



Pockets of water that remain on the course subject the turf to potential injury from submersion.

It's Raining, It's Pouring, The Golf Course Is Flooding

Floods may be unpredictable, but the turf manager's recovery program should be well organized.

by **CHRIS HARTWIGER**

IT'S RAINING, it's pouring, the golf course is flooding" are not words a turf manager wants to hear. By the way, the pesticide storage facility is flooding, too, and the member/guest is scheduled for next week. Is there ever a good time for a flood?

Flooded golf courses and flooded pesticide storage facilities were a reality last year on golf courses in the eastern United States. While no one can predict when a flood will occur, everyone can understand the potential for turfgrass injury and everyone can develop a recovery program. This article will review the types of flood damage, out-

line turfgrass recovery strategies, and discuss dealing with flooded pesticide storage facilities.

Types of Flood Damage

The three types of flood damage are erosion, submersion injury, and soil deposition. Golf courses in many parts of the country may have to deal with one or more of these types.

• **Erosion** — This form of injury is most likely to occur in flood plains adjacent to rivers that flow rapidly. Generally, putting greens are constructed high enough to avoid most floods. The extent of the injury be-

comes apparent once the flood waters recede and can range from minimal to severe.

• **Submersion Injury** — Tolerance to submersion varies by turfgrass species, as indicated in Table 1. Bermudagrass has excellent tolerance to submersion injury, and research has revealed that bermudagrass can survive after more than 55 days of complete submersion. Bentgrass is classified as having good tolerance to submersion. The extent of the injury is related to the duration of submersion, depth of submergence, and light intensity. The physiological basis for submersion tolerance is not



Silt removal is a slow and tedious process, but it must be done to restore the golf course to a playable state.

completely understood at this time. Little can be done to assess the amount of injury from submersion until the floodwaters subside.

• **Soil Deposition** — It is possible for several inches of silt, clay, sand, and other debris to be deposited on the turf during a flood. The problems associated with deposition can be immediate and long term. Injury can occur if the turf remains completely buried for an extended period. Additionally, the deposition of a less permeable clay or silt layer on top of existing soil can have long-term drainage implications. The deposition of sodium and/or soluble salts can be a concern for flooded coastal courses, too. Degradation of soil structure, foliage injury, and salt-induced drought stress are all associated with this type of deposition. Reducing the sodium and soluble salts is necessary for the turf to make a full recovery.

Recovery Program

Outlined below are tips to help minimize flood damage and to promote complete recovery of the turf on putting greens and other parts of the course.

Putting Greens

• **Sediment Removal** — Physically remove and/or rinse as much sediment as possible from the putting greens. It is undesirable to have a silt or clay layer capping a sand-based putting green.

• **Cultivation** — Aerify the greens with hollow tines and remove the cores. This practice will help increase

soil oxygen levels, which may be low due to the flooding and sediment deposition. Additionally, small amounts of sediment will be removed with the cores.

• **Increased Fertility** — The application of a balanced or starter fertilizer will help provide a boost to the turf. The fertility program should favor the growth of the turf until the greens have completely recovered. At that time, more of an emphasis can be placed on playability.

• **Gypsum Application** — If salt water or sodium deposition is suspected, apply gypsum at a rate of 2 to 5 lbs. gypsum per 1,000 sq. ft. Conduct a soil test as soon as possible to deter-

mine whether a long-term sodium and salinity management program is warranted.

• **Flush Drain Lines** — Some sand-based putting greens are constructed with flush-out ports. If flush-out ports exist, flush the drain lines with fresh water until the discharge is clear. This will help clean out any sediment that may have accumulated in the drainage system.

Tees, Fairways, and Rough

• **Sediment Removal** — The broad-scale removal of sediment from these areas will be labor intensive and will require some amount of trial and error to determine the most efficient removal method. For example, it may not be desirable to allow the sediment to completely dry before attempting to remove it. Some types of sediment can become extremely hard if allowed to dry completely.

• **Cultivation** — Core aerification of all affected areas will help stimulate recovery.

• **Increased Fertility** — Flood injury can leave turfgrass weak and damaged. A supplemental fertilizer application containing nitrogen and potassium can help stimulate recovery and improve the stress tolerance of the turf.

• **Weed Control** — Be prepared for major weed problems in subsequent seasons. No one can determine how much weed seed was deposited by the floodwaters, but it is safe to assume that flooded golf courses will see more of their typical weeds as well as a few new ones, too.

• **Gypsum Application** — If salt and sodium problems are suspected,

Table 1
Relative Submersion Tolerance of 12 Turfgrasses (Beard, 1973)

<i>Submersion Tolerance</i>	<i>Turfgrass Species</i>
Excellent	Buffalograss Bermudagrass Creeping Bentgrass
Good	Timothy Rough Bluegrass
Medium	Meadow Fescue Kentucky Bluegrass
Fair	Crested Wheatgrass Annual Bluegrass Perennial Ryegrass
Poor	Red Fescue Centipedegrass

take a soil test and apply at least 5 lbs. of gypsum per 1,000 sq. ft.

• *Examine Drainage System* — Floods can damage subsurface drainage systems. First, locate and clean out any catch basins. Next, flush out the drain lines as much as possible.

• *Equipment* — The following equipment will be helpful in cleaning up the golf course: hoses, tractor with box blade, trailers for debris removal, hand tools (flat-bottom shovels, rakes, etc.), broadcast spreader, and pumps.

Flooded Pesticide Storage Facilities

A flooded pesticide storage facility presents entirely different problems for the turfgrass manager. Spills inside a storage room are relatively easy to clean up, but they do pose a greater inhalation and exposure hazard. Outdoor spills have the potential for contamination of surface and ground water. Proper cleanup can be a complex procedure and will require contact with the appropriate state and federal authorities. Outlined below are brief

guidelines that are in no way designed to replace direction from state and federal authorities.

1. *Stop the Leak* — Stop the spill as quickly as possible by restoring the container to its upright position, closing a leaky valve or hose, or putting a secondary container in place to catch the leaking solution. Bags that are broken or soaked through need to be carefully placed in a secondary container such as a drum or heavy plastic bags.

Wear appropriate personal safety equipment, including gloves, boots, goggles, respirator, and spray suit.

2. *Contact the Authorities and Retailer* — The Comprehensive Environmental Response Compensation and Liability Act (CERCLA) requires the reporting of many pesticide spills if the reportable quantity of that pesticide is spilled. These spills must be reported immediately to the National Response Center (800-424-8802). Many states require reporting of any size spill. Contact the appropriate state agency for more information. Also, contact the retailer

who sold the chemical for additional information on cleanup.

3. *Prepare a Written Report* — The report should contain the following information:

- Exact location and time of spill
- Identification of spilled substance
- Estimate of amount spilled
- Area where the pesticide was released — air, land, or water
- Potential for off-site movement
- Your response
- Anticipated human or animal risks
- Any medical attention required

4. *Contain the Leak and Isolate the Area* — Surround the spill with a spill kit, dirt, or pet litter to prevent the pesticide from spreading.

5. *Begin Cleanup* — Begin cleanup as soon as the situation has stabilized. Quick response is not only required by law, but also prevents the chemical from washing away.

6. *Properly Dispose of Contaminated Materials* — Use absorbent materials such as activated charcoal, vermiculite, absorbent gels, pads, or pillows to capture the spilled liquid.



Silt deposition during a flood can be so severe that the fairways can become completely covered.



Flooded maintenance and pesticide storage facilities require a specific protocol for cleanup.

These materials can be shoveled or swept into recovery bags or drums. Properly dispose of the recovered materials per local regulations. If there is standing water in your pesticide storage facility, assume it is hazardous until you can check all pesticide containers for leaks or breakage. Do not allow any skin contact with this water. If there is no evidence of pesticide leakage into the water, it can be safely pumped out. However, if pesticides have mixed with this water, the water will have to be pumped to a storage tank for land application. Land application has to be at or below label rates, so first the amount of product spillage will have to be estimated. The water should be filtered before it enters the spray tank to avoid nozzle clogging. Be sure to wear personal protection equipment during all cleanup operations.

Conclusion

Floods are a potential risk for many golf courses. Having a recovery plan and the needed supplies on hand before a flood hits will help make recovery efforts as efficient as possible.



Rapidly flowing water can erode stream banks, which can be prohibitively expensive to repair.

General References

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CHRIS HARTWIGER keeps his head above water as an agronomist in the Southeast and Florida Regions.