

**Title:** Evaluating Options for Changing Groundwater Monitoring Requirements for Landfills to Reduce Mercury Used by Laboratories

**Project I.D.:** DNR Project #151

**Investigators:** *Principal Investigators:*  
Jack Connelly, Hydrogeologist Program Coordinator, Bureau of Waste Management, Wisconsin DNR;  
Donalea Dinsmore, Quality Assurance Coordinator, Bureau of Integrated Science Services, Wisconsin DNR;  
Terry Hegeman, Hydrogeologist, Northeast Region Waste Management Program, Wisconsin DNR;  
Byron Shaw, Emeritus Professor of Soil and Water, UW Stevens Point - Environmental Task Force Laboratory;  
Richard Stephens, Advanced Chemist, UW Stevens Point - Environmental Task Force Laboratory;  
Nancy Turyk, Research Specialist, UW Stevens Point - Environmental Task Force Laboratory  
*Research Assistant:*  
Jennifer Schultz, UW-Madison Engineering Geology Student, Bureau of Waste Management, Wisconsin DNR

**Period of Contract:** *July 1, 1999 - June 30, 2001*

**Background/Need:** Wisconsin DNR is looking actively for ways to reduce mercury-bearing waste. Routine groundwater monitoring for compliance includes testing for chemical oxygen demand (COD). Reagents used to test for COD in the laboratory include mercury and other toxic metals. Hydrogeologists within the Bureau of Waste Management at Wisconsin DNR believe that this test is not very useful for determining whether groundwater is being impacted by landfill leachate.

**Objectives:** This study evaluated whether COD is an effective indicator of groundwater contamination originating from landfills accepting various types of waste, assessed whether data from other indicator parameters were sufficient to identify contamination if COD data were eliminated, and evaluated alternative methods or analyses that could replace COD.

**Methods:** Investigators chose 50 landfills with known groundwater contamination. Landfills were located in each geological region of Wisconsin and were representative of sites dominated by municipal solid waste (MSW), MSW combustor residue, paper mill sludge, fly or bottom ash, foundry, or demolition waste types. During Phases I and II (the first year), investigators evaluated box plots and time versus concentration plots prepared from existing compliance monitoring data to determine which of the required indicator parameters in NR 507 Wis. Adm. Code indicated impacts to groundwater. Investigators considered landfill operations, monitoring history, and well placement in their data evaluations. In addition, investigators assessed whether eliminating COD data would compromise contamination assessment. In Phase III (FY 2000), investigators obtained groundwater samples from a subset of sites evaluated in Phases I and II and performed the following analyses: COD, redox potential (Eh), manganese, iron, ammonium, dissolved organic carbon (DOC), dissolved oxygen, and Hach's Manganese III COD (Mn III COD). Investigators applied Pearson Correlation Coefficients to determine the relative strength of direct and inverse relationships.

**Results and Discussion:**

Although COD data indicated contamination at about one third of the landfills, inorganic indicators alone or in combination with volatile organic compounds (VOCs) provided sufficient evidence of groundwater impacts at all but one landfill. Investigators found that case studies that included history, operation, and other relevant information were crucial to understanding the data and correctly assessing the effectiveness of the test data. Early in Phase III, investigators discarded the Mn III COD as a viable replacement for COD because the detection limits were too high to provide reliable results in most circumstances. All of the other parameters studied provided good correlations with COD in some groundwater matrices. DOC had the highest correlation with COD and also correlated well with most other pollution indicators at paper mill and MSW sites. In spite of the good correlations for the other parameters studied, their effectiveness was limited by natural conditions present and uncertainty introduced during sampling.

**Conclusions/  
Implications/  
Recommendations:**

Considering the amount of toxic waste generated by COD testing and the limited value of the results, COD should be replaced or eliminated from routine groundwater monitoring requirements. Results suggest that COD can be eliminated at fly ash or bottom ash landfills because inorganic indicator parameters effectively indicate contamination. At MSW landfills, COD can be eliminated if VOCs are included in the monitoring plan. At older landfills that are not monitoring routinely for VOCs and at paper mill sludge, demolition, and foundry waste landfills, COD should be replaced with DOC. A similar comparison study should be performed to determine whether DOC or TOC can be substituted for COD in leachate. Further study is needed to evaluate whether VOCs should be added to routine monitoring requirements for demolition, foundry waste, and paper mill sludge landfills.

**Related Publications:**

None to date

**Key Words:**

Landfill, monitoring, COD, Manganese III COD, indicator parameters, mercury emissions, groundwater quality, box plots

**Funding:**

This project was funded by the WI Department of Natural Resources

**Final Report:**

A final report containing more detailed information on this project is available for loan from Wisconsin's Water Library, University of Wisconsin - Madison, 1975 Willow Drive, Madison, Wisconsin 53706 (608) 262-3069.