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NATURAL ATTENUATION FOR ECOSYSTEM RESTORATION IN NY/NJ HARBOR

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Industrial activities that support a large human population have contaminated large volumes of sediments in the NY/NJ Harbor and have thereby caused serious deterioration in its ecosystem.
Thus, there is great interest in producing a "green" Harbor that provides for the coexistence of the human activities with an improved state for the natural ecosystems. This is evidenced by the ongoing work of the NY/NJ Harbor Estuary Program on developing sediment management polices, reduction of point source discharges, remediation of contaminated regions in the aquatic environment, and restoration of brownfields. Examples of particular work sites relevant to ecosystem restoration are the Passaic and Hackensack Rivers and Newark Bay in New Jersey and Gowanus Canal and Newtown Creek in New York.

We focus here on a site at the tip of the peninsula (Kearny Point) formed by the confluence of the Passaic and Hackensack Rivers as they flow into the north end of Newark Bay. The BASF Corporation has proposed an ecosystem restoration in this confluence area that contains contaminated sediments from these two rivers. Using clean dredged material to cap and limit the bioavailability of the sediments, approximately 26 ha of estuarine marsh and 16 ha of shallow subaqueous environment will be constructed in Newark Bay. The effectiveness of the cap is dependent on the natural populations of sulfate-reducing bacteria in the sediments that can bring about a reduction in organic compounds and a change in the chemical state of the metals. We report the results of an investigation that shows that the metals are found in the form of metal sulfite complexes that have very low dissociation constants under anaerobic conditions. Thus, they will only become soluble or bioavailable when the sediments change to an aerobic state. Therefore it is necessary to seal the sediments with a vegetation cap to prevent disturbance of the anaerobic state. Our measurements include use of BIOMET sensors to obtain a clear picture of heavy metal bioavailability for Zn, Cd, Cu, Ni and Pb, and sediment toxicity. We are also using several techniques, including most probable number estimations on specific growth media (e.g. for consortia of sulfate-reducing bacteria) and molecular ecological techniques to examine community composition and functioning to measure the activity of the microbial populations. Using batch experiments we found that a consortium of *Desulfovibrio* sp. (*D. burkinabensis*) and *Clostridium* sp. (*C. glycolicum*) is the primary engine to obtain the appropriate sulfate-reducing and metal-immobilizing conditions. The results of the experiments show that the Newark Bay sediments contain sufficient sulfate-reducing bacteria to effectively eliminate organic compounds and to minimize bioavailability and solubility of the metals.

An outline of the project components will be presented together with the experimental results on natural attenuation and other site properties.

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