

US EPA ARCHIVE DOCUMENT



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
REGION 5  
77 WEST JACKSON BOULEVARD  
CHICAGO, IL 60604-3590

March 15, 2013

*Attached to EPA Area C BERA Comments*

**SUBJECT:** United States Environmental Protection Agency (EPA) review of the August 2011 Report: Potential Impact of Fly-ash Groundwater Contamination on Vegetation of Cowles Bog, Indiana Dunes National Lakeshore (Report), prepared by Taylor University.

This Report documents the results of a preliminary two-fold research study conducted during the 2010-growing season on the effects of fly ash on the vegetation in the Cowles Bog area of the Cowles Bog Wetland Community Complex. Over the growing season, 34 observation sites were each visited three times to look for visible symptoms of heavy metal and nutrient toxicity in the wetland vegetation of Cowles Bog. Concurrently, a greenhouse experiment was conducted to determine the effects of varying concentrations of aluminum (Al), boron, (B), and molybdenum (Mo) on three wetland plant species. These three elements are commonly found in fly ash in elevated concentrations and have been found in elevated concentrations in the soils and groundwater of the study area.

The Report details symptoms of heavy metal and nutrient toxicity as including necrosis and marginal chlorosis in leaves from elevated Al, leaf tip and edge burn, necrotic spots in the leaf blade, and premature leaf drop and death from elevated B, and leaf malformations, golden-yellow discoloration of shoot tissue and inhibition of root and shoot growth from elevated Mo. Over the course of the study, the most frequently observed symptom in the plume area was leaf blade necrosis. However, symptoms of incomplete flowering, leaf tip burn and necrosis, necrotic spotting, chlorosis of the leaf blade and veins, marginal leaf curl, and purpling of the stem were observed in both the field observations and greenhouse experiments. In addition, qualitative inhibition of root growth was observed in all three plant species under all three nutrients.

The 2011 BERA, which was previously reviewed by EPA, had multiple lines of evidence pointing to uncertainties associated with the potential adverse risks to plants in the same study areas; Area C. In particular, the presence of barren soil was linked to low pH and elevated metals concentrations. For example, Mo concentrations in the barren soils were as much as 50 times greater than concentrations in the reference soils. In addition, important differences were apparent between the assemblages of plants in the impacted areas versus the reference areas. For example, the Mean C values for the Central Blag Slough and Eastern Wetland areas were lower than those in the reference areas. More specifically, more invasive species were found in the BERA survey plots than in the reference areas. Similarly, this Report documents a virtual *Typha latifolia* (cattail) monoculture in some areas of Cowles Bog. This fact coupled with the

knowledge that the invasive cattail is inherently tolerant to elevated levels of heavy metals, such as B and Mo, points to this Report as yet another line of evidence suggesting that risks to plants in these areas are unacceptable and that negative impacts may be occurring. More specifically, it suggests that the elevated metal concentrations are impacting the plant community composition, leading to more invasive, pollution tolerant species at the site-related areas, as compared to reference areas.

In addition, EPA had several concerns with the plant toxicity study submitted as part of the BERA. One issue surrounded the lack of a wetland plant being included in the study and the possible implications that had on the non-wetland plants ability to perform in the study; i.e. non-wetland plants ability to grow in wetland soils. In addition, it was unclear whether the tested locations adequately spanned the range of concentrations observed at the site. In fact, it appeared that none of the samples used in the BERA toxicity tests had contaminant concentrations that were similar to the maximum concentrations or exposure point concentrations found in the study areas. In contrast, the Report subjected wetland species of plants to varying concentrations of contaminants. The maximum concentrations of B, 79 mg/L and Mo, 7.5 mg/L, applied in the Report study are substantially lower than the maximum concentrations of B, 253 mg/L and Mo, 804 mg/L, found in the Eastern Wetland as part of the BERA. Even with these lower contaminant concentrations, the Report found that B toxicity was uniformly expressed both in qualitative as well as quantitative measures of plant response across the range of concentrations. Mo and Al also exhibited toxicity qualitatively, but were less uniform across the range of concentrations and quantitative measures. Given these substantial negative effects were observed on plants more representative of those found at the site and given those plants were exposed to contaminant concentrations much lower than those observed at the site, this Report again suggests more negative effects are occurring at the site than are proposed in the BERA study.

Overall, this Report and its conclusions add to the already abundance of uncertainty associated with the potential ecological risks in Area C. Furthermore, it adds to the already numerous lines of evidence suggesting that risks that are unacceptable and negative impacts to ecological receptors may be occurring.