

Surface water quality trends from the TIME/LTM programs

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Surface water chemistry provides direct indicators of the potential effects of anthropogenic impacts, such as acidic deposition and climate change, on the overall health of aquatic ecosystems. Long-term surface water monitoring networks provide a host of environmental data that can be used, in conjunction with other networks, to assess how water bodies respond to stressors and if they are potentially at risk (e.g., receiving pollutant deposition beyond its critical load). Two EPA-administered monitoring programs provide information on the effects of acidic deposition on headwater aquatic systems: the Temporally Integrated Monitoring of Ecosystems (TIME) program and the Long-Term Monitoring (LTM) program. These programs were designed to track the effectiveness of the 1990 Clean Air Act Amendments (CAAA) in reducing the acidity of surface waters in: New England, the Adirondack Mountains, the Northern Appalachian Plateau, and the Ridge and Blue Ridge Provinces. LTM water quality trends from 1990 to 2010 indicate significant decreasing concentrations of sulfate in most monitored sites in the Northern Appalachian Plateau, Adirondack Mountains, and New England regions, but in only 31% of streams monitored in the Ridge and Blue Ridge Provinces. Most sites exhibited constant or only slightly declining nitrate concentrations over the same time period. Acid Neutralizing Capacity (ANC) levels improved at over 50% of sites in the Adirondacks and Northern Appalachian Plateau, but few sites showed increases in New England or the Ridge and Blue Ridge Provinces. The ANC of northeastern TIME lakes was also evaluated from 1991 to 1994 and 2006 to 2008. The percentage of lakes with ANC values below 50 $\mu\text{g/L}$, lakes of acute or elevated concern, dropped by about 7%. Critical loads were calculated for TIME lakes in the Adirondack Mountains and TIME streams in the Ridge and Blue Ridge Provinces. For the period from 1989 to 1991, before implementation of the CAAA, 45% of lakes and 41% of these streams received levels of combined sulfur and nitrogen deposition that exceeded the critical load. For the 2006 to 2008 period, 30% of lakes and 31% of streams were in exceedance. Information from long-term monitoring has shown that emission reductions, have resulted in improved environmental conditions and increased ecosystem protection. However, despite some ecological recovery, lakes and streams in these regions remain at risk due to current acid deposition levels. The TIME/LTM programs, along with other monitoring networks, will continue to monitor surface water trends for effects of acid deposition and other anthropogenic impacts.