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From Drought to Flood

By **Nigel Pickering and Kate Bowditch**//Special To The Tab
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Last month in this column, the emphasis was on the spring drought, the effects of dry weather on the Charles River, and measures that homeowners could be taking to try to keep water on their own property. This month, the story seems to be the opposite, as many in Massachusetts have experienced the worst flooding in many decades. Yet the drought and the flood are really one and the same story: the natural environment and the human environment are bound together, each dependent on the other.

The storm systems that battered New England from May 9-15 dumped more than 15 inches of rain on some Massachusetts communities. In Newton, there was over 5.5 inches of rain in just three days. As of this writing, there has already been over 10 inches of rain in Newton this May. The historical average for the month is 3.3 inches.

The effects of a deluge such as the one in May are dramatic. Rainfall becomes runoff as soils are saturated, rivers swell to overtop their banks, and floodwaters cause millions of dollars in material damage. Fortunately, in this storm and flood, few lives were claimed. The Charles River never actually flooded, though many streets, parks and basements were inundated by runoff and rising groundwater.

Other river systems, and the communities in those watersheds, were hard hit, however, and more than a week after the rains stopped, there are still flooded sections of many towns. So what caused some areas to have more floods than others? Two factors that affect flooding are basin characteristics, and rainfall patterns. Both of these factors came into play in the last storm. Both the rainfall pattern and the local basin characteristics were extremely variable, causing some areas to have the worst flooding on record, while others had only moderate flooding.

The most important basin characteristic that impacts flooding in this area is 'basin storage.' Basin storage consists of rainwater that infiltrates into the soil or groundwater and runoff that fills wetlands, dams, or other man-made stormwater controls. Think of basin storage as holding capacity: it is the amount of water an area can hold before it runs out into the main river channel. An area with a lot of basin storage will not flood as fast as an area with little basin storage.

Rainfall distribution affects the local rainfall amount and intensity. Even in an area with a lot of basin storage, high intensity rainfall can overwhelm the infiltration capacity of the soil, stormwater conveyance structures and river channels, causing high flows and potential flooding.

This particular storm was not evenly distributed, causing large variations in both the rainfall volume and intensity. Radar estimates of the rainfall pattern in Massachusetts and surrounding areas show that northeastern Massachusetts had 8-16 inches of rainfall compared to about 4-8 inches in the Charles River watershed near Boston.

Since the rain all fell in a period of about 5 days, not only were the amounts different, the intensities were also highly variable from one area to the other.

The resulting streamflows varied widely and can be measured by the 'return period' of the flow. For example, a 10-year return period is one that will occur, on average once in 10 years. The Charles River came within inches of flood stage but only reached a 2-year return period. In contrast, the return period for the Merrimack at Lowell was 40 years and the whole Ipswich River was over a 100-year return period.

Some of the muted streamflow response in the Charles might be attributed to the extensive area of wetlands in Cutler Park on the Newton/Needham border, and those on the Medfield/Millis border. In the late 1960s, Charles River Watershed Association (CRWA) was instrumental in working with the Army Corps of Engineers to permanently protect 8,103 acres of wetlands called the Charles River Natural Valley Storage Area. Riparian wetlands rapidly expand to store floodwaters then slowly release the water back to the river after the storm. This wetland storage project serves as a nationwide model for natural flood protection.

In urbanized areas, basin storage can be severely reduced, increasing flooding problems. Impervious surfaces like rooftops, driveways, parking lots and roads reduce evaporation, soil storage, and travel times. The double-edged effect of impervious surfaces is that is disconnects rainfall from ground water, thus creating more larger peaks and runoff volume (floods) while reducing recharge and base flow. The result is more storm flow with less base flow, that is, more of the wrong kind of water.

Perhaps not surprisingly, the same actions that CRWA encourages communities and homeowners to adopt to cope with drought will help reduce the impacts of flooding: reduce paved surfaces; let rainfall percolate into the ground; direct runoff to vegetated areas; keep water out of pipes; protect wetlands and open space; plant more trees. Global warming will likely cause more droughts, and more floods. We need to design our environment so we can live with both.

Nigel Pickering, PhD, Senior Engineer and Project Manager at CRWA, is a computer modeling and mapping expert. Kate Bowditch, MA, a Senior Environmental Scientist at CRWA, is a hydrologist.

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