



TIMBER IMPACT ASSESSMENT

Hurricane Matthew, October 8-9, 2016

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BACKGROUND

Hurricane Matthew impacted multiple southern states, and all coastal counties of Georgia experienced extreme winds and heavy rain, beginning October 7th and lasting through October 8, 2016. Hurricane wind gusts were felt 50 miles inland, with 71 – 96 miles per hour winds in Savannah and Tybee Island, Georgia. The eyewall of Hurricane Matthew remained offshore along Georgia's coastline and official landfall was southeast of McClellanville, South Carolina on October 8th as a category 1 hurricane. Had the eye wall moved 25 miles to the west, hurricane winds would have resulted in catastrophic damage along the coast and well inland. Hurricane Matthew was the longest-lived major hurricane forming after September 25th in the Atlantic basin and the closest call for coastal Georgia since Hurricane Floyd passed within 119 miles in 1999.

During the hurricane, rainfall at Hunter US Army Airfield was measured at 17.49 inches and heavy rain inundated soils far inland. Tropical storm force winds were felt at least 60 miles inland and trees with shallow root systems and heavily thinned stands, with little support from other trees, experienced the worst damage across the region.

Pecan orchards and individual pecan trees were devastated by the strong winds and saturated soils.

Governor Deal declared a state of emergency on Tuesday, October 4, for 13 counties in Georgia's coastal region: Brantley, Bryan, Bulloch, Camden, Charlton, Chatham, Effingham, Evans, Glynn, Liberty, Long, McIntosh and Wayne. A presidential declaration of emergency was issued on October 7, 2016. The map depicts this zone (*Figure 1*). <https://www.fema.gov/disaster/3379>

The National Weather Service provided continuous predictions and updates to identify areas of risk and potential impacts. These updates helped narrow the expected areas for the Timber Impact Assessment. The Forest Health Management group began ground surveys of the coastal counties on Monday, October 10. Using the "Collector App," field observations were taken from 50 miles inland toward the Atlantic coast to determine the extent of damage to the overall forest. Georgia Forestry Commission Air Operations began aerial reconnaissance on Tuesday, October 11, 2016 and the initial reports revealed that widespread damage, as was observed following Hurricane Hugo, was not present.

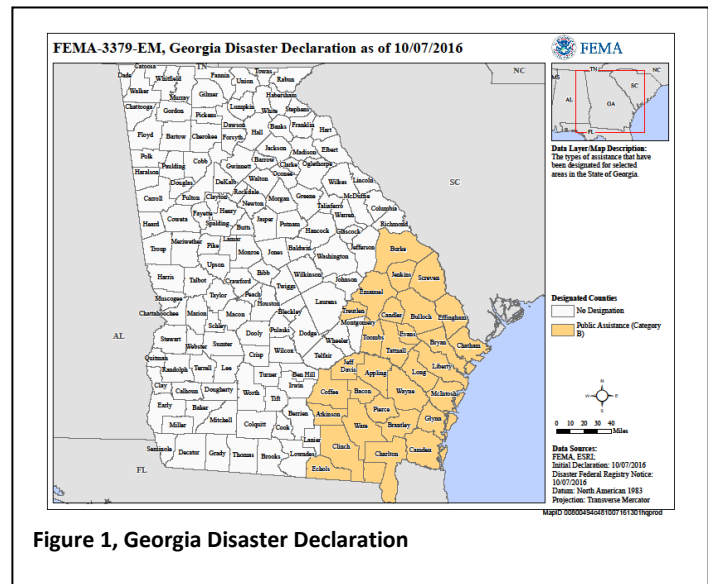


Figure 1, Georgia Disaster Declaration

The goal of the Timber Impact Assessment survey was to determine the current overall damage to the forest in Georgia, and to document widespread impacts to the region affected by hurricane conditions. This is not to say that damage was not or could not be found further inland from the declared state of emergency area, but the damage outside the disaster area was isolated and confined to localized impact.

OBSERVATIONS

A team of Georgia Forestry Commission foresters surveyed the zone believed to have endured the greatest impacts to our forests, and developed the map below (*Figure 4*) using field observations combined with a geospatial analysis of this region. Please note that damage was observed beyond these counties, but damage was less intense than that shown by the map's shaded areas. Overall the Timber Impact Assessment revealed minimal to light damage in rural forested areas. Well established pine plantations that were properly stocked, healthy, and vigorously growing were very resilient and suffered little to no damage. Pine stands that had been thinned and maintained an adequate residual stand-density showed little damage, with the exception of occasional wind-bent trees that were leaning but not severely bent. (Figure 2) It should not be concluded that there



Figure 2, Healthy Thinned Pine Plantation

was no damage in these well managed pine plantations, but the majority of these stands showed only broken limbs and very few broken tops. Managers and landowners are encouraged to monitor their stands for insect damage during the next year. The stress placed on these trees could attract Southern Bark Beetles or increase the likelihood of disease across the stands as these trees recover.

The most severe timber damage in our rural forests was found in recently thinned pine stands, and in most cases, damage was found when excessive thinning had been conducted leaving a low stand-density that did not allow the residual stand to rely on protection from neighboring trees. (Figure 3) These stands had not developed adequate individual root systems to anchor the tree nor stems strong enough to withstand heavy winds.



Figure 3, Open Thinned Pine

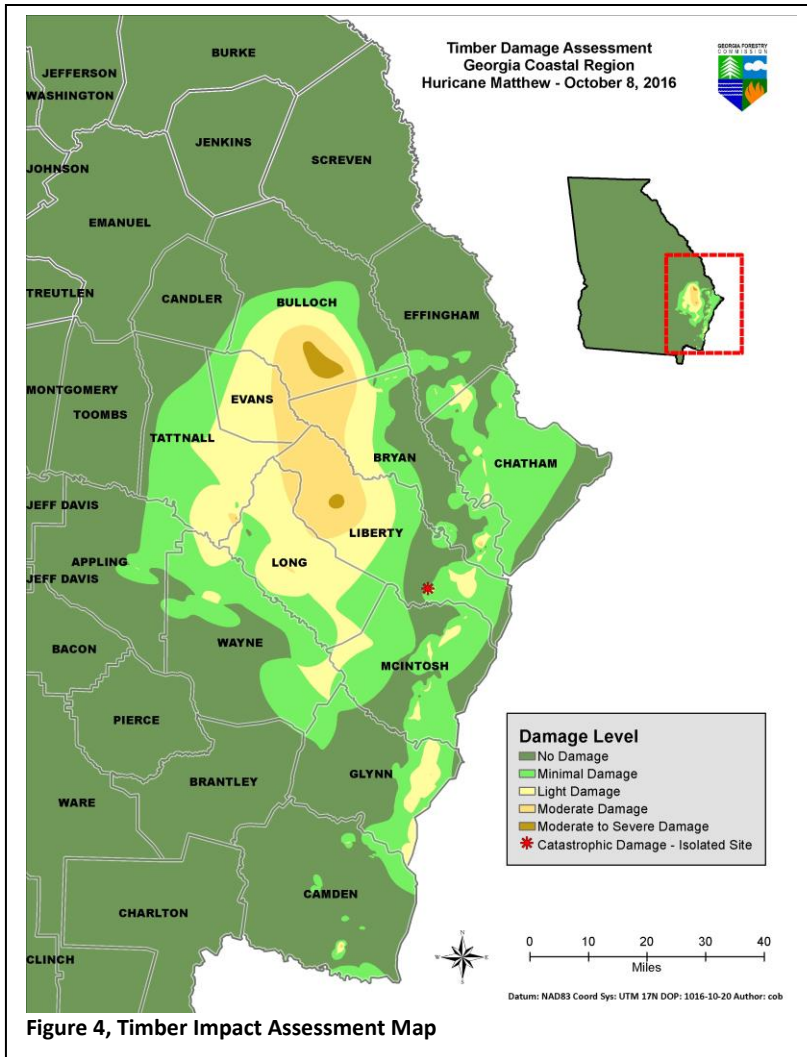


Figure 4, Timber Impact Assessment Map

This survey examined landscape-level impacts and classifies them accordingly. The categories of damage are based upon field observations about:

- Occurrence (frequency) of damage within a county.
- Levels of damage within two types of pine that were most frequently damaged (young pine stands, and pine stands on which a first-thinning had recently occurred.)

Storm Damage Intensity:

Minimal damage – Scattered branches and limbs broken from trees, with little to no damage to the overall stand and scattered trees bent less than 45 degrees. No salvage operation will be necessary and the stand should recover with no additional management requirements.

Light damage – Only branches and limbs broken from the tree, with minor damage to the overall stand and trees bent less than 45 degrees. No salvage operation will be necessary and the stand should recover with no additional management requirements, though long term yields will likely be impacted.

Moderate damage – Branches and limbs broken from the trees with damage to the overall stand. More than 25% of stems broken and a salvage operation should be considered to minimize losses and remove trees that likely will not survive.

Severe damage – More than 30% of stems broken, tops broken out across the stand, limbs stripped, and trees bent more than 45 degrees. A salvage operation must be considered and a clear-cut may be the prudent management decision.

Catastrophic damage – More than 50% of stems broken, multiple trees blown down across the stand, tops broken out across the stand, limbs stripped, and trees bent more than 45 degrees. A salvage operation is considered unlikely and the stand is considered a total loss.

Storm damage was not detected on most timber types but was concentrated on two types of pine stands: recently thinned pine stands, and younger stands less than 25 feet in height.

Recently thinned pine stands: These are primarily pine plantations that were thinned for the *first time* within the past year. Trees adjust to the amount of space and competition within a stand, and those that have been thinned for the first time are adjusting to reduced protection from neighboring trees and are growing in diameter, which strengthens the main stem. They also respond by accelerating root growth which helps anchor the tree and aids in the increased moisture uptake needed to support larger live crowns. Depending on residual stand-density after thinning, it takes trees about five years to fully respond to the increased growing space. In the meantime, they are more prone to wind damage.

The vast majority of the first thinned stands sustained little to no damage that will require any salvage operation or additional thinning to maintain the stand. The stands most impacted had been primarily thinned during the past year, and had been heavily thinned. First-thinning typically removes lower value wood (such as pulpwood / fuel wood), with the objective of allowing the residual stand to produce higher value products (such as sawtimber, plywood, and poles). From an investment standpoint, timber growth following a first thinning maximizes profits, so salvaging storm-damaged stands is a devastating blow to expected returns. In this hurricane we found little to no damage in these first thinned stands and losses for landowners is minimal. Again, the damage to recently thinned pine stands appeared to be found in heavily thinned stands that had not had time to adapt to the open conditions and had lost support from surrounding trees.

Photo (Figure 5) – Fifteen year old, heavily thinned, loblolly stand in Bulloch County; suffered over 40% wind-damage. Stand thinned within one year of Hurricane Matthew.

Any salvage cut will involve removal of leaning and broken trees. This stand will require a salvage clear-cut and replanting.



Photo (right) (Figure 6) –
Twenty year old loblolly
stand in Bryan County;
suffered light damage

Numerous older pine stands that had been thinned twice (or more) were also examined. Although some had damage, most would be considered minor, with the majority requiring no salvage operation. The damage in these stands tended to be uprooted trees rather than stem breakage. This type of wind-throw (tree that is completely uprooted) in older stands appeared light throughout the region.



Figure 6, Older Thinned Loblolly Stand

Young pine stands: Pine plantations (of most species) that were 25 feet and taller - and *had never been thinned* - seemed to weather this storm well. The ability of dense stands to provide tree-to-tree support and prevent winds from uprooting individual trees was a big factor in these stands' withstanding minimal damage. Younger (and shorter) stands, however, were observed with light to moderate damage. The majority of these young pine stands were between two and ten years old. A critical factors appeared to be that the trees had many live branches almost to ground level, which acted as sails to block wind and cause the young seedlings and saplings to lean with the wind but not reach a breaking point. The combination of saturated soil and strong winds helped the trees withstand the storm. Overall these young stands seemed to fare well, even though some of these have many bent stems (with some breakage). Younger trees, however, tend to correct this problem.

The resiliency of nature can be surprising, and the fate of these stands will become evident over the next few years. When tops break out, a lateral branch will assume dominance and there will be variation in long-term stem straightness. Careful examination will be needed to determine the number of permanent problems this storm has inflicted on each stand. Re-evaluation after the next growing season should give managers a better perspective on what lies ahead.

EXTENT OF DAMAGE

GFC foresters evaluated the counties noted on the previous map (*Figure 4*) and developed estimates of damage based upon a combination of this field work combined with a geospatial analysis of this region. These estimates do not include areas outside this zone, nor do they include hardwood, which was also impacted. Most hardwood damage consisted of limb and top breakage with most trees retaining enough live branches to support survival. Damage can be expected in the growth form of these trees and possibly in sluggish growth rates. Data for hurricane damage was gathered using the “Collector App” and The Georgia Forestry Commission Geographic Information System (GIS) team compiled the data that produced estimates of damage across the affected area.

Damage estimates from Hurricane Matthew showed that 1,951,400 acres (87.5%) of **minimal to light damage** (light green to yellow) was detected across forested, agricultural, and urban landscapes.. These areas suffered little to no damage, in forested lands, other than broken limbs and will require no salvage operations. Forested stands in these areas should recover with no additional management requirements. Agricultural crops of Pecans sustained moderate to severe damage even in this area. The Farm Service Agency in Bulloch County reported extensive damage to production pecan orchards, and one grower in Tattnall County lost over half of its production orchards.

An area of **moderate damage** (light brown) of 260,500 acres (11.7%) is identified from south Bulloch County to Fort Stewart in Liberty County. This would indicate more severe damage to the overall stands and that more than 25% of stems would be broken and a salvage operation should be considered to minimize losses and remove trees that likely will not survive. After reviewing this information and performing additional ground surveys, it was found that this area is a transition area between light damage and moderate damage. The assessment of this area revealed some additional damage in stands with uprooted trees and minor stem breakage, but the increase in wind-throw and stem breakage in older stands appeared minimal throughout this survey region. Landowners in this moderately damaged area are encouraged to use the services of a professional forester to assist in making informed decisions for the management of their individual stands.

Two areas of **moderate-severe damage** (dark brown) of 18,060 acres (.8%) are identified in south Bulloch County (**Photo (Figure 5)**) and near Fort Stewart in Liberty County. In both of these areas the majority of the damage was found in recently thinned pine. In Bulloch County the damage was noted in recently thinned pine stands that had been heavily thinned, did not have time to adapt to the open conditions and had lost support from surrounding trees. In Liberty County damage was noted in old growth loblolly pine near Fort Stewart that had been thinned within the last year. The older, larger, pine stands had an extreme change in their normal environment and did not have time to adapt. The new open condition did not allow for support from surrounding trees, and the weight of the individual trees was too great for the root system to endure.

One area of **catastrophic damage** (red asterisk) was found from an isolated tornado tract near I-95 in Liberty County. The tornado damage appeared to be approximately 50 yards wide and two miles long.

RECOMMENDATIONS

With the damage inflicted by this hurricane, there will likely be three distinct categories by which landowners make their evaluations:

- 1) Light damage or losses that may not warrant a salvage operation. This could include merchantable stands (trees are large enough to sell), which simply don't have enough timber damage to warrant a commercial harvest, or pre-merchantable stands where there is a good chance they will recover over time.
- 2) Stands with severe damage, mandating a salvage operation to recoup whatever value can be obtained from the stand. This might include a complete harvest for widespread damage, or a partial harvest of damaged timber to provide a commercial harvest.
- 3) Stands with moderate damage or situations falling between the two scenarios above, in which a good bit of the timber is damaged but there might be enough timber to leave growing. In these cases, landowners are encouraged to use the services of a professional forester to help make the best decision for the situation. Immediately following a storm, it is difficult for landowners to accurately gauge how well a stand may recover, or to measure the amount of timber that could be allowed to remain for future growth and income.

For landowners facing a complete harvest to salvage their damaged timber, please consider reforesting the area. The Farm Service Agency (FSA) has a cost share program that can assist with site preparation and planting costs called the Emergency Forest Restoration Program (EFRP). Apply at your local FSA office.

*Special thanks to other GFC foresters who helped develop this Timber Damage Assessment:
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Mark McClure, Michael Torbett, and Charles Bailey.*

Stasia Kelly, Media Relations Specialist, worked diligently to assist with the production of this report.

URBAN TREE ASSESSMENTS

Georgia Forestry Commission certified arborist/foresters surveyed damage and storm-generated tree debris left to be removed from urban and rural communities. Survey results showed the highest amount of damage, as one might expect, was found in Chatham County, although communities in other counties also experienced damage. Additional assessments are being conducted on Tybee Island and elsewhere in Chatham County. Overall, urban areas with the greatest canopy cover suffered the most damage, and even inland communities such as Statesboro, where over a thousand trees were damaged, were impacted.

The effects of the hurricane were irregular, with some neighborhoods experiencing significant damage while others experienced none. Most damage consisted of uprooted trees and some limb or trunk breakage. Many trees were uprooted due to shallow root systems and sandy, rain-saturated soils (*Figure 7*), while much of the limb or trunk breakage was due to a previously existing defect (*Figure 8*). The tree species that suffered the most damage included water oaks, laurel oaks, hickory, pecan, eastern red cedar and pines. Overall, urban tree canopies in the affected areas suffered only light or moderate damage due to the strength and hardness of live oaks, which is the majority species in these areas.

In most urban communities, power was restored in one to four days, and debris management became the greatest concern. Much debris remains to be cut and stacked by homeowners and tree care companies before its removal from community rights-of-way can begin. Many trees that have lost more than 50% of their limbs, and trees that have been uprooted or split so that heartwood of the main trunk is evident, will need to be removed. Otherwise, impacted trees will require pruning, with particular attention being paid to higher risk trees with “hangers” (limbs broken, but not yet detached) and split limbs (*Figure 9 below*). This will likely increase the total biomass (beyond initial assessments) that will eventually be collected.



Figure 7, Uprooted Tree



Figure 8, Failure Due To Existing Defect

One of the communities that experienced the most damage to both structures and trees is Tybee Island. The Public Works director for the City of Tybee Island requested the assistance of GFC’s Urban Forest Strike Team to help with their recovery efforts. A team of six GFC foresters who are certified arborists will be deployed to the island to assess storm damaged trees and provide mitigation recommendations to reduce any remaining hazards. The information provided by the team will allow the city to prioritize their pruning and removal work, which will accelerate risk reduction and improve community safety.



*Special thanks to GFC Foresters who helped with field work: Joan Scales,
Mark McClellan, Joe Burgess*

These resources can help forest landowners learn more about options and considerations for situations in which trees have been damaged by severe weather:

TIMBERLAND SEVERE WEATHER DAMAGE:

Wind Wood Utilization (this has numerous documents and links that are beneficial):

<http://www.windwoodutilization.org/salvage.asp>

How to Evaluate and Manage Storm-Damaged Forest Areas:

<http://www.forestpests.org/storm/>

Evaluation and Management of Storm Damage to Southern Yellow Pine

http://www.ncforestservice.gov/Managing_your_forest/pdf/EvaluationMngt-StormDamageSYellowPines.pdf

TIMBER SALES:

Selling Your timber (General Advise)

<http://www.gatrees.org/forest-management/private-forest-management/timber-selling/>

Selling Your Timber

<http://www.gfc.state.ga.us/resources/publications/sellingyourtimber.pdf>

TAXES:

National Timber Tax website (Master Index has good list of subject areas):

<http://www.timbertax.org/>

Landowners are encouraged to utilize professional foresters and arborists to help with decisions about timber management or potentially hazardous trees around homes and urban environments. Seeking independent advice is a sound way to reduce hasty judgments and insure all available options are considered.