The Source

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Climate Change Presents Water Quality Challenges

By Bethann McCarthy, Small Systems Engineer/Climate Resilience Coordinator

New Hampshire's climate is changing, as evidenced by an increase in annual average temperatures and increases in annual as well as extreme precipitation. The impacts of these changes can include water-quality challenges for public water systems, especially those that use surface waters as their source. Specifically, more frequent and extreme rainfall and flooding events, higher water temperatures, and lower summer water levels are all likely contributors to water quality issues for drinking water sources. In a survey conducted by DES during the summer of 2013, almost 50 percent of community water systems that use surface water as a source indicated an increase in water quality impacts due to extreme weather events over the past 5 to 10 years. These water quality challenges have increased the need for source water protection. A better understanding of these challenges will help water systems identify and implement appropriate adaptation strategies.

Water quality is significantly impacted by changes in precipitation. As air and ocean temperatures have increased, so too has the amount of moisture moving into the Earth's atmosphere. In the Northeast, increased moisture has led to more frequent and more extreme precipitation events. This increase in precipitation results in increased surface runoff, flooding and stream bank erosion that introduce sediment, nutrients and pollutants to our water bodies. Higher water temperatures in surface water are conducive to accelerated growth of bacteria. In turn, higher levels of turbidity and bacteria in source water can be expected to require higher dosages of disinfectants, which can lead to higher levels of disinfection by-products (DBPs).

Another mechanism by which climate change is likely to contribute to water quality issues is the increased algae growth resulting from increased nutrient loading and higher water temperatures. The increased nutrient loading is both external (nutrients attached to sediment and dissolved in runoff from the watershed) and internal

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Climate Change in New Hampshire: Past, Present, and Future

A publication released this spring by the Granite State Future project provides important climate information to assist municipalities and other NH entities to make decisions regarding future investments. Projections of future climate indicate that NH will continue to experience increasing temperatures and more frequent extreme precipitation events, trends experienced in NH for over 40 years. There are also expected to be increases in the occurrence of short- and medium-term drought during summer and fall.

Cameron Wake, a professor at the UNH Institute for the Study of Earth, Oceans, and Space, director of Climate Solutions New England (CSNE), and lead author of the study, has said, "More frequent extreme precipitation events combined with development in our watersheds will likely lead to more frequent and larger flooding events. If we decide to deal with this issue, the good news is that we have the time, the tools, and the civic structures to help our communities become more resilient to future flooding events."

The publication is a valuable resource for NH's local communities to understand the impacts of our changing climate and improve resilience in our state in the interest of public health, safety and environmental protection.

You can read the publication by going to the UNH website at www.unh.edu and searching "Climate Change in NH."

Concord's Water Conservation Program

By Josh Worthen, Water Conservation Technician for the City of Concord

The concept of water conservation in New England seems to take many Concord residents by surprise, since New England features large lakes, ponds and rivers that are used for recreational purposes and as sources of municipal drinking water. However, as population and development continue to increase, so does the associated water use. Increasing water use sometimes stems from our society's social norms, such as the value we place on the creation of larger, immaculate lawns that use irrigation systems. It can also be related to household appliances that use excessive amounts of water, as well as other water-intensive uses associated with everyday life. The New Hampshire Department of Environmental Services (NHDES) has been very proactive by supporting water systems' efforts to adopt local water conservation measures and complete leak detection surveys to limit waste. The City of Concord has taken the next step by establishing a water conservation technician position focused on implementing important water conservation efforts that preserve the availability of the City's drinking water resources.

Preforming a leak detection survey on a Concord fire hydrant

As the Water Conservation Technician for the City of Concord, I inform the public on water-saving practices; work with the metering, backflow testing, and distribution pipeline staff; perform digital leak detection surveys; communicate with the treatment plant on water concerns; and prepare reports and water audits for management and City Council. The goal is to promote and implement water conservation practices for the preservation of our water source, Lake Penacook.

Recently, NHDES Water Conservation Program recommended that the City become a promotional partner with the U.S. Environmental Protection Agency (EPA) WaterSense Program. Since Concord became a partner with WaterSense, EPA has been providing resources and promotional tools to help the City communicate with the public to ensure they know that WaterSense labeled products actually do conserve water! Other "low-flow" devices have been on the market for years; however some have performed very poorly. All water conservation products bearing the WaterSense label are certified by a third party to use less water and perform as well as or better than their water wasting counterparts.

In the end, using leak detection and promoting water conservation practices to residential and commercial consumers ultimately will conserve water in Lake Penacook, and that may be very important under drier conditions that may occur in the future.

Viewpoints expressed in contributed articles are those of the author and not necessarily those of NHDES. Furthermore, NHDES has not necessarily verified the accuracy of all statements in the article.

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NEW HAMPSHIRE DEPARTMENT OF Environmental Services

29 Hazen Drive
PO Box 95
Concord, NH
03302-0095

Commissioner	Thomas S. Burack
Asst. Commissioner	Vicki Quiram
Division Director	Eugene J. Forbes
Bureau Administrator	Sarah Pillsbury
Program Manager	Paul Susca
Editors	Pierce Rigrod
	Holly Green
Design Editor	Laurel Pushee

To subscribe, contact Pierce Rigrod at (603) 271-0688 or pierce.rigrod@des.nh.gov
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(from internal cycling of nutrients such as releases from lake-bottom sediments), but the consequences are the same: increased algae growth and the resulting organic compounds, which can include taste-and-odor causing compounds as well as DBP precursors.

With respect to water supply wells, extended periods of pumping to meet increased water consumption needs during times of the year when groundwater levels may be lower can be expected to expand the capture zones of wells into areas where there is more development, thereby increasing the potential to capture man-made contaminants.

The need for source water protection is heightened by the challenges presented by a changing climate. Public water systems can take pro-active measures to improve water quality, including the following:

- Develop a Source Water Protection Program that includes: public education, management of potential contamination sources and restricting high-risk land uses.
- Reduce nutrient loading in rivers and streams by protecting stream banks susceptible to erosion. When stabilizing and/or armoring stream banks, bio-engineering techniques which use natural materials to resist the forces of flood waters should be used to the extent possible. (See photos to the right of this paragraph)
- Maintain a vegetated buffer on the banks of water bodies to help maintain cooler water temperatures.
- Encourage Low Impact Development (LID) and other innovative stormwater infiltration practices, such as green roofs, rain gardens, reduction in impervious land cover and use of pervious pavement.
- Purchase or conserve tracts of land within the watershed that are critical to protect water quality.
- Partner with community stakeholders to reduce sources of transported sediment and other non-point pollutants in watersheds, thereby minimizing the amount of treatment required.
- Educate customers, municipal officials and commissioners on the impacts of climate change and how the changes are expected to impact the water system. This may help in obtaining "buy-in" for watershed protection plans, green infrastructure, conservation of critical land, etc.
- Work with your planning boards to explain the importance of those practices and encourage incorporation of these techniques in land use regulations.
- Participate in community and regional planning events related to climate change adaptation.

Above, a stream bank stabilization project that used bio engineering techniques.

It is important for public water systems to anticipate, recognize and address the water quality challenges that can be expected as a result of climate change. As is typically the case with source water protection, adapting proactively can lead to solutions that are more cost-effective than those associated with reacting to water quality problems. If you would like more information on proactive measures you or your public water system can take to protect water quality, please contact Bethann at Bethann.Mccarthy@des.nh.gov or (603) 271-2949.

Studies Assess the Impact of Arsenic on Intellectual Development

By Brandon Kernen, P.G., NHDES Hydrologist

A recently published study led by researchers from Columbia University reports that school children from three school districts in Maine who were exposed to arsenic in drinking water exhibited lower measured intelligence. Similar studies in Asia have previously identified a correlation between exposure to arsenic in drinking water and lower intelligence levels in children, but the Maine study is the first to assess this issue in the United States. The study concludes that there is a possibility that children exposed to drinking water with arsenic in excess of 5 parts per billion (ppb) may experience adverse intellectual development. Wells drilled into New Hampshire's bedrock fractures have about a 1 in 5 probability of containing naturally occurring arsenic above 10 ppb. The study comes on the heels of a similar study in Quebec published in the September 2010 *Environmental Health Perspectives Journal* which found a relationship between increased levels of naturally occurring manganese in drinking water and an impairment in intellectual development in children.

Recognizing that exposure to arsenic at any concentration in drinking water could possibly cause adverse effects on the health of a person, EPA established a goal of zero arsenic in drinking water. EPA has adopted an enforceable Maximum Contaminant Level of 10 ppb based on balancing treatment costs and public health benefits. This is the same standard that the Food and Drug Administration has established for arsenic levels in bottled water. The concentration of arsenic in food is not regulated by any entity at this time. Studies have shown that chronic or repeated ingestion of water with arsenic over a person's lifetime is associated with increased risk of cancer (of the skin, bladder, lung, kidney, nasal passages, liver or prostate) and non-cancerous effects such as diabetes and cardiovascular, immunological and neurological disorders.

The arsenic study in Maine, and the manganese study in Quebec, are important to NH because groundwater in the state can have elevated levels of these naturally occurring contaminants. Community water systems and non-transient public water systems regularly test for these constituents and owners of private wells have been strongly encouraged to sample their wells for these and other constituents on a regular schedule. As findings from these types of peer reviewed published studies gain broad agreement from environmental and public health experts, NHDES uses this information to work with stakeholders to determine when and how its drinking water public health protection policies should be prioritized and amended.

NEW HAMPSHIRE DEPARTMENT OF Environmental Services
DRINKING WATER SOURCE PROTECTION PROGRAM
29 HAZEN DRIVE, CONCORD, NH 03301
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