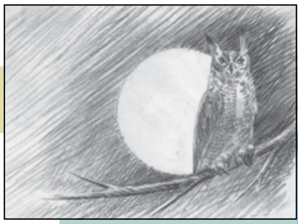


See related policy article, pages 11-13.

Tom Marshall

The floods of 2008 devastated this crop field along the Upper Iowa River, scraping right down to the bedrock and making it unusable for farming. With so many Iowa streams experiencing multiple 100-year or 500-year flood events in the past couple of decades, it's time for Iowans to consider that we're facing a "new normal" for Iowa flooding and to respond accordingly.

by Mary Skopec

Iowa floods: the 'new normal'?

Recent floods have taken a tremendous toll on Iowa's communities, businesses and people.

They've also taken a toll on our natural resources. New studies show that damage to Iowa's remaining fragile habitat is even worse than many imagined. Floods change Iowa's landscape by carving away large chunks of river bank, washing away tons of soil and nutrients and depositing sediment downstream.

> **"Some Iowa streams delivered more sediment during the floods of 2008 than they typically deliver in 100 'normal' years."**

Iowa is fortunate to have abundant water resources, including more than 72,000 miles of streams. Yet in a quest to improve agricultural systems, expand urban and suburban areas, and live close to nature, we've gradually increased the speed at which water drains from the landscape and enters these waterways. As detailed in "Why More Floods?" on the facing page, this practice has resulted in serious consequences for the state.

While floods are natural phenomena of the physical environment, society's contributions and reactions to catastrophic flooding are a strictly human endeavor. Iowa's recent spate of floods should make us stop to examine how we manage our land and water. If more frequent flooding is indeed "the new normal," does Iowa need a new approach to avoid or reduce flood impacts?

The new normal

Rainfall data from Iowa show increases in annual precipitation over the last century. They also show increasing *intensity* of rainfall events, especially in March, April and May (Mark Seeley, 2007).* Spring storms are particularly troublesome because the land is often still saturated from snowmelt, while young vegetation does little to retain the water and soil.

Limited data on stream flow hamper historical comparisons, but the number of catastrophic events in the 1990s and 2000s

Ecology College continued on page 10.

is hard to ignore. Streamflow modeling by researchers at Iowa State University demonstrates that extreme flooding has increased and will likely increase in the future.

In *A Watershed Year*, Eugene Takle provides a compelling argument that "it is likely that the dice have been loaded toward a higher probability of extreme flood events, with more occurring now than 30 years ago, and with even higher-frequency precipitation conditions leading to such floods in the future." *

Residents of northeast Iowa have experienced this situation first-hand. The Turkey River had major flooding events in 1991, 1999, 2004, 2008 and 2010. The 1991 flood was greater than a predicted 500-year event and 1.5 times more than the previous record flood (1922). The 1999 flood was again estimated to be beyond the 500-year flood level, and it eclipsed the record set in 1991. The 2004 flood was 2.5 feet over the 1999 record. The Turkey's 2008 flood was the river's fourth-highest crest.*

In 2008, *Science* magazine published an article entitled "Stationarity is Dead: Whither Water Management?" At its core, *stationarity* assumes that the variability of natural systems is essentially non-changing. Using the past to predict the future is the hallmark of stationarity – and the basis for concepts like "100-year floodplain" and "500-year floodplain." However, Iowa's recent events suggest that our history-based flood models no longer work. Like it or not, Iowans may need to start defining and adapting to the "new normal."

Impacts

We've all heard anecdotal information about the damage inflicted on Iowa's landscape by more frequent and severe flooding – but the hard data are even more disturbing.

To explore the impact of the 2008 flood, the Iowa Department of Natural Resources and U.S Geological Survey examined the amount of sediment and nutrients transported in various Iowa streams during peak flow. Researchers knew the rivers carried heavier sediment and nutrient loads during flood events, but they were disturbed to discover these loads were *higher by orders of magnitude*. Sediment yield from northeast Iowa streams during the flood event was *more than 100 times* what is typically found. In other words, some Iowa streams delivered more sediment during one bad flood year than they typically deliver in 100 "normal" years. Similar extremes in nutrient yields were also documented from other Iowa streams. (See "Floods and Water Quality" on page 10.)

Implications

In the face of such extreme soil and nutrient displacement, one is left to wonder if all the money and effort spent in past years to reduce these pollutants were wasted. *Can* Iowans

**For complete source citations, see the online version of this article at www.inhf.org.*

Why more floods?

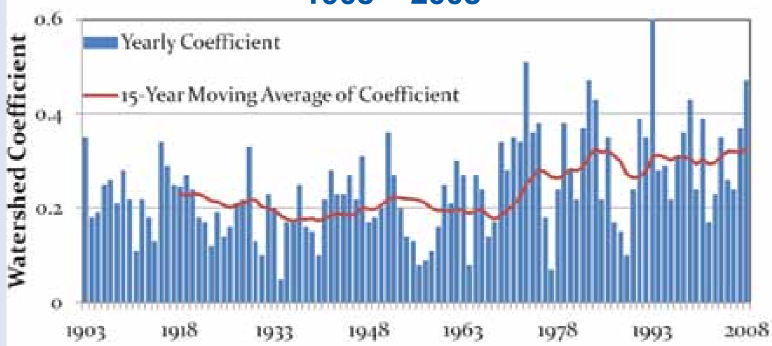
Iowa's rainfall data show a trend toward increased precipitation and, more disturbingly, increased rainfall intensity (bigger rains in a shorter time period). However, rainfall alone does not account for increased flooding. The land itself has changed.

Iowa's "plumbing system" has been reworked since the late 1800s, and the process continues. Changes include nearly one million miles of agricultural drain tile, plus drainage ditches and straightened streams – not to mention acres of non-permeable roads, parking lots and other urban development.

Instead of allowing rain to soak into the landscape where it falls, this new plumbing puts rain onto an express route to streams and rivers. Thus, even *without* increased rainfall, Iowa's rivers can flood more quickly and with greater intensity than they did just decades ago.

In technical terms, Iowa streams now have a higher *watershed coefficient* (the ratio of the total stream flow volume to the total precipitation volume). Figure 2 charts the changing watershed coefficient on just one Iowa waterway, the Cedar River basin, for more than a century. Though the watershed coefficient varies from year to year, the overall trend is upward – while the spikes have become higher and more frequent.

Cedar River at Cedar Rapids: Watershed Coefficient 1903 – 2008



Mary Skopec and Rob Middlemis-Brown (former director of the Iowa USGS Science Center). Data from USGS streamflow gauges.

Flood lingo

In this article, **watershed** means all the land drained by a given waterway and its tributaries.

The terms **100-year and 500-year floods** are based on statistical models used to determine building codes and flood insurance policies. Based on these models, floodplain levels are plotted on maps. A **100-year floodplain** means that these experts believe there is a 1 percent chance in any given year of a flood of this magnitude or higher (a flood that will reach this part of the map). A **500-year floodplain** indicates a 0.2 percent chance. However, these models were based on the best information at the time and are subject to change.

For more details, including how to find **YOUR** watershed address, see the online version of this article.

positively and significantly influence our future water quality and, if so, how?

The critical question is not whether we can completely avoid floods, but rather what steps slow and reduce water's movement from the landscape to major waterways, reduce stream peak flows (and associated stream velocity), and reduce downstream delivery of sediment and nutrients.

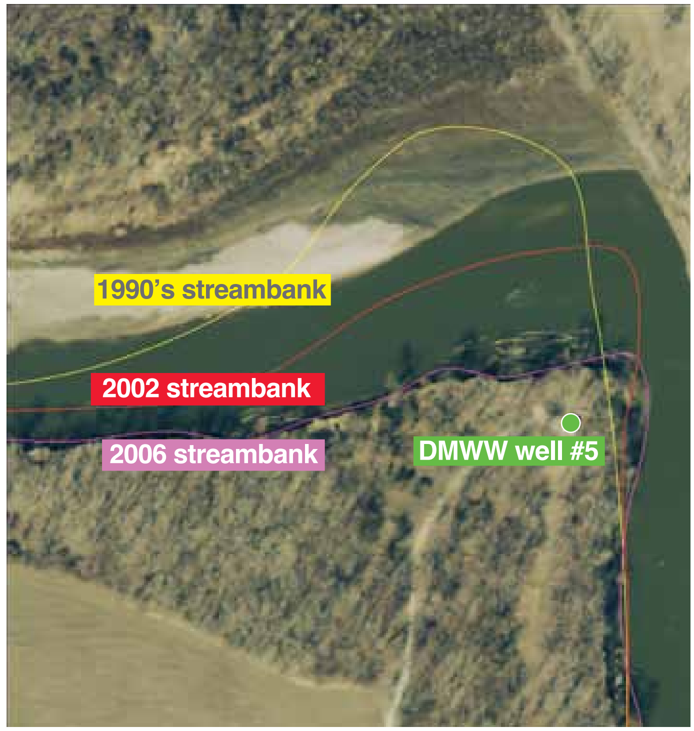
Research shows that much of the sediment moving within a stream originates from the stream bed and bank itself. (Estimates range from 40 to 90 percent.) However, river corridor restoration is not part of the State's regular dialogue on water quality issues. Incentives for practices that hold water on the landscape, encourage infiltration into the ground, and replace lost wetlands are nonexistent or less desirable in the face of other pressures. Scientifically assessing our optimal hydrologic system – to minimize flooding, reduce contaminant delivery from watersheds and improve wildlife and habitat – is not deemed a priority.

Effective water quality improvement in Iowa will require a true watershed approach – not one that simply funnels money into priority watersheds, but a comprehensive vision of modifying the way water is shed from the landscape starting with the extreme headwaters, moving through the feeder streams and ultimately to the largest water bodies.

There are no easy answers, of course. But avoiding the tough questions is no longer an option.

Mary Skopec, Ph.D., is a research geologist with the Iowa Department of Natural Resources where she coordinates stream monitoring for the State.

Streambank comparison over past fifteen years



Jake Benedict/Iowa DNR (info from DM Water Works)

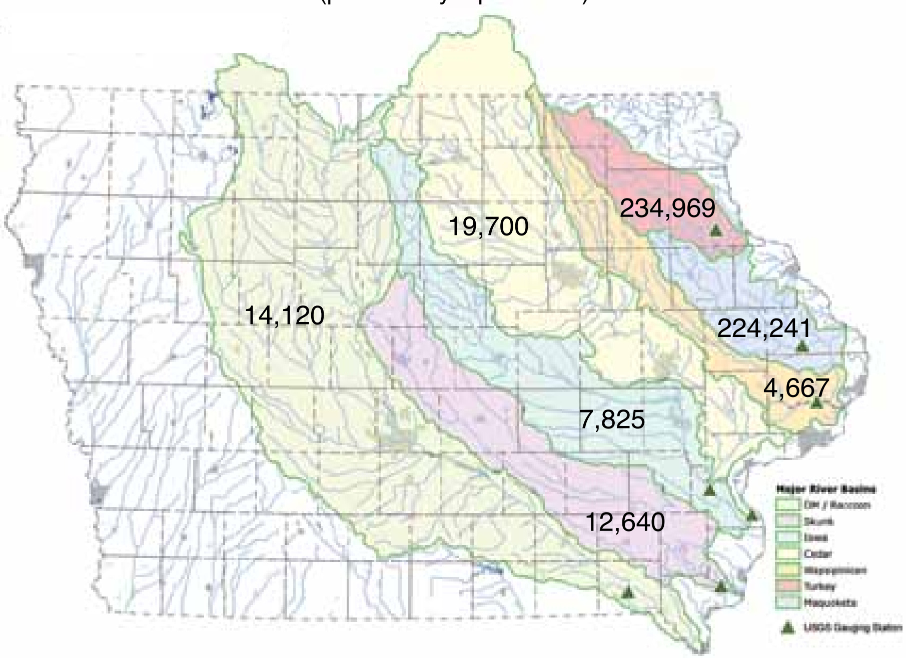
Accelerated streambank erosion is a major source of sediment in Iowa streams. This photo shows the loss of nearly 40 feet of bank along the Raccoon River from 2002 to 2009. The river now threatens to undercut the Des Moines Water Works Well #5.

Floods and water quality

This map shows water quality data collected during the 2008 floods. Researchers were measuring the "suspended solids yield," which is the amount of solid material (soil, vegetation, etc.) carried by the moving water. The 2008 measurements were *up to 100 times higher* than measurements taken during a typical non-flood year. In other words, catastrophic flooding causes catastrophic increases in erosion and pollution:

- Typical sediment yields from Iowa streams are roughly 2,000 pounds/day/square mile. During the 2008 flood event, the Turkey and Maquoketa Rivers each carried more than 200,000 pounds/day/square mile. That's 200 tons per day!
- Typical total phosphorus yields from Iowa streams are roughly 2 pounds/day/square mile, but they reached 14 to 118 pounds/day/square mile in 2008.
- Typical nitrogen yields are 18 pounds/day/square mile, but they reached 215 to 980 pounds/day/square mile in 2008.

Suspended Sediment Load Yields During 2008 Flood
(pounds/day/square mile)*



*Iowa's mean daily yield is 2,061 lbs/day/mi²

Map by Cam Conrad (Iowa DNR), data from Iowa DNR and USGS