

## **ANTHROPOGENIC EFFECTS ON NEW HAMPSHIRE SURFACE WATER QUALITY: LONG TERM EVIDENCE FROM LAKE SEDIMENTS**

*Investigators: Henri E. Gaudette, and W. Berry Lyons, University of New Hampshire*

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### *Problem and Research Objectives:*

The purpose of this study is to determine the impacts from a sanitary landfill to the sediments of a stream and pond. The Turnkey Landfill of Danbury, NH, which has been established as a source of organic and metal contaminants, is located in an abandoned sand and gravel pit just west of US route 4 and adjacent to Frazier Brook in west central New Hampshire. This unlined landfill was in operation from 1976 to 1986 when it was closed and capped with a clay and vegetative cover.

Possible environmental impacts were first indicated in the Spring of 1981 by the discoloration of Frazier Brook, approximately 100 meters west of the landfill. By 1984 the discoloration of Frazier Brook had extended to Eagle Pond approximately 2.4 km south, initiating an application of potassium permanganate and aluminum sulfate, ordered by the New Hampshire Water Supply and Pollution Control Commission, in order to precipitate the contamination out of the surface water. Subsequent repetitive water samples from the brook and pond have shown a general decrease in the levels of organic and metal contaminants since the application in 1984 and the closure in 1986. The sediments of the brook and pond have not, however, ever been investigated.

The main questions of this research are what are the quantities of contaminants in the sediments of Frazier Brook and Eagle Pond and how are they distributed spatially in the brook and pond system.

### *Principle Findings and Significance:*

The groundwater flow direction, hydraulic gradient and flow rate through the landfill show a slight variability due to seasonal water table fluctuations. The direction of groundwater flow is generally east to west through the landfill and perpendicular to Frazier Brook. The groundwater hydraulic gradient and flow rate were estimated to have long term average values of 0.025 m/m and 2300 m<sup>3</sup>/d (0.027 m<sup>3</sup>/s) respectively.

The seepage meter and piezometer data suggest that leachate is still being generated at the landfill and incorporated into the groundwater which is then being discharged into Frazier Brook at an average rate of 0.030 m<sup>3</sup>/s. The long term mean annual flow of the brook in the vicinity of the landfill and discharging into Eagle Pond was determined to be 0.2 and 0.89 m<sup>3</sup>/s respectively.

The results of the sediment metal (aluminum normalized) concentrations show the majority of sediment samples to be enriched in all metals. The one exception is chromium which is not enriched in any of the samples. Analysis of <sup>137</sup>Cs and <sup>210</sup>Pb from Core C was used to estimate a sedimentation rate for Eagle Pond of 0.50 and 0.76 cm/yr respectively and to determine a time sequence for Cores A and B. The metal concentrations versus depth and time profiles show that the influence of the landfill on the sediments is much higher than the ambient concentrations and has remained fairly constant since the landfill began operating in 1976. Therefore, the closure of the landfill, and the preventive steps which have been taken since closure, have not mediated the chemical impact of the landfill upon the stream and lake sediments. Our chemical data suggest that the landfill contaminants still exist in

quantities in the upper portions of the lake sediments to pose a significant concern should environmental conditions change sufficiently to cause re-mobilization of these contaminants.