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Technical and Regulatory Guidance Document for Constructed Treatment Wetlands (WTLND-1)

EXECUTIVE SUMMARY

Constructed treatment wetlands are manmade wetlands built specifically to treat contaminants in surface water, groundwater, or waste streams such as leachate and acid mine drainage. The purpose of this document is to provide technical and regulatory guidance to help regulators, industry, consultants, and technology vendors understand, evaluate, and make informed decisions about the use of constructed treatment wetland systems. While there is extensive published literature on the subject, constructed wetland applications have generally been limited to the treatment of stormwater and municipal wastewaters. However, this technology is now emerging as a valid treatment option for a variety of waste streams, including acid mine water, remedial wastewaters, and agriculture waste streams. This guidance documents a number of current successful treatment systems, while it demonstrates the maturity of the technology in many emerging applications.

The document describes the fundamental mechanisms of wetland contaminant removal and overall wetland functions. Degradation mechanisms are described in more detail in *Phytotechnology Technical and Regulatory Guidance Document* (PHYTO-2), published in April 2001. The Wetlands Team's approach in this document is to provide both scientific accuracy and basic understanding of these mechanisms regardless of the regulatory authority overseeing the site or regulating the contaminant. Simply stated, the technology is mature and tested. It is now being used in new applications and in some cases on new contaminants. This guidance provides detailed descriptions of the various contaminant treatment objectives, treatment efficiencies, and goals of different constructed wetland applications. Detailed, site-specific predesign criteria and conceptual designs are outlined, followed by final design, postconstruction activities, operation and maintenance, monitoring, and implementation costs.

The document provides decision trees for each of the major constructed treatment wetland applications, designed to enable users to take basic information from a specific site and, through a flow chart, decide whether a particular wetland system is appropriate for the site.

There are regulatory issues affecting any remedial technology, and constructed wetland systems are no exception. Constructed treatment wetland discharges are normally regulated under the National Pollution Discharge Elimination System (NPDES). Many states have internal oversight of this program. The implementation of constructed treatment wetlands at a site generally encounters other regulatory issues with regard to performance, contingency plans, and potential ecological impacts. Some important considerations include

- use of nonnative, invasive, or noxious plants;
- clearly identifying the mechanism responsible for treatment;

- accounting for seasonal variability in system performance and maintenance requirements;
- determining the length of time to establish the wetland treatment system;
- documenting the expected future use of the site and deciding whether future use is compatible with sustaining the wetland or removing all traces of the wetland;
- removing mercury prior to wetland treatment or monitoring methyl mercury (Treatment of mercury in constructed wetlands can led to the production of methyl mercury, which may biomagnify in the food chain. Mercury should be removed prior to wetland treatment or methyl mercury monitored to avoid causing additional environmental problems.)
- determining ecotoxicity; and
- balancing water quality improvements with failure to meet regulatory standards. (At abandoned sites, constructed wetlands may improve water quality but not succeed in meeting meet strict numeric standards.)

Numerous case studies included in the document were selected to represent various constructed wetland systems and their various applications. These studies are under way, and contact information is provided so readers can follow up on continually progressing demonstrations and full-scale operations. Every effort was made to include detailed performance and cost information and a comparative evaluation against what may be considered more conventional techniques.