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The Great Windstorms of 1995



A Report to the
Minnesota House of Representatives
Environment and Natural Resources Finance Committee



February 1996

Copies of this report are available from :

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Executive Summary

The Events

From July 9 to 14, 1995, a tornado and several wind storms caused severe damage all across northern Minnesota. The extended duration of tremendous straight-line winds in excess of 100 miles-per-hour snapped, leveled and bent large expanses of trees. Small communities and rural residents were also affected, experiencing widespread power outages, blocked roads, and limited damage to homes, barns, sheds and granaries.

The Damages

- Approximately 375,000 acres of forest land were affected by the wind storms. Approximately 60 percent of the affected forest land is in public ownership, with the majority of this being county administered lands, and 40 percent is privately owned.
- About 7.2 million trees were bent, broken, or uprooted, representing a volume of approximately 750,000 cords. This is enough wood to build more than 30,000 average size homes and is a little less than 20 percent of the current total annual statewide timber harvest.
- Roads were heavily affected by the storm, with many miles of state highways, county, township and state forest roads entirely impassable from large quantities of trees and debris on road surfaces.
- Although property damages were minimal considering the magnitude of this storm, some scattered property damage did occur.

Federal Disaster Declaration

- Fifteen counties and the White Earth Reservation were declared a federal disaster area by President Clinton in August 1995, authorizing the Federal Emergency Management Agency (FEMA) to act on the incident to provide assistance and funding. FEMA teams toured the storm damage area, reviewed projects and developed funding and hazard mitigation recommendations. The Department of Public Safety took over primary responsibility in late September.

Economic Implications

- The sudden availability of storm damaged timber produced a flood of wood on the market causing timber prices to drop to a fraction of their normal rate. The low timber prices will reduce the potential for landowners to recoup lost value. Most county land departments derive a major portion of their annual budgets, commonly up to 75 percent, from sales of timber. As little as 20 percent (or less) of the damaged wood will likely be salvaged, resulting in a significant loss of revenue to county, state and private landowner.
- The volume of wood damaged by the storm (i.e., 750,000

cords) and the amount of undamaged wood likely to be harvested along with the damaged wood during salvage operations totals about 1.5 million cords. Before the storm, this timber potentially might have been worth about \$42 million to landowners. In general, every dollar paid to a landowner for standing timber multiplies into \$25 or more in local economic activity, making the \$42 million of timber potentially worth \$1 billion to local communities. As a result of the storms, the actual post-storm value of this timber is perhaps \$3 million, reducing the potential worth to local communities to roughly \$75 million . . . a potential loss of over \$900 million to local communities!

- Economic impacts to local landowners and communities dependent on the forest industry are significant and will be long lasting as shortages of trees of harvestable age and size begin to appear in the next few years.

Recovery Efforts to Date

- Since ground travel was impossible in many places, aerial reconnaissance began shortly after the storm. Aerial photos were taken of the entire blow-down area to evaluate the extent of the incident. More precise aerial photography was completed later in the summer when wilted foliage of damaged trees was more apparent from the air. Existing permanent forest inventory plots within the blow-down area will be identified and reevaluated.
- A Governor's Executive Order was issued to allow extensions of existing state timber sales, without penalty, for loggers willing to purchase storm damaged wood. Similar permission has been granted by other affected land management agencies.
- Timber salvage efforts are underway. Salvage logging operations are extremely hazardous, as loggers must deal with trees piled like jackstraws, sometimes as high as 15 feet. Salvage must be carried out slowly and cautiously.
- Representatives of affected agencies in the western blow-down area, including DNR, BIA and County Land Commissioners, are working together to identify priority areas for a variety of future forest management treatments based on a number of factors including access, site conditions and historic land use patterns. Treatments being considered prescribed burning, shearing, site preparation and planting, seeding, etc.
- Days of cutting and hauling were required just to reopen main travel routes to the point that they were passable in one lane. Many additional weeks of labor were needed to restore roads to their former right-of-way width.

Future Forest Management Implications

- Costs related to forest regeneration will be tremendous, especially in areas where timber has not been salvaged (i.e., 80

percent or more of the damaged area). Tree planting will require the greatest investment in these areas. Other options include shearing for increased aspen sprouting, hardwood stand improvement, prescribed burning and aerial seeding where site conditions are favorable.

- As a result of salvage activities, truck traffic is exceeding the levels for which forest access roads were designed and budgeted for maintenance. Erosion potential is increased and maintenance costs will be higher than usual in the next few years. Additional investments will be needed just to maintain forest roads at current safety and design standards. This is especially important given the increased logging traffic on roads that are used primarily (e.g., over 95 percent on state forest roads) for recreation.

- The large, continuous expanses of storm damaged timber, especially in the western blow-down area, have greatly increased the potential for catastrophic wildfires. To reduce this potential, additional efforts need to be made to improve access into storm damaged areas, establish fire breaks, and reduce available fuels through continued salvage operations and prescribed burning.

- The large volumes of dead and damaged timber has also increased the potential for outbreaks of insect and disease infestations. Additional efforts will be needed to monitor insect and disease populations through aerial surveys, ground checks and pheromone trapping. Control methods such as continued salvage, pheromone trapping, and spraying need to be considered when the potential for loss exceeds the cost of control.

- Ecologically, this series of storms offers a rare opportunity for research into natural processes of forest disturbance and regeneration. Large portions of the storm damage areas will be left to recover on their own, some will be specifically set-aside to regrow on their own for scientific study, and some will be managed to restore a vigorous new forest. Study plots established in these areas would provide valuable information to compare various forest management alternatives and their impacts on the environment.

Mitigation and Restoration Funding

- To date, projects from 123 applicants, totalling \$6.4 million, have been determined eligible for reimbursement through the FEMA Infrastructure Support Program. FEMA estimates that it will reimburse 75 percent of this, or \$4.8 million. The majority of these funds will likely be allocated to rural electrical cooperatives, counties and townships for repairs to service and infrastructure. Restoration of natural resources (i.e., forest land, timber, wildlife habitat) is not considered reimbursable by FEMA under this program.

- Approximately \$2.5 million of projects have also been submitted to FEMA for consideration for funding from \$765,000 set aside for hazard mitigation. Again, the majority of this funding will likely go to rural electric service projects (e.g., burying power cables) with very little for natural resource hazard mitigation projects. However, approximately \$130,000 of this has been earmarked for wildfire risk mitigation.

- The DNR has submitted a \$313,000 supplemental budget request to the 1996 legislature for storm damage costs not reimbursable through FEMA.

- The Department of Public Safety has also submitted a \$513,000 supplemental budget request for the state portion of the 25% state/local match for costs determined to be reimbursable by FEMA. The DNR has \$62,000 of matching state funding in this request.

- Several counties whose forest resources were most heavily affected by the wind storms have also developed a supplemental budget request for consideration during the 1996 legislative session.

Overview

From July 9 to 14, 1995, several early-morning wind storms ripped through northern Minnesota, including a tornado in Kittson County and tremendous straight-line winds of extended duration in several other locations. These intense storms snapped, leveled or bent large expanses of trees and caused prolonged power outages all across northern Minnesota.

Eyewitnesses reported that there was so much lightning that you could watch the wind's effects on the forest. The first night, winds appeared to be whipping the trees in circles, but this caused very little apparent damage. The second night started like the first with incredible lightning displays, but with the winds blowing more in a steady, single directional. Then the lightning display and winds died down prior to one final push . . . the big one. This intense straight-line wind lasted about 20 minutes and caused the most severe damage. Some large areas were totally leveled, with essentially all trees either broken or uprooted for miles in all directions. Other areas had fewer broken trees but broad expanses of trees bent into graceful curves. Still other areas experienced scattered patches of blowdown, ranging in size from a few acres up to a square mile.

A wind monitoring station near Detroit Lakes, managed by the MN Department of Public Service and Otter Tail Power Company, recorded early morning surface wind speeds on July 13 averaging 55 mph, with a maximum speed of 129 mph. They calculated that winds over 100 mph were sustained for at least 20 minutes.

The Federal Emergency Management Agency (FEMA), in its Hazard Mitigation Survey Team Report, characterized these storms as *derechos*, severe thunderstorms accompanied by extended periods of high speed, straight-line winds. Rare in northern Minnesota, derechos are known in the central plains states for their extreme and damaging winds.

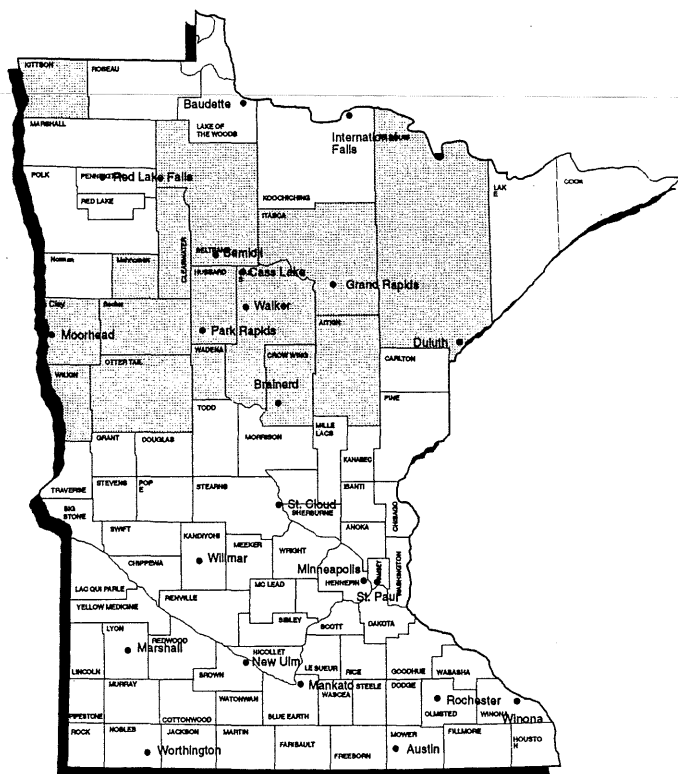
Federal Disaster Declaration

Twelve counties and the White Earth Reservation, were declared a federal disaster area by President Clinton on August 18, 1995, which authorized FEMA to provide assistance and funding to affected areas. Three more counties were added to the list on August 23, 1995. Affected counties include: Aitkin, Becker, Beltrami, Cass, Clay, Clearwater, Crow Wing, Hubbard, Itasca, Kittson, Mahanomen, Otter Tail, St. Louis, Wadena, Wilkin, and the White Earth Indian Reservation.

FEMA, in cooperation with the Minnesota Department of Public Safety, set up a temporary office in Detroit Lakes. FEMA teams toured the storm damage area, reviewed projects and developed hazard mitigation recommendations contained in the report, "FEMA-1064-DR-MN." The Department of Public Safety took over primary responsibility for the disaster recovery efforts in late September, acting as liaison with FEMA and coordinating communications.

The state Department of Public Safety, Division of Emergency Management officials were extremely helpful in sorting out various FEMA requirements for funding. Most affected agencies and communities had not been faced with similar emergency situations prior to this storm, were not familiar with FEMA and its procedures, and found the various programs confusing.

Federally Declared Counties FEMA -1064-MN



Damage Description

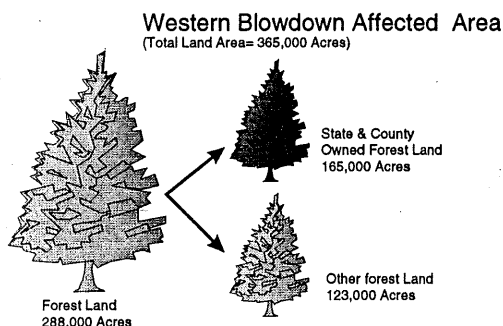
Area Affected

The storms left scattered damage throughout the northern half of the state (i.e., see counties included in federal disaster area), much of which is heavily forested. Because much of the area is relatively uninhabited, the storm caused little property damage and no loss of life. Had the same series of storms hit a major metropolitan area, the consequences would have been devastating.

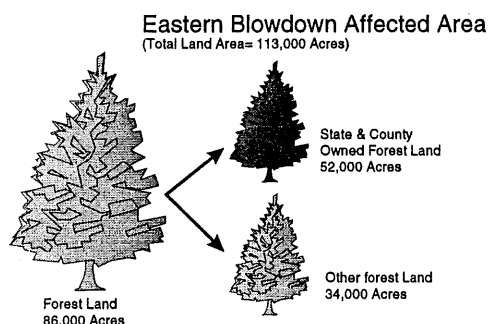
Although scattered damage occurred to forest land throughout the affected counties, damage to forest land was most concentrated in two distinct patches, hereafter referred to as the western and eastern areas. Within these two areas of concentrated damage, estimates show approximately 480,000 acres, an area about twice the size of Washington County, were affected by the mid-July windstorms. More than three-fourths of this area was forested, of which over half is owned by counties or the state.

The western area is an almost continuous expanse of flattened trees, up to eight miles wide and almost 50 miles long, from Detroit Lakes to Bemidji. Of the 365,000 acres included in this area,

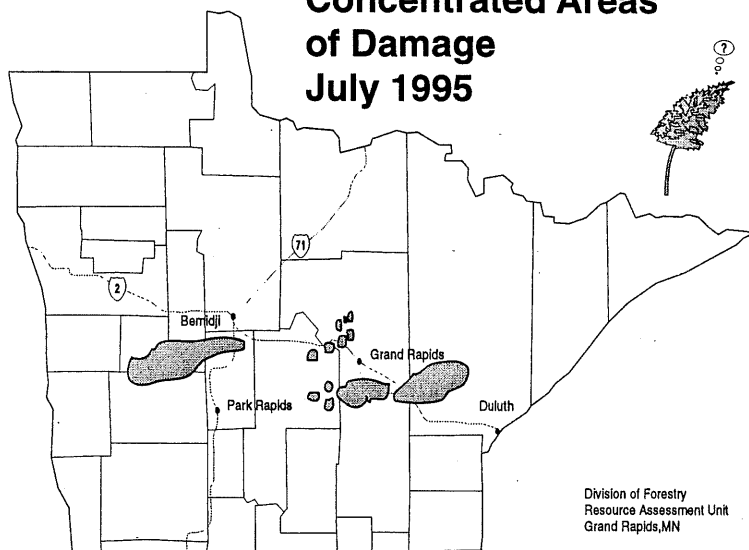
288,000 acres (i.e., 79 percent) is forest land. The state or counties own approximately 165,000 acres of this forest land. This area displays the most serious damage to natural resources. The DNR Division of Forestry is nearing completion of a more thorough assessment of the western area using aerial photographs, permanent plot inventory data, and computer analysis. This assessment shows that slightly more than 66,000 acres of forest land in the western area suffered slight to extreme damage (i.e., contained trees that had been tipped, or blown down), as discernable from aerial photos. Of this 66,000 acres, the state or counties own 40,000 acres.



The eastern area is less contiguous, consisting of a series of damaged patches, stretching about 60 miles from Grand Rapids to Duluth. Some patches are quite large, but the scattered nature of damage in this area makes assessment more difficult. Damage in the eastern area was generally less severe than in the western area, with the amount of timber



Concentrated Areas of Damage July 1995



damaged estimated at roughly 10 percent of total timber volume in the area. This area covers approximately 113,000 acres, of which 86,000 acres (76 percent) is forest land. The state or counties own approximately 52,000 acres of this forest land.

Summary by Ownership

State Lands

Based on the recent, more thorough analysis of the western area, approximately 10,000 acres of state-owned forest lands suffered light to extreme damage from the wind storms. Approximately another 14,000 acres were affected in the more scattered damage of the eastern area. Approximately 114,000 cords of wood were damaged on these lands: 100,000 cords in the western area and 14,000 cords in the eastern area. The estimated pre-storm value of the damaged timber on state lands approaches \$3.2 million.

To date, 17,000 cords of wood have been salvaged from state forest lands. A total of 40 state timber sale permits, previously sold for timber not damaged by the storms, have been extended to encourage the salvage of damaged timber. Ten permits that were previously sold, but had not yet been harvested and were subsequently damaged in the storms, were modified or reappraised to reflect reduced timber volumes and values.

Nine small state wildlife management areas (WMAs) in Clearwater County were affected, with about 200 acres of timber and four access trails damaged. Four state WMAs in Becker County received heavy damage, requiring seven days of area staff time and 22 days of MCC crew efforts to clear roads and trails. Numerous other patches of damage to state WMAs occurred throughout northern Minnesota.

Approximately 3,000 acres of forest in Itasca State Park received some level of damage, including a significant amount of pine. This represents about 10 percent of the park's land base. However, the level of disturbance in the park was spotty. The northwestern corner of the park was flattened or sheared off and there were other scattered areas in the park where there was severe damage, such as the entrance areas to the camp-grounds and Peace Pipe Vista. Fortunately, only 1,000 trees were lost in the high-use areas thanks to an aggressive hazard tree removal program over the past several years.

County Land

Lands administered by Clearwater County received some of the most severe damage. About 33,000 acres of county owned forest lands were in the affected area, or 45% of all the forest land that the county manages. Almost 12,000 acres sustained heavy damage, essentially totally flattened. The rest of the county forest land in the affected area received varying levels of partial damage. Regeneration and management efforts are expected to cost about \$1 million over a period of up to five years. Approximately \$4 million in stumpage value was destroyed. Only a fraction of this will be recovered in salvage sales.

About 16,000 acres of Becker county tax-forfeit lands are within the affected area. The pre-storm value of the timber on these lands was almost \$4.4 million. Aspen received the bulk of the damage, with lesser damage in hardwoods and pine. They will likely shift forest management activities toward high-quality hardwoods, since much of the aspen is gone and will be in regeneration stages for many years.

Many other counties sustained less severe damage. In Hubbard County, for instance, four townships received the most severe blowdown, totaling about 4500 acres, originally worth approximately \$1.75 million. Replanting costs are expected to approach \$250,000. Itasca, St. Louis, and other eastern counties experienced scattered pockets of wind damage that are much more difficult to assess.

White Earth Reservation

The White Earth Indian Reservation was heavily impacted. Privately owned lands are intermixed with Tribal and Band lands on this Reservation. Approximately 8,000 acres of Tribal and White Earth Band land were within the affected area. In the most severely damaged areas, 60% to 100% of the trees were blown down, much of which was aspen. Moderate damage surrounded the most severe areas.

Salvage logging is continuing throughout the winter. Deep snow conditions and other results of storm damage, spring poles, tipped up roots, etc., make logging difficult and dangerous. However, concern for adequate aspen regeneration has prompted Reservation resource managers to keep salvage efforts going all winter. Salvage harvests soon after the storm concentrated on pine, a higher value species, to minimize damage from blue stain fungus and reduce the risk from bark beetle infestations. Most accessible pine has now been salvaged from the blowdown areas.

Chippewa National Forest

The Chippewa National Forest is not included in either the western or eastern areas described in this report. However, like much of the northern half of the state, there was scattered light damage throughout much of the Forest. A few concentrated patches had moderate to heavy blowdown, primarily in the Trout Lake & Soumi Hills areas near Marcell. The widely scattered nature of the blowdown makes salvage economically and environmentally unfeasible in many places.

About 850 acres of moderate to heavily damaged timber will

likely be salvaged, primarily where damage occurred in concentrated patches and along roads or trails. As of early December, 16 timber salvage sales were sold, containing a volume of about four million board feet (8,000 cords.) Another six million board feet (12,000 cords) of damaged timber is being evaluated for salvage potential. Less than ten percent of the total amount of damaged timber is expected to be recovered.

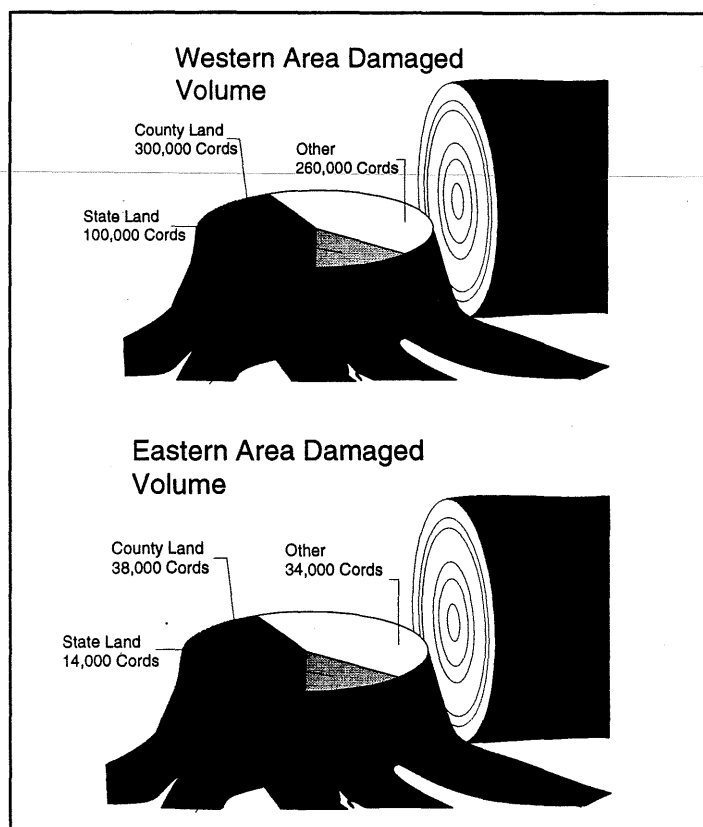
Private Lands

About 50,000 acres of privately-owned forest lands (i.e., both industry-owned and nonindustrial) were affected by the wind-storms. The pre-storm value of the estimated 210,000 cords of damaged wood on these lands is nearly \$6 million. Forest products companies have been actively salvaging damaged timber on the forest lands they own. However, salvage operations on non-industrial private forest lands have been more sporadic, with many landowners uncertain about what they can or should do

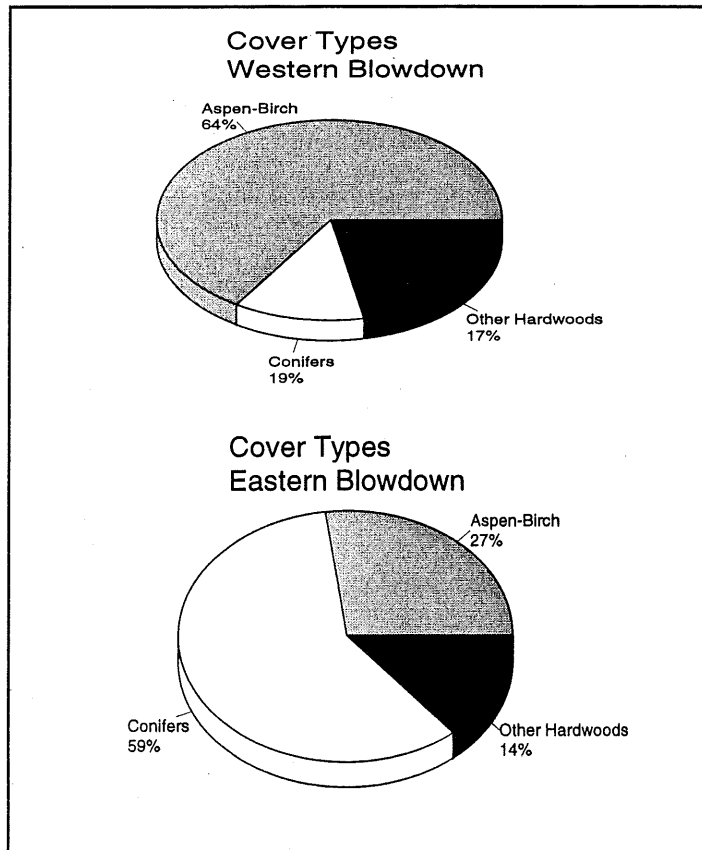
Natural Resources

Timber

About 7.2 million trees were bent, broken, or uprooted in the western and eastern areas combined. Broken trees often snapped off well above the ground, leaving unsightly broken snags and ruining the potentially highest quality part of the tree for any possible salvage. The damaged trees comprise a volume of approximately 750,000 cords of wood. This is enough wood to build more than 30,000 average size homes and represents a little less than 20 percent of the total annual statewide timber harvest in Minnesota.



About 2/3 of the damaged area in the western block is aspen, while only about 1/4 of the eastern area is aspen. Although rare in pure stands, white pine is an essential component of many mixed forest types. Three pure stands of white pine in Clearwater County were totally destroyed. However, many more individual white pines in mixed stands were blown down or had their tops broken out, decreasing their capacity for producing cones and seed.



Ecological Systems

A fundamental principal of biodiversity is retention of natural processes. Long-term changes in the forest are very important from a wildlife habitat standpoint. The storms instantly converted a very large area from mature forest to a disturbed, early-successional condition. This significant change will, of course, immediately benefit some wildlife and plant species and harm others. From an ecological standpoint, the storm has created a large patch of what essentially will be an even-aged regenerating forest, designed without human influence.

The general goal of forest management efforts has been to regulate the age of the forest so a sustained balance of all ages of each forest community can be maintained. Balanced age classes, ranging from young stands to "extended-rotation" or very old forests, provide habitat for diverse wildlife species and diverse and sustainable opportunities for the harvest of forest products. Forest managers carefully plan timber harvests on public land to remove the older trees before they deteriorate beyond usefulness for wood products, and then regenerate the stand into a healthy young forest. The storm has set back years of effort in attempting to regulate the age class distribution of forests in the affected areas of the state.

Wildlife

Estimates of short term impacts to wildlife populations are subjective at best, as ground surveys are nearly impossible to complete within the blowdown area. Changes to habitat structure had an immediate effect on use of the forest by wildlife, altering availability of cover as well as insects, soft mast, and other important food sources. Direct mortality certainly occurred due to falling trees and branches. Local canopy nesting birds were undoubtedly severely impacted by the timing of the storm, since it coincided with peak fledgling and brood rearing of many forest birds. Smaller, ground-dwelling species probably fared better, but there have been anecdotal reports of deer carcasses pinned under downed trees.

Property

Property damage was limited considering the magnitude of these storms. However, some scattered damage did occur as is typical of rural windstorms. Small communities were affected by widespread power outages and blocked roads. Barns, sheds and granaries were blown over. Many trees landed on roofs. A mobile home was blown by storm winds into the middle of a county road. Another unoccupied mobile home was levelled by a very large cottonwood tree, collapsing the roof, yet leaving three walls standing.

Small communities were ill-equipped to deal with a storm of this intensity, as illustrated by the city of Hawley, a small town (e.g., population 1,665) near Morehead. Hawley was hit by the storm at 3:00A.M. Early-morning reconnaissance attempts by police and city officials were complicated by more than 100 fallen trees laying across parked cars, debris in the streets, and the town's residents milling about checking the damage. Power was out, so the sewer lift station was not functioning and the water towers had to be drained into the sewer system to keep it from backing up into residents' basements. This resulted in a water shortage which further complicated matters. Local media began broadcasting notices to conserve water soon after 5:00 A.M.. Homeowners began cleaning up their own property as soon as they were able. The National Guard arrived on duty in Hawley later that evening and worked several days to provide security and to clear trees and brush from the streets.

The Hawley city administrator referred to cleanup efforts as "organized chaos." Emergency officials generally knew their roles and did them.

Assistance arrived from towns 100 miles away, as closer towns were also busy with their own storm cleanup efforts. Local farmers and implement dealers were very cooperative, providing tractors, chain saws, and other equipment.



Roads

Road right-of-ways were also heavily affected by the storm, with many miles of State highway, County, Township and state forest roads impassable from large quantities of trees and debris on road surfaces. Days of cutting and hauling were required just to reopen main routes to the point that they were passable in one lane. Many additional weeks of labor restored roads to their former right-of-way width.

An absentee landowner called a local friend to check on his cabin in the blowdown area to evaluate what the damage was. The local friend had been to the cabin many times and knew the area well. Several days after the storm, once the county roads were reopened, he drove to the area of the cabin and literally could not find the driveway. Debris was so thick that, once the drive was located he kept wandering off the drive and into the woods as he climbed his way back to the cabin. Every square foot of driveway surface was covered with debris. The cabin suffered only minor damage from trees and limbs, but all trees were lost.

Recreation Facilities

Itasca State Park

The park was filled to near capacity, with almost 1,000 visitors, when the storm hit. Amazingly, only one visitor was injured (a broken leg) and no injuries were sustained during the clean-up. A few tents, vehicles, and boats were damaged. All visitors and non-maintenance park staff had to leave since water and electrical service was cut off indefinitely. This was especially difficult for the University Field Station since the storm hit right before final exams for the first summer session and for the Douglas Lodge which had an international caddisfly conference in residence.

The entire park was closed for three days and Wilderness Drive was closed for eight days.

Forest Campgrounds

A popular Clearwater County park and campground on Long Lake, just west of Itasca State Park, suffered substantial damage. Trees were tipped over and broken throughout the park, but facilities were quickly reopened. Some more remote recreation areas may not be reopened, or perhaps reopened just with limited services. Arrow Point campground, a DNR-Forestry campground in Clearwater County, was nestled among large trees along a small fishing lake. The entire area was leveled. Although it will likely continue to be used as a public access, camping will be of lesser importance and Arrow Point will likely be reopened as a walk-in campground rather than a drive-up facility.

Trails

Approximately 300 miles of recreational trails were affected by the western blowdown area. Severe damage occurred on 20% of the trails, while 40% of the trails received only light damage. All snowmobile routes are open this winter, although major segments have been rerouted to avoid salvage operations near trail routes. Some portions of the White Earth State Forest and surrounding destinations will be accessible only by rerouted trails.

Hunting

Hunters and other fall recreationists had to adjust to the altered forest conditions. Most deer hunters traditionally use the same areas year after year. Many travel long distances for a few days of hunting. Despite press releases warning of difficult vehicle and walking access, some may not have been aware of the local conditions when they arrived for their hunt. Some hunters were reported to have shortened their hunts, returning home earlier than they had originally planned.

Tourism

Tourism did not suffer significantly and may have slightly increased immediately after the storm. Tourists in the area at the time of the storm generally found the inconvenience as a challenge. Damaged resorts have recovered quickly and very few reservations were canceled.

Economic Impacts

General

The long-term effects of the storms on forest industries in the storm damaged areas will have significant negative economic implications for local communities. The volume of wood damaged by the storm (i.e., 750,000 cords) and the amount of undamaged wood likely to be harvested along with the damaged wood during salvage operations totals about 1.5 million cords. This timber potentially might have been worth about \$42 million to landowners if the storms had not occurred, and almost \$180 million when processed into finished products. Every dollar paid to a landowner for standing timber can multiply to \$25 or more in local economic activity through money spent for fuel, equipment, parts, groceries, etc. Therefore, the estimated \$42 million worth of trees before the storm could have been worth as much as \$1 billion to local communities.

Following the storm, the value of standing timber plummeted to between 1/10 and 1/2 of the pre-storm value. Pulpwood which was selling for about \$25 per cord before the storms, is now commonly selling for about \$2 per cord. Sales with pockets of blowdown or less severe damage sell for only slightly more, perhaps \$8 or \$10 per cord. Standing, undamaged wood is selling for about 30% less than normal, due to the flood of wood on the market.

Salvage efforts will recover only a small percentage of the timber volumes damaged by the storms. Thousands of acres of damaged woodlands, once scheduled for future harvest, will never be salvaged because of the large volumes of timber involved, poor access, flooded wood markets, and the short time period for salvaging much of the wood before it deteriorates beyond usefulness for wood products. Other areas will be intentionally set-aside for scientific study and biological diversity purposes. As a result, the estimated \$42 million of timber in the areas damaged by the storms will likely be reduced to an actual post-storm value of perhaps \$3 million, reducing the potential worth to local communities to roughly \$75 million or less.

Once salvage efforts are completed, timber harvesting and related forest products industry activity will likely drop dramatically in affected areas as trees of harvestable size and age will be in short supply for years to come. Likewise, forest products industries' contributions to local economies will likely be greatly reduced.

Intense competition for the limited supply of harvestable trees will likely drive timber prices up. This could possibly force some loggers to move (if they are able) or force some out of business if they cannot afford to purchase enough wood to maintain their operations and provide a steady supply of wood to the mills. As demonstrated on the West Coast in recent years, entire communities can suffer economic hardships when logging companies fold or relocate.

County Revenues

Most County Land Departments derive a portion of their annual budgets, commonly up to 75%, from timber sales. As little as 20 percent (or less) of the damaged timber will likely be salvaged and the salvaged timber will be sold at drastically reduced prices. This will result in a substantial loss of county revenues.

Aitkin, Becker, Clearwater, Hubbard, Itasca, and St. Louis counties were all affected to varying degrees by the storms. Becker

and Clearwater counties, the most severely affected counties, estimate over 300,000 cords of aspen and 6.5 million board feet of white and red pine were damaged/destroyed by the strong winds. The loss of future revenue to the land departments in these two counties alone from just these three species is nearly \$6.4 million!

Taxpayers will be directly affected by this revenue loss, since excess timber sales revenues that are not spent in forest management activities by the land department are usually apportioned back to other county accounts, such as schools, townships, and general revenue. Projections for substantially decreased timber sales revenues has prompted the Becker County Board to consider levying an unprecedented tax to provide revenue for the Land Department in FY 1997.

Several County Assessors have received requests to lower private property valuations to reflect storm damage. They are currently reevaluating properties and estimate that values may decrease in severely affected areas, perhaps as much as 5 percent. Average lakeshore values on Tulaby Lake in Mahanomen County, for example, will likely decrease from \$170/foot to \$155/foot. Clearwater County is also making reductions to consider decreased marketability of affected properties.

Based on shade tree valuation techniques, the value of lost or damaged yard trees can be substantial. One shade tree in a yard or boulevard can be worth thousands of dollars. Although property damage was not widespread, the value of all of the trees lost on residential property in this incident is significant. Property values of homes and vacation cabins have certainly decreased. The reduced value of property in the areas affected by the storm will result in further reductions in county revenues.

Private Landowners

Economic loss to private woodland owners is significant. For example, three adjoining landowners near Tulaby Lake sold aspen timber to a logger before the storm for \$14,732. He had not yet begun cutting. To get the timber salvaged after the storm, they had to reduce their selling price to \$3,683, a loss to these three landowners of \$11,049. They were fortunate to be able to sell it at all.

A private woodland owner with 715 acres near Detroit Lakes was planning to harvest his aspen before the storm hit. Appraisals showed approximately 4,000 cords, valued at \$20/cord, or \$80,000 total. This parcel was completely blown down. The value is now \$2/cord, or \$8,000 if all of the damaged wood is usable. Landowners are finding that only a percentage of their wood is actually available for salvage, so actual receipts to this particular landowner will certainly be less than \$8,000. The storm has forced a glut of wood on the market, so this stand may never be harvested.

A dense 100 acre stand of mixed hardwoods, marked by DNR foresters, showed 30% loss of down or broken oak, basswood, ash and elm. Stumpage values fell from almost \$200 to \$50-100 per unit (i.e., thousand board feet). The storm was particularly damaging for valuable hardwoods such as this, because these species are generally managed for higher quality by a series of selective thinnings, taking out the worst trees and constantly improving the quality of the woodlot. Management of many hardwood stands, carefully improved over the years, will have to begin again at square one.

Restoration Efforts to Date

Damage Assessment

Since ground travel was impossible in many places, aerial reconnaissance began shortly after the storm. Aerial photos were taken of the entire blow-down area to evaluate the extent of the incident. More precise aerial photography was completed later in the summer when wilted foliage of damaged trees was more apparent from the air. The DNR Division of Forestry's Resource Assessment Unit is currently working on photo interpretation, determining forest cover-types and digitizing the data for computer analysis. They expect to have complete information ready for distribution in February 1996. Existing permanent inventory plots within the blowdown have been identified and reevaluated.

Timber Salvage

Before the storm, many loggers had already purchased the timber they planned to harvest during the upcoming fall and winter seasons. To attract loggers to salvage storm-damaged timber,



Governors's Executive Order 95-11 was issued on August 28, 1995 to allow extensions of existing state timber sale permits, without penalty, for loggers willing to purchase storm-damaged wood. With the permit extensions, loggers were able to buy salvage sales without having to be concerned about harvesting standing timber which they had previously purchased. Similar permission has been granted by other affected land management agencies.

Timber salvage efforts are underway. DNR Forestry, County land departments and Reservations are cooperating in timber sales whenever possible. Salvage logging operations are extremely hazardous, as loggers must deal with trees piled like jackstraws, sometimes as high as 15 feet. Tipped-up root mounds with their attendant pits and sprung-over young trees that snap back with great force when released present additional hazards. Salvage must be carried out slowly and cautiously.

While most storm damaged wood is suitable for pulp products, such as paper, pulpwood is a relatively low value product. Large quantities of pulpwood will be left unsalvaged, simply because

it would cost more to recover it than the product is worth. Trees with potentially higher value, such as Norway and white pine or large hardwoods, were salvaged as soon as possible to avoid degradation by stain fungi, insects or rot. Large portions of these higher value trees had to be left behind, however, as wind shattered trees are not suitable for solid wood products such as lumber.

Ecosystems

The storms crossed several ecological landscape units, primarily the Pine Moraines, St. Louis Moraines, and Tamarack Lowlands units. DNR landscape teams, representing the various DNR divisions, are currently assessing the effects of the storms on ecosystems and opportunities created by the storms for pursuing ecosystem management, including identifying priorities for various treatments. Landscape team recommendations will be applied to state lands through the Regional Land Management Plan, a long-range strategic plan for ecosystem-based management.

In addition, representatives of affected state and local agencies in the western blow-down area, including DNR, BIA and County Land Commissioners, are working together to identify priority areas for both intensive and extensive management treatments based on a number of factors, including access, site conditions and historic land use patterns. Treatments being considered include prescribed burning, shearing, site preparation, and planting, seeding, etc. Some areas will not receive restorative management, but will be allowed to regenerate on their own. This committee has many common members with the DNR Pine Moraines landscape team and will assure complimentary management goals across the broad landscape.

Wildlife Management Areas

Some work has already begun to clear and restore wildlife openings in the storm damage area. For example, five person-days (\$750) were expended this fall by the DNR Park Rapids Wildlife Area personnel. Another 5-10 days (\$1500) of work is planned there for spring/summer of 1996, with supplemental contract work also possible, funded through the Deer Management Account for about \$2500. Therefore, state WMAs in the area around Park Rapids alone will require a total of approximately \$4750 to renovate.

Recreation Facilities

Itasca State Park

Many of the forest stands in Itasca State Park are candidates for designation as state old-growth forests and, therefore, clean-up and salvage are inappropriate. Only the high use areas, roads and trails were cleaned up to remove safety concerns and allow access. Salvage efforts recovered a total of 101,000 board feet of pine sawlogs, 46 cords of aspen and jack pine, and 10 cords of firewood, for a total value of \$24,000.

The estimated cost of the storm to Itasca State Park is \$310,000, which includes damage to buildings and other facilities, revenues lost to the lodge and gift shop operations, costs of labor, fleet, and contractors, restoration of deer exclosures, and necessary

tree transplants into the high use areas. Additional costs which are not factored into all this are the hazard tree program, long-term trail maintenance as damaged trees continue to fall, and the maintenance of bark beetle traps. The park received \$20,000 from LCMR for emergency funds to pay the private contractor who helped open the roads (FEMA reimbursed 75% of this) and made \$24,000 from the salvage operation.

Interpretive materials about the storm are being developed. A slide program was assembled soon after the storm and presented many times this past summer and fall. It is being refined and will be a "regular" feature of the summer program schedule in 1996. Almost all hikes covered the windstorm in some capacity. Hikes planned for this coming season will not only cover the storm, but also the pheromone trapping program for bark beetles. Three fact sheets are being developed to cover the windstorm, bark beetles and pheromone trapping, and the general natural processes that effect the forest ecosystem (wind, disease, insects, and fire). In addition, the park is developing "the Blow Down Trail," an approximately 2-mile loop off of Wilderness Drive to show people the effects of some of the blowdown, standard logging practices and a comparison of natural succession within these two management units.

The storm had a drastic effect on some of the natural communities of the park and this impact will be monitored over the long term. It offers an opportunity to accelerate pine restoration by planting seedlings and experimenting with under planting white pine. Significant pressure to "clean up" the damage so wood would not be wasted and make the park "look neater" prompted increased efforts to educate people about the role Itasca plays in the landscape as a relatively pristine old growth ecosystem and as a baseline for comparison with more manipulated sites. Park managers are developing a long term vegetation plan to restore the entire park ecosystem, not just the blowdown areas, although there is no budget for this additional work.

Trails

To date, almost \$60,000, most of which is eligible for 75 percent FEMA reimbursement, has been spent to reopen blocked trails. All snowmobile routes are open this winter, although major segments were rerouted to avoid salvage operations near trail routes. Some portions of the White Earth State Forest and surrounding destinations will be accessible only by rerouted trails. About \$50,000 additional funding will be necessary to complete rerouting and reconstruction work.

Private Lands

A mailing was sent to all affected landowners by Forest Management Services, a Grand Rapids area consultant, in cooperation with the DNR Division of Forestry, to evaluate the need and demand for professional forestry assistance for private landowners in the blowdown area. They were advised to contact consultants or DNR for advice. Several consultants are working with landowners in the affected areas. Many landowners, however, are being contacted by loggers directly and are harvesting timber without foresters' assistance.

Future Forest Management Implications

Timber Salvage and Timber Supply

The availability of large volumes of storm damaged wood has saturated regional pulpwood markets. Wood yards at most wood products industries are filled to capacity. As a result, interest in blowdown wood has decreased, with many salvage sales selling at appraised price (i.e., no bid-up at auctions). Some salvage sales and even tracts of standing timber are not being purchased by loggers, as they have already bought all that they can finance. Salvage harvests are expected to continue to decrease over the next year. By the end of 1996, when pulpwood markets begin to recover, there will likely be little sound salvage wood available in the area and most forest products industries will return to wood harvested from undamaged stands located in other parts of the state. Trees that were tipped over with roots still attached may remain viable for somewhat longer, but probably will not be useable after the summer of 1997.

There may be serious long-term impacts to wood supply in the areas affected by the storm. While a temporary surplus of wood is available at this time, in a few years there could be a shortage of merchantable timber for a short period of time. Trees tipped over with their roots still attached can probably live for a few years, extending the period that salvage efforts can continue. Trees that snapped off, however, begin to stain and rot within a year or so and soon become unusable for forest products. It is critical that salvage operations proceed as quickly as possible in areas that contain primarily broken trees.

A possible mitigation for the anticipated reduction in timber supply is increased planting of hybrid poplars on marginal agricultural land near the storm impact area. Hybrid poplar is a fast-growing tree, related to the cottonwood that can grow to pulpwood size in 7-15 years and could provide a product to harvest while

natural forests recover and grow back from the windstorm.

Forest Roads

As a result of salvage activities, truck traffic on forest access roads is exceeding the levels for which they were designed and budgeted for maintenance. In addition, a wet summer and fall compounded the effects of additional traffic on these roads. Erosion potential is increased and maintenance costs will be higher than usual in the next few years. Additional investments will be needed just to maintain forest roads at current safety and design standards. This is especially important given the increased logging traffic on roads that are used primarily (e.g., over 95 percent on state forest roads) for recreation (i.e., hunting, fishing, hiking, birding, driving, berry picking, etc.).

Forest Regeneration

Proper regeneration of storm damaged forests will depend on efforts taken by forest managers. Some areas will be left to regrow on their own for scientific study, but most storm damaged forests will be managed to assure that a vigorous new forest will return as soon as possible.

Management needed to assure a healthy new forest depends on the species of trees and on management prescriptions. Treatments will vary and include prescribed burning, shearing, seeding, or site preparation and planting. Hardwoods will often sprout from the stump, but high stumps or quantities of bent and broken trees will reduce the quality of future stands to little more than firewood. Conifers may regenerate from seed but generally require replanting. Aspen, a major species damaged by the storms, sprouts vigorously from the roots when the forest is disturbed through a windstorm or a clear-cut. Little further management is needed if sprouting is adequate.

Many aspen stands that blew down started to regenerate



within just a few weeks; sprouts were three feet tall by autumn. Sprouting was less dense than usual, however, because of the large quantities of debris and midsummer timing of the disturbance. Further reduction in sprout success will follow salvage logging, which may break many of these young sprouts and reduce the vigor of future sprouting. Salvage efforts must conclude within the next year or so, otherwise more value will be lost through damaged young sprouts than would be gained by the salvaged wood.

If, after a period of years, aspen regeneration is evaluated and found to be inadequate, it may be necessary to mechanically regenerate the stands. Properly timed shearing of the sparsely growing young trees, too small to sell as pulpwood, will stimulate vigorous sprouting and help assure adequate regrowth. This expense will likely be necessary on some portions of the storm damaged area.

Hardwood stands, such as oak, maple and basswood, will require treatment to promote proper development of a high quality future forest. Stands that have not been salvaged should receive improvement work, cutting broken trees to promote healthy sprouting, reducing overhead competition from bent-over trees, etc. Seedlings may have to be planted to assure a fully stocked future forest, although poor access and large amounts of unsalvaged timber in many areas will make planting extremely difficult and very expensive.

Reintroducing white pine into heavily damaged mixed forest types will provide biological diversity and add genetic variety. Reintroduction of white pine will require planting or seeding due to the loss of many seed producing white pines. Hand-planting would be effective on salvaged sites, but will be nearly impossible in tangled blowdown debris. Aerial seeding of white pine can be an effective way to reintroduce this species in some of the wind-damaged areas (i.e., where trees tipped over with roots still attached have exposed enough bare soil).

Increased funding will be needed for continued assessment and monitoring of forest regeneration, as well as for follow-up regeneration efforts such as shearing or aerial seeding.

Wildlife Management

The overall imbalanced age-class structure (i.e., many acres of mature and over-mature forests, many acres of young forests, but generally fewer acres of intermediate ages) of the state's forest land became even more pronounced in the storm damage areas. The current statewide shortage of intermediate-aged forest patches, which would eventually grow into mature forest, is now further diminished in the blowdown areas. The greatest effects of the storm to wildlife, therefore, may not be realized for twenty to forty years. Consequently, forest managers need to be especially careful in timber planning efforts in surrounding areas to maintain an element of mature forest patches for wildlife species requiring such habitat.

Permanent wildlife openings on state lands will require cleanup of slash and downed trees to maintain the open grass-forb habitat. This cleanup will occur gradually over the next 5-10 years during routine opening maintenance.

Forest Insects & Disease

Forest managers must now be concerned about potential forest pest buildups in storm damaged areas. Dead and dying trees can provide the source for high populations of insects and disease, which may spread to undamaged pockets, new plantings and adjacent timber stands. If insects and disease become established, they will increase the risk of wildfires as more trees die.

Aerial survey, ground checks and pheromone trapping will be used to monitor pest population levels and dispersal. Forest stands whose value is designated as high or important, due to visual, recreational, environmental or timber characteristics, will be mapped and monitored. The traditional direct control options of salvage, trap tree removal and spraying will be evaluated and implemented when loss potential exceeds cost of control.

Mixed forests affected by the blowdown could be further damaged by armillaria root rot, two-lined chestnut borer, and longhorn beetles. Cankers and stem rots will enter trees' tissue through wounds. Defoliating insects could likely increase in the foliage of stressed trees. The most promising control measures include directed salvage of damaged trees and promotion of vigorous regeneration of mixed tree species. Aerial spraying of BT, a biological control frequently used in Gypsy moth infestations, has proven effective when high value hardwood stands are designated for direct control.

Damaged upland conifers, such as jack, white and red pines, may be attacked by bark beetles and wood borers during periods of drought stress. Bark beetles can develop extremely high populations in short periods of time, infesting and killing large numbers of trees over a wide area.

High value pine stands can be protected by strategic logging of beetle trap trees and mass trapping with pheromone traps. Such attempts will be made in Itasca State Park and would also be appropriate with other high value trees in resort and homesite situations.

Trees with little apparent external damage may have sustained internal or structural defects that jeopardize the health of the tree, such as root damage or rot, separated wood fibers, soil compaction, cankers, etc. Some trees will likely follow a slow decline, although failures may not be evident for several years. Hazard tree identification, followed by tree removal or corrective pruning and monitoring, will be essential in high use areas to avoid injury to recreational users or homeowners. Cooperative training is underway with private landowners and rural power utility companies.

Itasca State Park

The native pine bark beetle, a natural part of the pine ecosystem, is not usually a problem in the park since most healthy trees are able to successfully fight off a beetle attack. Pine trees, however, were severely stressed at the time of the storm due to hot, dry weather in early summer and were highly susceptible to bark beetles. Weather throughout the rest of the summer and fall continued to be ideal for the beetles. Bark beetle populations, dormant over the winter, are estimated to be very high and all the conditions are set for a catastrophic outbreak of beetles in the

spring/summer of 1996. This could translate into significant losses of scenic pines in such visible areas as the Douglas Lodge Complex, Preachers Grove, and Peace Pipe Vista.

In an attempt to reduce the numbers of bark beetles and decrease the severity of an outbreak, the park will be installing 1000 to 2000 pine bark beetle pheromone traps in early spring 1996. These traps, which look like a six-foot long stack of nested black plastic buckets, lure male bark beetles to reduce the breeding population. Signs will be placed near the traps to explain the procedure to park visitors.

Wildfire

The risk of major wildfires in the blowdown area is increased because of increased fuel loads and limited access. However, the scattered nature of damage in the eastern area results in a relatively minor potential for catastrophic fire occurrence. The western area displays the most serious damage to natural resources as well as the highest potential for wildfire occurrence and large catastrophic fires. A fire risk assessment has been completed for the western blowdown area by fire behavior specialists from the MN Incident Command System (MNICS) at the MN Interagency Fire Center in Grand Rapids. The White Earth Reservation has completed a similar assessment on their lands to determine areas of highest potential danger. MNICS is a multi-agency organization which works to integrate and coordinate wildfire management efforts of DNR-Forestry, U.S. Forest Service, Bureau of Indian Affairs, National Park Service, MN Department of Public Safety, U.S. Fish and Wildlife Service, and other related state and federal agencies.

Large catastrophic fire potential is a major concern in the western area because of increased fuel loading, limited access, suppression problems and proximity to population centers. About 16,000 acres of the storm damaged area are high hazard conifer fuel types. Conifers present the highest potential for ignition and catastrophic fires and occur throughout the blowdown, either in large contiguous areas or concentrated in smaller pockets, mixed with other species.

Pine, a higher value species for wood products, is being salvaged as much as possible to decrease fuel loads and improve access to remote areas via logging roads. However, as little as 20 percent (or less) of the damaged wood will likely be salvaged, leaving large quantities of fuel available for the next several years. In addition, piles of conifer logging debris in large concentrations are fuel "jackpots" that, if ignited, will burn with extreme intensity, potentially showering the surrounding area with sparks and glowing embers. A high risk of wildfires will continue for several years until fine fuels (i.e., needles, twigs, small branches) rot and larger fuels (i.e., larger branches, tree trunks) have settled close to the ground.

Pre-storm fuels were primarily grasses and timber, with available fuel loads of 3-6 tons per acre and fuel depths of only a few inches, primarily consisting of dead needles and leaves. Fires ignited under these conditions would burn with relatively low intensities, manageable with hand crews and small equipment.

Following the storm, however, fuel loads are 60-80 tons per acre, with more flammable dry material within the critical ignition area near the ground. Fuel depths in the blowdown area are now 3-

4 feet or more, consisting of small to large branches and tree trunks in addition to larger quantities of dry leaves and needles. Fires occurring in these situations will exhibit much more severe intensities, making control with hand crews infeasible. Flame lengths could reach 4-20 feet or more. Fire spread rates could double from their pre-storm potential. On high fire danger days, fires could spread more than 25-30 feet per minute, rather than 10-15 feet per minute under pre-event conditions.



Direct attack on a wildfire in the blowdown area may be impossible because of poor access, heavy woody material on the ground and increased fire intensity. Suppression resources will be hampered by the large amounts of debris, making construction of control lines difficult and hazardous. Fire fighters will likely have to resort to indirect approaches, such as large dozers and retardant dropped from aircraft to make large firebreaks well ahead of a fire. Larger fires result from this approach, with more expense incurred in equipment and suppression activities, but at a much reduced risk to emergency personnel.

Recommended measures to reduce the threat to life and property from catastrophic wildfires in the storm damage areas include:

•Prevention/Awareness

Private landowners in and near the blowdown area must be educated about the potential risk for catastrophic fires. Most wildfires are caused by people. Rural landowners commonly burn piles of brush or debris in the spring and increased burning can be expected as owners of homes and cabins clean up remaining storm debris. Embers can stay hot in the ashes of burned piles for a long time, ready to blow up and escape on a dry, windy day. Seasonal visitors may not be aware of the serious consequences of unsafe burning. An increased awareness of burning regulations will be critical over the next few years.

•Improved and strategically located access roads

Access roads are essential for fire control as well as timber salvage. Benefits of an effective road system include ingress and egress for fire suppression resources, potential escape routes for the

public and improved access for salvaging blowdown timber.

•Continued salvage

Salvage of merchantable timber, especially conifers, will reduce the amount of available fuel load by removing some of the heavy fuels. In addition, contiguous expanses of blowdown fuels can be broken up into manageable units.

•Prescribed burning

Piling and prescribed burning of debris, particularly from conifers, will reduce the amount of finer fuels and greatly reduce the potential for ignition and fire intensity should a wildfire occur. This will also help create breaks in the large continuous expanses of fuels left in the wake of the storms, and thus reduce the potential for large, catastrophic fires.

Erosion

Wet soil conditions at the time of the storm contributed to potential water quality problems. Uprooted and tilted trees occurred more frequently due to saturated soils, exposing more soil to surface erosion. Tipped trees, however, while they expose soil to rain and runoff, generally remain in place and the exposed soil generally does not move much past the root pit. Best Management Practices (BMPs) for water quality include various forestry techniques designed to prevent erosion and degraded water quality, such as water-bars on logging roads, preventing tree tops from remaining in wetlands, etc. Minnesota loggers are trained in BMPs and commonly follow them when harvesting timber. To avoid erosion problems, salvage logging was delayed in some cases until the ground was frozen. Forest managers must consider the impacts to water quality when designing timber sales, and not ignore BMPs in their hastened efforts to salvage blowdown timber. Visual Quality BMPs are also in effect in Minnesota and will continue to be used to maintain aesthetically pleasing harvests to the extent possible.

Research Opportunities

We stand to learn a lot about natural regeneration by observing the forest's recovery, both in treated and untreated areas. Long-term opportunities to study natural forest regeneration processes must not be wasted. We have a unique opportunity to conduct long-range planning for implementing ecosystem-based management on the landscape and to study the long-term social and economic impacts of this large-scale incident. It is essential that permanent plots be established to document forest renewal under different post-storm intervention treatments. Possible research opportunities could include regeneration of a very large patch of interior forest through natural processes and human intervention, soil building from rotting woody material, or creation of unique habitat niches in snags and downed logs.

Before the storm, a cooperative research project was started between Clearwater County and the US Forest Service North Central Forest Experiment Station. This project was designed to monitor the impact of logging activities on water chemistry in various wetlands. The research will continue despite the blowdown, perhaps altering the original purpose of the research but providing

interesting results none the less.

The Pine Moraines Landscape Team is looking into a broad-based interdisciplinary project. Professors from the University of Minnesota - Crookston and Drew University, with Itasca State Park's support, are applying for grants from the Conservation Biology Research Grants Program and the National Science Foundation. In addition, the University of Minnesota - College of Natural Resources has agreed to do research on the blowdown areas and compare succession processes.

At this time, no agency is taking the lead or coordinating research efforts. Funding will be required to develop and maintain research data. While everyone agrees that monitoring and research is critical, no agency can undertake the necessary steps to carrying out research projects without funds.

FEMA Hazard Mitigation Recommendations

FEMA's Hazard Mitigation Survey Team Report (FEMA-1064-DR-MN) included the following twelve recommendations, many of which are already underway or have been completed:

1. Convene a task force to address coordinated efforts in forest management, electric distribution systems and public information.
2. The task force should establish a group to deal with forest management issues, review plans and future needs.
3. The task force should review fire response plans and develop a coordinated effort to reduce fire risk.
4. Forest health specialists should develop a comprehensive forest health action plan to reduce the potential for insect & disease outbreaks and distribute this information to the public.
5. The task force should conduct a corridor management review and develop a plan to identify areas requiring increased corridor width, areas needing shorter trees along the corridor, intensive management areas, and that protects wildlife, cultural resources and visual values.
6. A public information campaign should develop or edit existing promotional materials to explain the intent and value of corridor management.
7. The task force should encourage forest land managers to provide incentives to loggers for harvest and salvage of damaged timber.
8. The task force should encourage private landowners to respond to the risk of insect, disease and fire on their property.

9. The task force should establish a group to deal with electric distribution system issues.

10. The task force should identify utility service areas susceptible to frequent storm related outages, and consider the feasibility of burying lines, using stronger poles, shortening spans between poles, intensifying corridor management, developing compatible communication systems and cross-training between cooperatives and municipal utilities.

11. Managers of woodland recreation areas should establish permanent plots to interpret and monitor changes in vegetation in the damaged area, adjust prescribed burn and fire suppression plans to reflect increased fuel loading, bury power lines, identify and remove hazard trees, review emergency plans, shelters and warning systems.

12. The National Hazard Mitigation Strategy should be amended to include straight line winds and their consequences.

Restoration and Mitigation Funding

Federal Reimbursement

The Federal disaster declaration made the counties and the reservation eligible for two types of federal assistance programs:

The Infrastructure Support Program (formerly Public Assistance Program) provides funds to counties, cities, townships, rural electric cooperatives, municipal utilities and state agencies for cleanup and reconstruction activities. Restoring roads, bridges, power lines, etc. is funded for 75% of cost. The state and local sources are obligated to pay the remaining 25%.

Projects submitted for Infrastructure Support were reviewed by teams made up of federal and state employees. State employees were from Department of Natural Resources, Department of Transportation and Department of Public Safety. Each team met with local agency representatives to examine specific damage sites and projects for rehabilitation, develop a report and cost estimate. At this time, projects from 123 applicants, totaling \$6.4 million, have been determined as eligible for reimbursement through this program. Final FEMA recommendations are not yet available because of the Federal employee furlough. However, FEMA estimates that it will reimburse 75 percent of this, or \$4.8 million. The majority of these funds will likely be allocated to rural electrical cooperatives, counties and townships for repairs to service and infrastructure. Restoration of natural resources (i.e., forest land, timber, wildlife habitat) is not considered reimbursable by FEMA under this program.

The Hazard Mitigation Grant Program provides funds for mitigating situations which may present a future risk. An inter-agency team developed an assessment of long term impacts to identify possible mitigations to prevent recurrence of similar events and damages in the future. FEMA dedicates a portion of the money spent in a disaster area (approximately \$765,000 for this incident) for projects to mitigate future hazards. Eligible projects could include a fire risk assessment, establishing firebreaks to reduce wildfire hazards, burying power lines or widening right-of-ways to reduce wind damage, etc. Twenty applicants submitted 27 pre-applications to the state Division of Emergency Management, totaling almost \$2.5 million.

Final applications for high priority projects had to be submitted to FEMA by January 31, 1996; processing of project funding requests has been delayed by the recent furloughs. Final selection of projects to be funded has not yet been determined. Again, the majority of this funding will likely go to rural electrical service projects (e.g., burying power cables) with very little for natural resource hazard mitigation projects. However, approximately \$130,000 of this has been earmarked for wildfire risk mitigation.

State Supplemental

Department of Public Safety

The Department of Public Safety has submitted a \$513,000 comprehensive 1995 disaster relief supplemental budget request for consideration by the 1996 Legislature. This request is for the state portion of the 25% state/local match for project costs determined to be reimbursable by FEMA. The DNR has \$62,000 of matching state funding in this request.

Department of Natural Resources

To date, the total costs to the DNR in responding to this disaster are estimated at over \$500,000. However, less than half (i.e., \$250,000) has been found by FEMA to be eligible for 75 percent reimbursement under the Infrastructure Support Program. The 25 percent state match for the DNR's eligible costs (i.e., \$62,000) is included in the Department of Public Safety supplemental budget request. The remaining \$313,000 in DNR restoration project costs that were not eligible for FEMA reimbursement are being submitted to the legislature as a DNR high-winds disaster supplemental budget request. The DNR's supplemental request will cover costs associated with the clean-up and repair of forest roads, state parks and campgrounds, reforestation of state lands, and tree replacement at state parks.

County Supplemental

Many of the counties in the storm damage area have submitted reimbursement requests through FEMA's Infrastructure Support Program. The state portion of the 25 percent state/local match of reimbursable costs from these counties is included in the Department of Public Safety's comprehensive supplemental budget request. In addition, a number of the counties hardest hit by the storms will be presenting a supplemental budget request to the legislature to address additional forest management costs resulting from the storms that were not reimbursable by FEMA through the Infrastructure Support Program.

Conclusions

A large-scale forest disturbance such as this is an uncommon event. While wind damage is common in forests, it rarely attains this magnitude. The effects of the storm have left some very real forest management challenges and concerns. It also presents a unique opportunity for scientific study and an opportunity for local communities to learn how to be better prepared for future emergencies or disasters.

While the state-wide impact on timber available for harvest will be small (i.e., the forestland acreage that was damaged by the storms is less than 1 percent of timberland in the state), the local effects will be much more severe. Directly, the state, counties, and private landowners have lost nearly \$42 million in potential timber sales revenue. Indirectly, landowners will suffer from reduced land values and the loss of a potential \$1 billion in economic activity that would have been generated by logging and industry activity had the storms not occurred.

But the damage has been done and nothing can change what happened as a result of the great wind storms of 1995. Landowners and forest managers must now move on to salvage what they can, take steps to protect what is left, and begin restoring as much of the damaged area as possible, as soon as possible. This will not be an easy task, since only 20 percent or less of the damaged area will likely be salvaged. Regeneration of forests will be expensive in some areas, and difficult or impossible to help along in others. Nonindustrial private landowners especially will need technical and financial assistance and encouragement to sift through the mess left by the storm and restore healthy, growing forests.

The increased potential of wildfire and forest pest outbreaks will continue to be a real threat to property and forest resources for years to come. Important steps need to be taken, especially over the next 1-2 years, to minimize this threat and protect the remaining healthy forest land and new forests that will follow in the storm damaged areas. Roads need to be restored and maintained to encourage continued salvage, provide safe use by the public, and provide access for wildfire prevention and suppression. Prescribed burning and fire break construction need to take place to reduce and create breaks in the vast amount of dead and dying trees that could fuel a catastrophic wildfire or forest pest infestation. Insect and disease occurrences in the area will need to be closely monitored and, if necessary, controlled.

While it is clear that the storms dramatically changed the visual and ecological landscapes in the area, the effects of which will last for decades, the ultimate impacts of these changes on ecosystem functioning, biodiversity, wildlife populations, local communities, and the economy is not clear. This unique occurrence offers a great opportunity to learn more about the short- and long-term ecological, social and economic effects of such a large-scale natural disturbance and the various management actions (including no action) that follow. This is a rare opportunity that should not be wasted.

Restoration of damaged facilities has been a lengthy process. Power lines, roads, trails and recreational areas have been reconstructed and the work continues. However, this series of storms

demonstrated a need for preparedness. Local units of government were generally not equipped to deal with an incident of this magnitude. Advanced warning systems may be required in populated areas outside of municipalities, such as Itasca State Park. Results could have been tragic if the storms had gone directly through the busy park, toppling large pines onto sleeping campers.

Local government administrators need an emergency response plan and lists of available resources to call if usual sources of assistance are unavailable. They need to be aware of resources located some distance away in case local sources are unavailable. Lists should include emergency and public safety agencies as well as arborists, tree trimmers, stump grinders, chippers, truckers, and other necessary logistical requirements, such as fuel distributors, electricians, media contacts and caterers. Assistance will be required in developing these emergency response plans.

The Incident Command System (ICS), upon which the Minnesota Incident Command System (MNICS) wildfire management mutual aid agreements are structured, provides an excellent organizational structure for coordinated response to all emergency events. This system has been effectively used in Minnesota to address other natural and man-caused disasters. There was some resistance to the use of an ICS in response to this event. Greater acceptance and use of an ICS in future events of this nature could improve agency and local government response and preparedness.

