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## Assessing Hurricane and Tornado Storm Damaged Forest Stands



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Severe thunderstorms, hail storms, hurricanes and tornadoes impact portions of our state almost every year. These weather events often damage urban and rural forests. Severe events such as tornadoes and hurricanes tend to cause tree breakage, and immediate losses, while less severe storms may leave trees damaged and standing or uprooted where the stems may live for a period after the event. Land managers can be faced with evaluating these areas to determine if the stand will recover without intervention or if salvage or partial removals are needed. Storm damage within a given area can vary greatly, so careful evaluation of each damaged area should always be the first step. Management decisions are often made on the worst areas within the damaged areas, and damage can vary to the point where areas within the same stand must be treated differently. This publication presents a set of points that should be considered when evaluating and managing storm damaged areas. It is recommended that you get a local, reputable professional forester to assist you in evaluating your timber stands.

In general, trees damaged in storms that cause tree breakage must be salvaged immediately, while stands with less damage such as limb or top breakage and leaning trees with partial uprooting or fallen trees with some roots still in the soil allow for much longer salvage windows. Trees with severe root damage rarely survive the growing season, but can last much longer if the weather event occurs during the cooler seasons of the year. Opportunistic insects and tree diseases will often find these weakened and stressed trees and hasten mortality so they should be considered when evaluating storm damaged stands.

General rules of thumb after hurricane and tornado storm events: (1) Unthinned, well stocked young pine (less than 10-years old and hardwood stands (less than 15-years old) with heights less than 20 to 30 feet generally have minimal stem breakage, lean, or uprooting damage. The lean, uprooting and stem damage in these young, unthinned stands tend to be on the edges of these stands where the winds were the strongest. (2) Recently thinned (within the last 2 years, and more so in stands thinned within the last year) pine stands tend to have the most damage, with leaning and uprooted trees when storms winds are less than hurricane strength) and high rainfall occurs, with minimal hurricane winds and greater, stem breakage (usually at the 8-16 feet stem height range) is common. (3) Pines with heights greater than 20 to 30 feet and lean greater than 45 degrees (from vertical) do not typically straighten up and recover. (4) Older, larger pines and hardwoods (diameters greater than 12-14 inches and greater than 60 – 80 feet in height) that are leaning to any extent will usually not straighten back up. (5) Uprooted pines and hardwoods that have a portion of their root system intact in the ground can survive for some time but will not be a viable part of the stand. (6) Pine and hardwood stumpage prices after these storm events can be greatly lower than pre-storm event due to a much higher supply of wood on the market suddenly. (7) Logger operations in storm damaged stands are generally much slower and more hazardous.

### ► Assess stand(s) damage and categorize

- (1) Minimal damage – Scattered branches broken from trees, with little to no damage to the overall stand (in particular the tree stems) and a few trees bent less than 45 degrees. No salvage operation will be necessary and the stand should recover with no additional immediate management requirements.
- (2) Light damage – Only branches broken from trees, with minor damage to tree stems in the overall stand and trees bent less than 45 degrees. No salvage operation will be necessary and the stand will recover with no additional immediate management requirements, though the long-term wood yields will likely be impacted to some extent.
- (3) Moderate damage – Branches broken from the trees with visible damage to tree stems in the overall stand. At least 25 to 33 percent of the stems are snapped or broken or noticeably uprooted with severe lean

(greater than 45 degrees from vertical), a salvage operation should be considered to minimize losses and remove trees that will likely not survive.

- (4) Severe damage – 33 to 50 percent of the stems are broken, tops broken out across the stand, limbs stripped, and trees bent more than 45 degrees. A salvage operation must be considered and a clearcut may be the prudent management decision.
- (5) Catastrophic damage – More than 50 percent of the stems are broken out across the stand, tops broken out across the stand, limbs stripped, and trees bent over more than 45 degrees from vertical. A salvage operation is considered unlikely (a case by case landowner, forester and logger judgement) and the stand is considered a total loss. care

**Major types of damage** (pine and hardwood trees are sold by weight so water loss is an important economic factor):

- (1) Snapped, broken stem pine and hardwood trees – these trees can lose weight relatively quickly (approximately 50% of a tree's weight is water) if broken below the live crown and should be salvaged sooner than pines and hardwoods that have been uprooted.
- (2) Uprooted pine and hardwood trees – if the root systems have been mostly uprooted but some of the root system is still in soil contact, these trees will generally lose their weight much slower than snapped stem trees and salvage operations may be done weeks to months after the uprooting has been done. For example, hurricane Matthew of 7-8 October 2016 caused many pines and hardwoods to be uprooted in the coastal counties of Georgia to about 70 miles inland due to the high amounts of rain during the hurricane. Many of these trees can be salvaged between October and early February (prior to the next growing season) without much weight loss.

**Merchantable pine stands (greater than age 15 to 20 years) -- Levels of damage:**

Pine stands tend to occupy moderately well, well, and excessively drained soils (upland sites) and therefore stem breakage and “leaners” and the common tree damage problems. In lower lying areas (somewhat poorly to very poorly drained soils) and with excessive rain (Hurricane Matthew of 7-8 October 2016) pines and hardwoods can be uprooted or will lean excessively. Valuable snapped pine and hardwoods trees should be salvaged sooner than uprooted hardwoods due to quicker water (weight) loss. Snapped pines and hardwoods, regardless of pre-storm event product class (pulpwood, chip-n-saw, sawtimber or pole class), are considered generally to be pulpwood. Exceptions include very tall, older pines that may have one, two or three logs of good wood eight feet above the snapped part of the stem. These high valued, visibly unaffected logs should be salvaged as soon as possible due to weight loss and wood degradation issues reducing their value with time (Table 1 and 2).

**CATASTROPHIC:** Stands with greater than 50 percent of the stems having significant damage and having not enough good trees per acre to thin back to (less than 60 to 150 trees per acre or less than 60 square feet of basal area per acre) standing and in good condition with little to no visible lean, no visible uprooting and small to no visible wounds (Photos 1 and 3).

**Options.** Where feasible perform a salvage operation (clearcut) as soon as possible to include removal of standing trees along with storm damaged wood. Post salvage options for reforestation include: (1) Pile debris, limbs, and tops away from standing trees and burn piles with burn permit under appropriate weather conditions. (2) Prescribe burn site with debris not moved to reduce debris level (fire breaks in place) then wait 2 to 3 months after burn and apply pre-plant site preparation herbicide treatment in late summer or fall. For all burning get a burn permit before burning. (3) Chemically treat or mechanically prepare the site for planting without burning (or burn 2-3 months after the chemical or mechanical treatment). Plant quality seedlings in December - February. If salvage operations are conducted after June, site preparation will likely have to be held over until the following growing season to allow sufficient resprouting of vegetation (1 to 3 feet tall or taller) to insure herbicide uptake and translocation to roots for most effective competition control. Regeneration weevils could be a problem following planting after mid- to late-season harvests (harvests after 30 June).

**SEVERE:** Stands with 33 to 50 percent stem damage (snapped or excessive lean; greater than 45 degrees).

**Option 1.** A salvage thinning operation, when feasible, leaving enough (generally considered at 50 to 150 trees per acre or at least 60 square feet basal area per acre, Table 3) good condition, standing trees to continue to grow to rotation age.

**Option 2.** A salvage thinning operation, when feasible, leaving standing trees to serve as seed or shelterwood trees (Table 3) for next rotation. Pile debris, limbs, and tops away from standing trees where feasible and burn piles under appropriate weather conditions with a burn permit. A September burn followed by a light disking in the year for natural seeding will enhance pine seed germination.

**Option 2.** Where option 1 above is not feasible a salvage clearcut operation to include removal of standing trees. Prescribe burn site to reduce debris level (fire breaks in place) with a burn permit and perform pre-plant site preparation (chemical, mechanical or both) in summer or fall, plant seedlings December - February.

**MODERATE:** Stands with 25 to 33 percent of the stems with significant damage with at least 60 to 150 trees per acre or at least 60 square feet of basal area standing and in good condition (little to no visible lean, small to no visible wounds, no visible uprooting portions of Photos 2, 4, and 5)

**Option 1.** Salvage thinning operation when feasible leaving standing trees to serve as seed trees for next rotation. Pile debris, limbs, and tops away from standing trees where feasible and burn piles under appropriate weather conditions with a burn permit. A September burn followed by a light disking in the year for natural seeding (natural regeneration) will enhance pine seed germination.

**Option 2.** Salvage clearcut operation when feasible to include removal of standing trees. Prescribe burn site to reduce debris level (fire breaks in place) with a burn permit and perform pre-plant site preparation (chemical, mechanical or both) in summer or fall, plant seedlings December - February.

**LIGHT:** Stands with less than 25 percent of stems with significant damage (at least 60 – 150 trees per acre or at least 60 square feet of basal area per acre standing and in good condition little to no visible lean, no visible uprooting, and small to no visible wounds, Photo 6)

**Option 1.** Typically there is not enough damage in these stands to warrant any salvage operation (thinning)

**Option 3.** In a few case a salvage operation removing broken stems, lean trees (trees with a visible lean) and uprooted trees may be performed. Prescribe burn the stand, where feasible, the first or second winter after the weather event with adequate firebreaks, good weather conditions, and with a burn permit. Grow stand out to desired rotation.

### **Pre-merchantable pine stands (age 1 - 15 to 20-years) -- Levels of damage:**

Generally stands with heights less than 20 to 30 feet and lean less than 45 degrees from vertical with no visible uprooting will recover. Assess level of lean and stem breakage. If there are > 300 to 350 stems that are in good condition (lean < 45 degrees no visible stem breakage and no visible uprooting) the stand can be carried out to thinning age (Photos 9 and 12).

► Table 1 lists a timeline for salvaging timber.

► In all damaged stand cases, keep an eye on the site every 2-3 weeks for beetle outbreaks or disease (root rot, pitch canker, etc.). Table 2 lists timeline for insect and disease infestations.

### **Hardwood and mixed pine-hardwood stands**

Hardwood and mixed pine hardwood stands tend to occupy lower slope positions with soils ranging from somewhat poorly to very poorly drainage classes. In these cases most damage is from uprooting, tree tops, stem, and branch breakage. Assess that stands in a similar manner as pine stands from severe (Photo 10), moderate to low and prioritize what stands need salvage first and what stands can wait.

### Follow-up visits to storm damaged stands

Damaged stands that have been left unthinned due to low amounts of damage or salvaged thinned should be visited every two to three weeks looking for insect (i.e., pine beetles) and/or disease (i.e., pitch canker) damage that can hit these damaged stands for the next two years. If evidence of insect or disease is present, contact a local, reputable forester for assistance in determining the need for further salvage thinnings. Photos 13, 14, and 15 illustrate pine stem damage (forking or broken tops) looks like years after a strong wind event in the stand.

Table 1. Timeline for timber to be salvaged to prevent degradation

Product	Harvest window	Comments
Pine and hardwood veneers	4 - 6 weeks	Blue stain prohibits use if left longer
Pine dimension lumber	3- 4 months	Should be kiln dried to prevent emergence of secondary pests
Pine posts	4 - 6 weeks	Blue stain will affect toughness and preservative treatment
Pine and hardwood pulp, fiberboard, particleboard and OSB	8- 12 months	As wood begins to decay, pulping process will be affected. Storm damaged wood should be mixed with sound wood

Table 2. Timeline for invasion of damaging insects and diseases

Species	Year one	Year two
Pine	Bark beetles, ambrosia beetles, sawyers, blue stain fungi, soft rot fungi	Decay fungi
Oak and Hickory	Wood borers, ambrosia beetles, sawyers, soft rot fungi	Sapwood decay fungi
Other hardwoods	Wood borers, ambrosia beetles, sawyers, soft rot fungi	Sapwood and heartwood decay fungi

### ► Does the stand qualify as a “casualty loss” for tax purposes?

A casualty loss is a sudden loss, so tornado and hurricane damaged stands can qualify as casualty losses. Casualty losses are deductible the year of the casualty on IRS Form 4684, Casualty and Thefts (Gaddis and Dicke 2006). The wind damaged stand qualifies as a casualty loss as the lesser of the fair market value (FMV) loss in timber and the timber basis. Timberland owned for more than one rotation will often have a zero basis whereas timberland recently purchased (i.e., \$1800 per acre for 100 acres of loblolly in 2000 with \$500 in a land basis and \$1300 in the timber basis) may have some timber basis. If the landowner has a timber basis, then a registered forester will need to (1) estimate the fair market value (FMV) of the timber pre-casualty, (2) the FMV following the casualty (# 1 and 2 by timber cruise) with the FMV loss = FMV before – FMV after (often the salvage value), The FMV loss is deductible up to the timber basis, and (3) the basis in timber.

Table 3. Southern pine basal area per tree, target minimum per acre (BA/ac) based on average dbh (diameter at 4.5 feet above groundline), and target minimum trees per acre (TPA) in good condition and well-spaced.

Average dbh (inches)	Basal area/tree (square feet)	TPA for 60 sq ft BA/ac (timber production)	TPA for 30 sq ft BA/ac (wildlife)	TPA for longleaf natural regeneration	TPA for loblolly/slash natural regeneration
6	0.1765	340	170	--	--
7	0.2673	224	112	--	--
8	0.3491	172	86	--	--
9	0.4418	136	68	--	--
10	0.5454	110	55	55	12
11	0.6600	91	45	47	10
12	0.7854	76	38	38	9
13	0.9218	65	32	33	8
14	1.070	56	28	28	6

Photo 16 is a cross-sectional loblolly pine wood disk illustrating basal area (0.20 0.44 and 0.85 ft<sup>2</sup>/tree) based on dbh for 6, 9 and 12.5 inch trees, respectively and the product classes based on dbh (for chip-n-saw and sawtimber with no visible defect)

#### Literature Cited

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Photo 1 and 2. Examples of a severely damaged pine stand (left photo) with less than 100 good crop trees per acre and a moderate to severely damaged pine stand (right photo) with a marginal number of crop trees left per acre.



Photo 3. Severe damage pine stand; less than 30 trees per acre standing in good condition



Photo 4. Low to moderate damage pine stand; 30 to 60 trees per acre standing in reasonable visible condition



Photo 5. Low to moderate damage pine stand with 100 to 200 trees per acre standing in reasonable visible condition



Photo 6. Low damage pine stand with greater than 125 trees per acre standing in good visible condition



Photo 7. A severely damaged stand (in foreground) clearcut 10 days post-tornado with moderately damaged stand thinned in background





Photo 8. A low to moderate damaged loblolly stand thinned 30 days post-tornado



Photo 9. Young pre-merchantable longleaf stand with low to moderate levels of damage, but with a sufficient number of trees per acre to carry to rotation with some clean-up



Photo 10. A mixed pine-hardwood stand with moderate to severe damage



Photos 11 and 12. Young old-field planted longleaf stands with varying levels of lean. The left photo longleaf trees with lean greater than 45 degrees will most likely not fully straighten to vertical. The right photo is a 16-year old longleaf stand 4 days after Hurricane Matthew came through in Bulloch County GA with portions of the stand having uprooted trees due to high rainfall and lower (76-90 mph) hurricane force winds. Overall, both stands should have enough good, healthy trees to carry the stands to rotation with some clean up.



Photo 13 & 14. Photo 13 (left photo) with a fork where storm damage broke the terminal growth and photo 14 (right photo) with a broken top from the same storm. If the fork or broken top is at least 17 feet above the ground, then the tree may have chip-n-saw or sawtimber value to that height.



Photo 15 and 16. Left photo (15) - a broken top living loblolly pine with 4 live limbs, 6 years after a storm event. Right photo (16) – a 32-year-old loblolly pine wood disk (cut @ dbh; 4.5 feet above groundline) showing examples of a 6, 9, and 12.5" dbh tree and basal area per tree (Table 3) and dbh for pulpwood, chip-n-saw, and sawtimber categories.