutes in some places. Thus, trees experienced higher than normal exposure and stress from these winds.
2. **Areal extent of high winds.** The storm complex was 12 hours old by the time it got to the Twin Cities, and had therefore become highly "outflow-dominant" and had also built up a large cold pool that fueled the downburst winds. Both of these factors contributed to a larger than

normal area of maximum winds, which subsequently exposed a larger than normal amount of trees and powerlines to prolonged stress.

3. **Saturated ground.** The first round of storms dropped 1-3 inches of rainfall on the Twin Cities, and was still being shed into surface water bodies when the evening storms moved in. The ground was softer than normal, and therefore provided less than normal stability for the trees to resist the winds.
4. **Root management policies.** The act of trimming boulevard roots before pouring cement or during other digging projects reduces counterweight stability of many trees. Many of the downed boulevard trees in Minneapolis were adjacent to new sidewalk slabs.^{vii}

9 PM to 1 AM

The main thunderstorm cell moved out of the Twin Cities area and into Wisconsin after 9 PM, but other storms had already developed and continued to form within the highly unstable environment across southern Minnesota (fig 17). These storms did produce some isolated reports of hail up to 2" in diameter into Carver county, and there was further wind damage reported across far southern Minnesota. By far, the biggest impact of this final round of storms was heavy rain, which led to and worsened flooding conditions over much of the area.

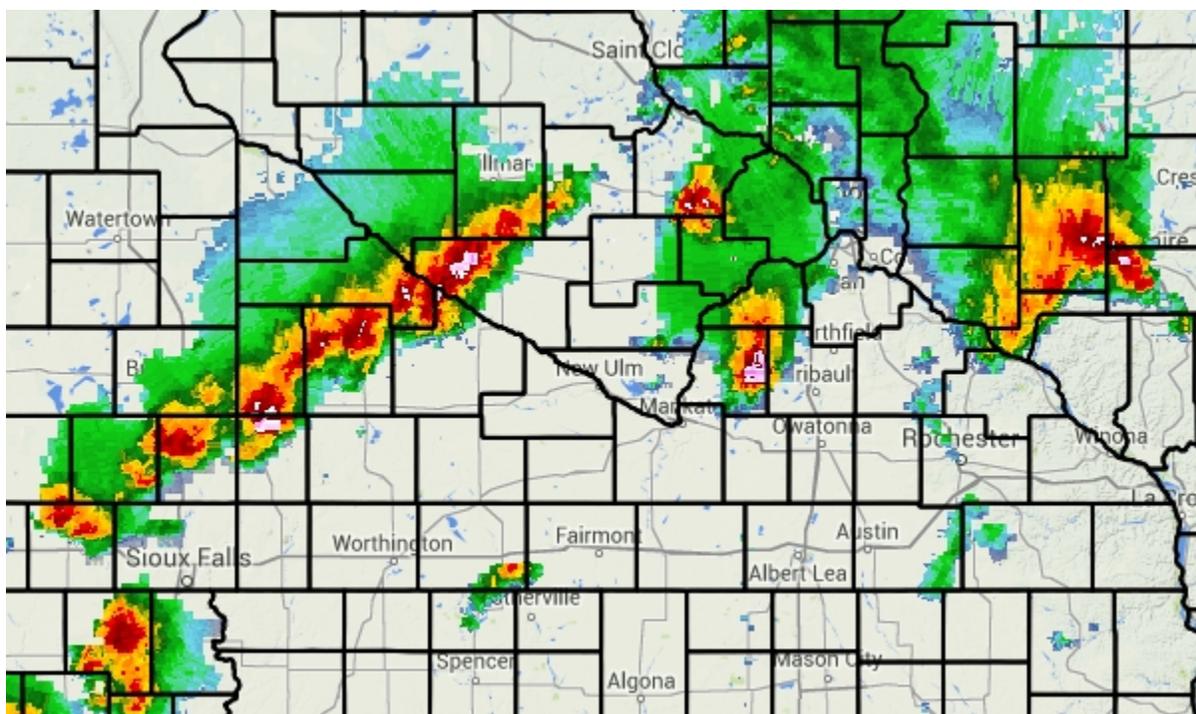


Figure 17. Composite radar at 9:30 PM CDT, showing main cell (right side of image) in Wisconsin, with numerous other strong storms producing heavy rainfall and marginally severe weather in southern Minnesota.

The evening round of storms produced intense rainfall over the southern third of Minnesota, and had some significant overlap with the southern part of the heavy rainfall area from earlier in the day (fig 18).

The pattern of severe weather reports differed somewhat from the earlier round of storms: whereas the morning storms had worked in from the northwest (see fig 8), these came out of the west-southwest (fig 19). And again, despite the high degree of damage and disruption, the winds in the Twin Cities were generally 50-70 mph—on the lower end of the spectrum of severe nontornadic winds (fig 20).

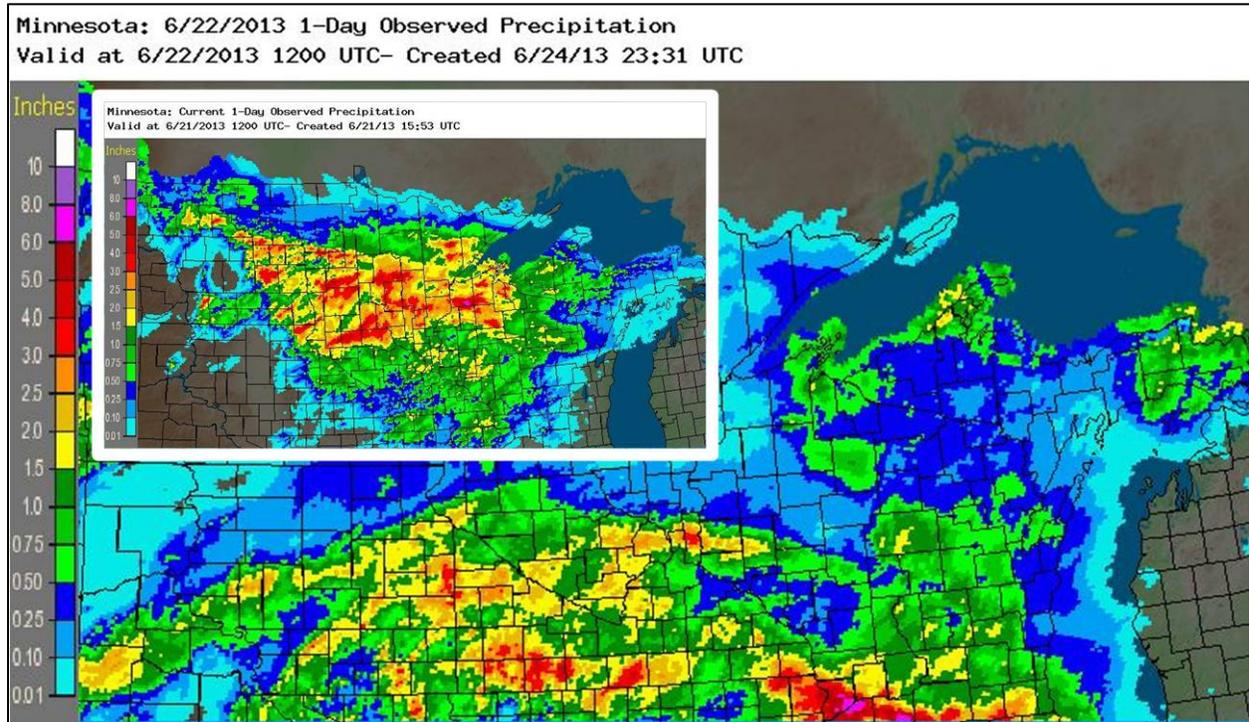


Figure 18. Observed and radar-estimated 24-hour precipitation pattern through June 22 at 7 AM. Note that inset is same image but ending June 21 (Fig 7).

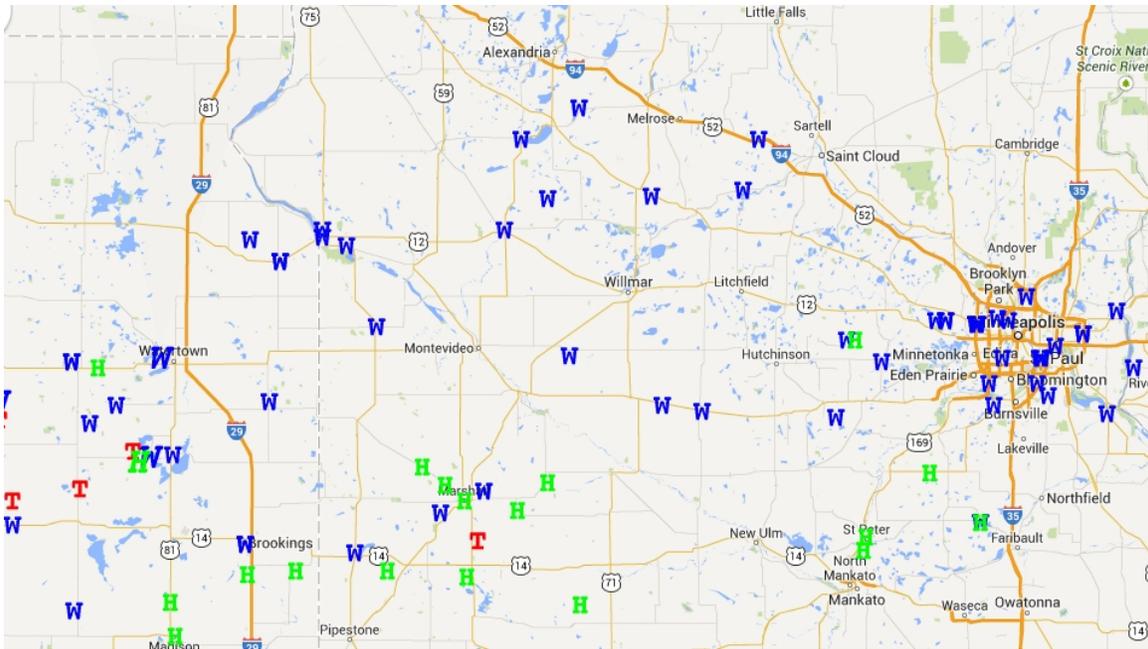


Figure 19. Reports of severe weather for through 7 AM CDT, June 22. Note general east-northeastward orientation of swaths. T=tornado, H= Hail, W= Winds.

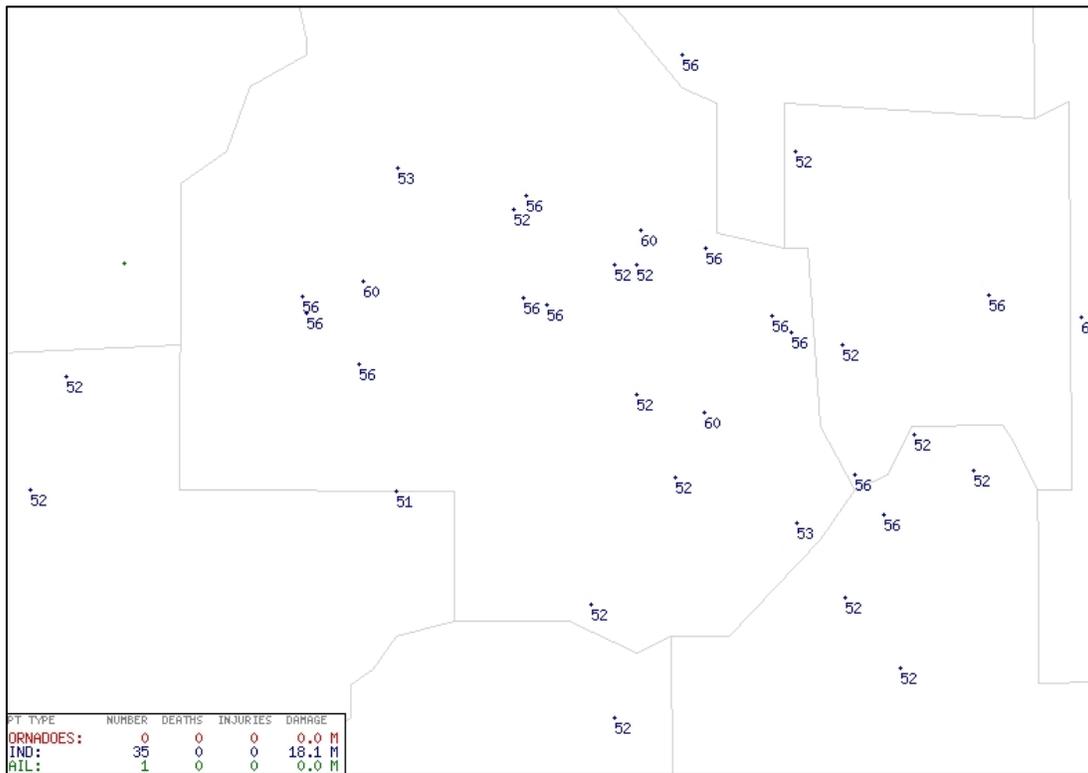


Figure 20. Wind reports in knots, ending 7 AM CDT (1200 UTC) on June 21, 2013. 1 knot = 1.15 mph. Wind damage occurred in absence of hurricane-force (65-knot, 75 mph) winds. Retrieved from Storm Prediction Center Severe Plot 3 tool.^{iv}

Impacts

The early morning storms uprooted trees, flooded roads and fields, and knocked out power to 133,000 Xcel Energy customers. The evening storms, uprooted more trees, flooded more roads, intersections and buildings, and knocked out even more power to Xcel and Hennepin-Wright customers. In total, over 600,000 customers lost power, with nearly 500,000 simultaneous outages on the evening of June 21st. The power outage was so extensive, up to 13,000 residents were still without power on the 25th, and 5,000 remained without on the 26th. Xcel replaced over 100 poles, 200,000 feet of wire and 80 transformers; it was the largest and costliest outage in the company’s history.

Although the two events were separated in time, their paths and impacts overlapped such that identifying exactly which impact came from which storm is nearly impossible. Damage and impact assessments from the first wave of storms were not complete by the time the second round began. Moreover, though the second wave of storms may indeed have been “worse,” it is clear that much of its wind damage and some of its flooding were exacerbated by the first storm: The morning storms saturated the ground and stressed natural and infrastructural drainage capacities throughout Hennepin County and the rest of the Twin Cities area. This made flooding with the second round of storms much more likely than it would have been if no morning storms had occurred. Likewise, the already-wet ground was unable to provide the stability and resistance necessary for large trees to withstand the prolonged, driving winds with the evening storms; the intense rain that accompanied those storms only further destabilized the soils.

In the wake of the storms (and as other storms struck with lesser impacts over the coming days), government agencies and municipalities began assessing the impacts and costs. Ultimately, a Presidential Disaster was declared for 18 Minnesota counties (fig 21). In Governor Dayton’s July 17, 2013 Disaster Request Letter^{viii}, Hennepin County was estimated to have \$4,592,663 in qualifying costs for public assistance. Of those dollars, about 75%, or \$3,466,807 were for Category A, specifically debris clearance. Ultimately Hennepin County’s publicly-qualifying costs totaled \$5,853,360 (see Table 1).

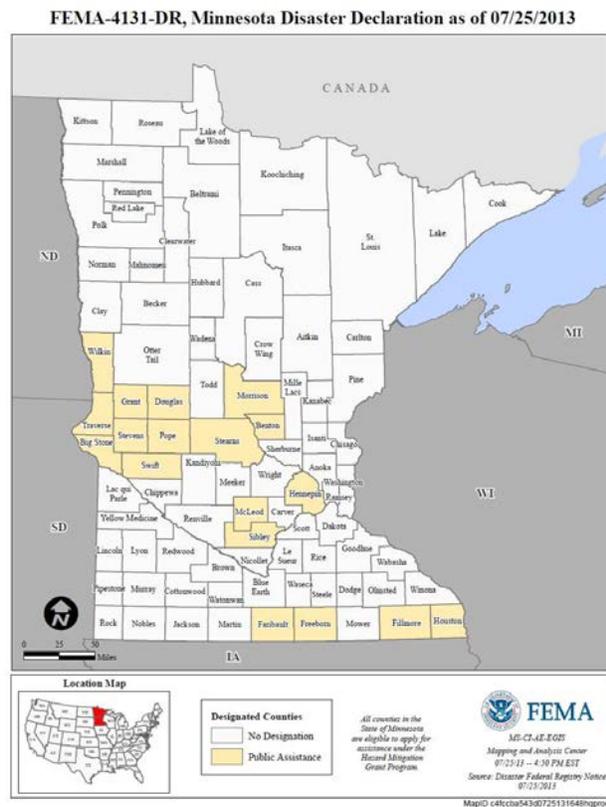


Figure 21. Map of 18 Minnesota counties covered by Presidential Disaster Declaration in wake of June storms.

Table 1 Preliminary estimated and final costs to municipalities and other Hennepin County entities qualifying for public assistance in Presidential Disaster Declaration.

Entity (Bold = final entrant name)	July 1 Estimate	Other Prelim. Estimates	Final Reimbursement/Request
Abbott Northwestern			\$ 203,596.48
Brooklyn Center			\$ 57,826.66
Brooklyn Park			\$ 100,378.85
Corcoran			\$ 104,529.19
Corcoran/Wayzata + Generator	\$ 141,593.00		
Crystal			\$ 66,207.18
Deephaven	\$ 4,096.00		\$ 13,105.89
EM Staff	\$ 1,480.00		
Golden Valley	\$ 105,106.00		\$ 91,722.61
Greenwood Elementary			\$ 24,985.61
HSPHD	\$ 66,198.00		
HC Dept Transportation	\$ 207,445.00		\$ 128,840.64
HC Property Management			\$ 9,394.97
Independence	\$ 1,094,000.00		\$ 19,609.16
Long Lake			\$ 23,521.50
Maple Grove			\$ 53,742.07
Maple Plain	\$ 2,044,700.00		\$ 27,982.77
Medina	\$ 48,500.00		\$ 21,326.59
Minneapolis	\$ 873,643.00		\$ 408,062.05
Minneapolis Park and Rec		\$ 973,683.00	\$ 2,285,456.14
Minnetonka			\$ 179,823.63
Minnetrista	\$ 6,000.00		\$ 25,712.67
New Hope			\$ 77,376.65
North Memorial Healthcare			\$ 413,763.72
Orono			\$ 42,071.83
Orono Public Schools			\$ 8,274.03
Phillips Eye institute	\$ 552.00		
Plymouth			\$ 366,847.85
Robbinsdale			\$ 135,471.35
Robbinsdale Area Schools			\$ 10,000.00
Shorewood	\$ 9,093.00		\$ 28,606.78
Spring Park			\$ 3,434.32
St. Anthony		\$ 63,242.40	\$ 77,319.98
St. Louis Park	\$ 322,275.00		\$ 445,026.65
U of M	\$ 5,602.00		\$ 116,930.34
Wayzata			\$ 105,707.46
West Hennepin Public Safety	\$ 2,590.00		\$ 14,856.49
Wright-Hennepin Coop Elec.	\$ 200,000.00		\$ 138,858.59
Metro Transit			\$ 22,989.17
TOTAL	\$ 5,132,873.00		\$ 5,853,359.87

Specific impacts to municipalities and other County entities

West Hennepin Public Safety: 200 homes with significant basement flooding

Brooklyn Center Lost at least 250 trees throughout the city, with power outages.

Golden Valley:

- Over 100 calls of arcing wires
- Hundreds of trees down throughout city

Maple Grove:

- Several city buildings ran on standby power for about 15 hours due to transmission lines down coming out of a substation.
- Rooftop HVAC unit blown off roof at Jimmy Johns on Bass Lake Road and Wedgewood.
- The canopy at the Holiday Gas Station on Bass Lake Road and I-494 blown apart.
- Numerous trees down incidents with some of the trees down were on homes and vehicles.

Medina: High concentration of tree damage and power outages. Lift stations and wells lost power and lacked enough backup generators to handle demand.

Minneapolis: As indicated in Table 1, some of the largest expenditures were in Minneapolis, which between city offices and the Park and Rec Board, accounted for 46%, or nearly \$2.7 M, of Hennepin County's costs.

- The city lost over 3,000 park and boulevard trees, with the greatest concentration stretching from the Cedar-Isles area to the Minnehaha Park/River Road area (see fig 22). Damage and debris removal was equivalent to over 2,300 semi truckloads^{ix}
- Over 800 of the downed trees fell across roads and/or intersections
- Power outages affected more than 15 of the city's recreation centers
- 800 traffic accidents were reported during the period of intensive clean-up, further strapping the city's response resources.

Plymouth:

- 80% of city lost power, with numerous utility system failures
- Over 1000 trees down
- Storm debris removal totaled more than 50,000 cubic yards

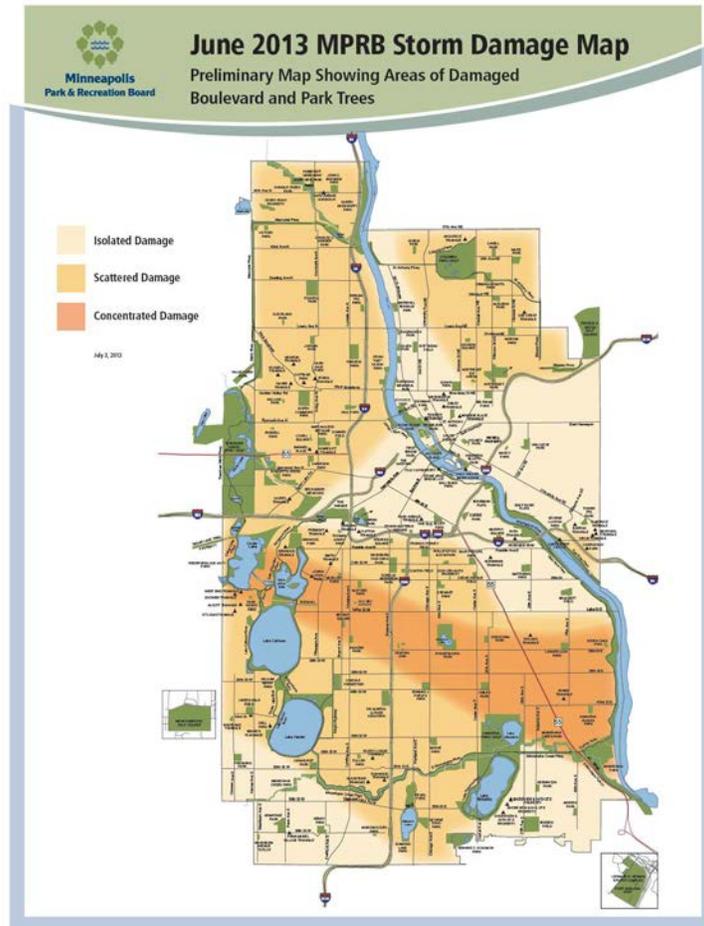


Figure 22. Tree damage pattern in Minneapolis^x

Robbinsdale: large sinkhole formed at 42nd Ave N and Bottineau Blvd after storm, as water main burst (fig 23).



Figure 23. Sinkhole on 42nd Ave N & Bottineau Blvd, courtesy of Star Tribune.^{xi}

Rogers: Rockin' Rogers celebration evacuated, then re-convened, then cancelled for evening.

Spring Park: over 50% of the community lost power, with trees down over a couple roads.

St. Louis Park:

- The Fire Dept's Nextel system failed so they switched over 800 MHz radio
- Power was knocked out at two Park water treatment plants, but the city used backup generators to keep the plants working. Majority of damage was north of Minnetonka Blvd^{xii}

University of Minnesota (Minneapolis campuses only):

- Trees down across west and east bank, including in parking areas and on cars
- West Bank Office Building (WBOB) had water damage in lobby and underground areas
- Washington Ave parking ramp had damage to electrical equipment and to UMPD property (fig 24)



Figure 24. Flooding damages to UMPD property.

Other Photos (Courtesy Star Tribune)



Further Considerations and Recommendations

The June 20-22 severe weather event in Minnesota was unique on several fronts.

1. Winds were relatively weak for level of damage incurred

The event set records for power outages, breaking the record from a similarly iconic and widespread severe wind event on May 30, 1998. The event also produced what is likely the most extensive non-tornadic treefall event in the recorded history of the Twin Cities. By comparison, winds in 1998 event, were estimated at 65-90 mph, whereas this one, even after accounting for both waves of storms, had 50-70 mph winds--a full level of severity lower.

2. Damage estimates were relatively low given the scale of the impact

Government-incurred damage totals in Hennepin County were just under \$6 million, and the statewide total was just under \$18M. Given a near-record treefall, record power outages, and over 1000 square miles encompassing of some degree of damage in the Twin Cities area alone, one could easily imagine a price tag into the hundreds of millions of dollars. In this case, the relatively low wind speeds prevented widespread structural damage. Most of the metropolitan flooding was of a short-term and isolated nature. If the storms had lasted even 20 minutes longer on the evening of the 21st, it is likely flood damages would have doubled or tripled.

3. The event was unusually widespread

Between the two waves of storms, virtually every community in Hennepin County was impacted by flooding, wind damage, or both. Events capable of such a widespread damage footprint have only occurred three or possibly four other times in the recorded history of the region. Thus, with limited other data available, such widespread events recur approximate every 30-50 years.

The key conclusion to be drawn from this event is that numbers can be misleading. Without the benefit of knowing the details, a \$6 million storm with 50-70 mph (and mostly 50-60 mph) winds would appear to be a relatively minor event. 50-70 mph winds occur somewhere within Hennepin county at least once a year. Multiple-thousand tree fatalities and 600,000 power outages do not, however. In terms of impact, this was a historical event.

The second round of storms likely would have had some impact even if the first storm had not occurred, owing to the long duration of the strong winds—even though they were only marginally severe. However, it is clear that the rain from the first storms had some major, though unquantifiable, impact on the damage potential of the second round of storms.

These factors point to a need to consider more than the usual variables and factors when assessing the potential for an event to have impacts. Saturated ground conditions can “lower the bar” for subsequent storm events, allowing marginally-severe winds to do the same type of damage expected from hurricane-force winds.

Additionally, the geographic extent of an event, in addition to its severity, needs to be considered. A large storm with a broad swath marginally-severe winds can exert a large impact—perhaps

substantially larger than a small storm with much more extreme winds. In the latter case, impacts would be relatively contained, whereas an event like June 21 spread impacts over an entire county.

Notes on Data Sources

Data and information for this report came from National Climatic Data Center publication, *Storm Data*, Vol 55, no. 6 (June 2013); the Minnesota State Climatology Office; the Midwest Regional Climate Center, The Storm Prediction Center's historical archive of products and historical severe weather event plotting interface (SVRLOT 3); the Twin Cities/Chanhassen office of the National Weather Service; and radar data largely came from the Iowa Environmental Mesonet. A number of accounts and much of the financial loss data came from communications received by Hennepin County Emergency Management from municipalities and other entities. Many of the images come from The Star Tribune or websites and are used here for informational and anecdotal purposes only.

References

ⁱ Daily Weather Maps, NOAA/Dept of Commerce.

http://www.hpc.ncep.noaa.gov/dailywxmap/index_20130621.html

ⁱⁱ National Weather Service Chanhassen Event Overview for June 21, 2013.

http://www.crh.noaa.gov/news/display_cmsstory.php?wfo=mpx&storyid=95623&source=0

ⁱⁱⁱ National Climatic Data Center (NOAA/Dept.of Commerce), *Storm Data*, Vol 55, no 6 (June 2013). Available at

<http://www.ncdc.noaa.gov/IPS/sd/sd.html>

^{iv} Storm Prediction Center event archive page of June 20-21, 2014.

<http://www.spc.noaa.gov/exper/archive/event.php?date=20130620>

^v Minnesota State Climatology Office, "Heavy Rains and Severe Storms: June 20-21, 2013," *Climate Journal*,

http://climate.umn.edu/doc/journal/severe130620_21.htm

^{vi} <http://www.spc.noaa.gov/climo/online/sp3/plot.php>

^{vii} "Minneapolis residents blame root cuts for downed trees." *Star Tribune*. June 25, 2013.

<http://www.startribune.com/local/minneapolis/213054631.html>

^{viii} https://mn.gov/governor/images/2013_07_17_Obama_Barack_President_Disaster_Relief_Request.pdf (see Enclosure B/Table A-1 at end of document)

^{ix} MPRB Storm Response. <http://www.minneapolisparks.org/default.asp?PageID=52&prid=2049>

^x http://www.minneapolisparks.org/documents/caring/forest/June_2013_Storm_Damage_Map.pdf

^{xi} <http://www.startribune.com/local/212605371.html>

^{xii} St. Louis Park Historical Society, "Weather Timeline."