PECONIC RIVER REMEDIAL ALTERNATIVES

Wetlands Restoration/Constructed Wetlands

Introduction

For nearly two decades, wetlands have been restored or constructed to meet a number of regulatory requirements, including compensatory mitigation for wetland losses, treatment of wastewater, and reduction of non-point-source pollution. Wetland restoration attempts to reestablish ecological processes in damaged or destroyed natural wetlands, while wetland construction attempts to initiate wetland processes, typically on a non-wetland site, often for such purposes as improving water quality.

Technology Description

Wetlands restoration and construction have been used frequently as mitigation to compensate for wetlands lost, typically due to construction projects. Wetlands can be designed to provide specific functions lost from the landscape. These functions may include development of wetland plant communities that can provide valuable habitats for invertebrates, fish, and wildlife. They also include surface water storage, which provides for the absorption of stormwater flows, and retention, transformation, and removal of nutrients, sediments, and contaminants.

Figure 1 Wetland restoration.

Figure 2 Wetland construction.

Restoration (Fig. 1) is used to replace wetlands or adjacent habitats eliminated during the remediation of contaminated sites. The restoration process is designed to replace the necessary soil structure and chemistry, soil microorganisms, and plant and animal communities. Both plants and soils can be salvaged from the remediation site, or ecologically similar sites, and used in restoration to decrease the recovery time. Following the final grading of clean soils, vegetation is planted as seed or live plants. Species are selected based on the wetland type desired and are matched to the characteristics of the planting site, such as soil moisture and light availability. Preparation of the soil increases the successful growth of plants and often includes loosening of compacted soils and addition of organic material, such as decaying leaves. Streambank stabilization is often required for wetland restorations along stream channels to prevent erosion and quickly establish bank-lining vegetation. Stabilization methods generally include use of plants (either as live plants or seeds) in combination with natural or artificial fiber rolls or mats.

Constructed wetlands (see Fig. 2) are also now used frequently for the treatment of contaminated or nutrient-enriched wastewater. These wetlands typically receive discharges from stormwater collection systems, sewage treatment systems, and other outfalls. Wetlands constructed for water treatment make use of natural wetland processes involving plants, soil, and associated microorganisms. These wetlands are designed to reduce flow velocity, capture suspended sediments, and adsorb contaminants. As retention time of water within the wetlands is increased, the effect of biological and nonbiological processes (both chemical and physical) that remove or transform organic and inorganic compounds, and incorporate materials such as metals into plant material or substrate, is also increased. Flow velocity may be reduced by such design features as decreasing the slope of the wetland soil, increasing the density of wetland vegetation, or reducing water depth by dispersal over a broader floodplain area in free water surface systems (see Fig. 3).

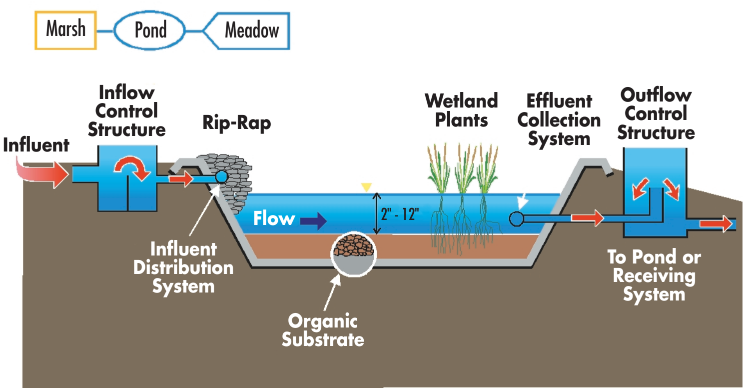

Figure 3   Free water surface wetland: marsh component.

Other applications of constructed wetlands include mitigation of surface runoff from agricultural fields, livestock operations, and golf courses. These wetlands reduce surface flow velocities, retain sediments, and remove or transform nutrients or contaminants, improving water quality in downstream waters.

Advantages

A diversity of wildlife habitats can be successfully developed on restored or constructed wetland sites. Ecosystem function can be restored to degraded or impacted wetland areas. Restoration can rapidly establish a stable biological community, including invertebrates and soil microorganisms. A good cover of fast-growing annual, as well as perennial, vegetation can be established within the first year. Within three years, a wetland restoration effort can produce a diverse community of desired plants and animals. In addition, constructed wetlands can be very effective in improving water quality in downstream waters. Constructed wetlands are effective in removing or stabilizing sediments, metals, and organic contaminants.

Disadvantages

Although constructed wetlands may function as sediment retention systems, excessive amounts of sediment can reduce function over time. In addition, contaminants immobilized in upstream sediments are not eliminated by downstream constructed wetlands. These contaminants remain in place unless they are removed using a separate remediation technology, such as phytoremediation or physical removal.

Relative Cost

The degree of impact or alteration of the natural wetland system influences the cost of successful restoration. Soil replacement and grading can increase the cost of restoration over that of simply preparing the existing soil and planting. Site-specific factors, such as slopes, water currents, or plant species required, can also influence the cost of wetland restoration. In general, restoring wetlands costs $3,500 to $80,000 per acre. This cost would increase with planting of trees and shrubs. Initial construction costs of treatment wetlands are relatively low compared with traditional water treatment systems. Because the wetlands require little maintenance, long-term costs are also quite low. The cost of the constructed wetland is proportional to the number and sizes of treatment cells required. In general, however, it costs $35,000 to $150,000 per acre for constructed treatment wetlands, or about 50% to 90% less than conventional treatment techniques.

Maturity of the Technology

The unique and complex characteristics of wetlands that are associated with specific wetland functions are well understood, and these characteristics can be incorporated into restored and created wetlands in a variety of landscape settings. Many wetland restoration and creation projects have been undertaken in the past two decades. Wetlands are often constructed or restored to provide specific functions, and the success of both wetland construction and restoration projects has greatly increased in the past 10 years.

The successful rehabilitation of degraded or impacted wetland systems includes revegetation, streambank stabilization, habitat creation for fish and wildlife, and creation of new wetland areas. A variety of wetland types can be restored, including stream-side wetlands composed of trees, shrubs, sedges, and cattails, as are found along the Peconic River.

Constructed wetlands have been used successfully for the treatment of degraded water quality at many sites for various problems, including suspended sediments. Constructed wetlands have been shown to remove and trap 86-100% of the sediments from water entering the wetland in summer.

Potential Technology Applicability – Peconic River

The potential impacts of the removal of contaminated sediment from areas of the Peconic River include the disturbance of wetlands within or adjacent to the stream channel. Wetlands are an integral component of the Peconic River system and provide numerous functions, such as waterfowl and fish habitat, and they are an important component of a remediation program. Disturbed wetlands can be restored and exposed banks and substrates stabilized in a cost-effective manner. For wetland restoration, clean soil will be added to areas along the Peconic River from which contaminated sediments have been removed. The soil surface will be contoured to match the pre-remediation elevation, and organic materials will be added. Plants and seeds of desired species, such as those present prior to sediment removal, will be planted. The desired biological communities will develop at these locations within several years and continue to increase in habitat value as the plants mature.

Constructed wetlands can be utilized to capture sediments moving downstream from contamination sites. Application of this technology would aid in the retention of contaminated sediments mobilized from unremediated areas of the Peconic River, thereby preventing migration of contaminants to downstream areas. An open area of several acres would be cleared, adjacent to the Peconic River, for the construction of one or more treatment cells. A gravity flow system may be used to convey Peconic River water to the constructed wetlands, or a pumping system may be installed. Contaminated sediments immobilized in the Peconic River would not be removed by this technology.

Following the completion of remedial activities, the constructed wetlands may remain in place to continue providing water quality improvements to the Peconic River.

Infrastructure Requirements

Wetland restoration would not require additional access roads or staging areas, other than those remaining from the remedial activities. Clean soil, plants, and other materials would be easily transported directly to remediation sites. Construction of treatment wetlands requires access roads for construction equipment. However, decontamination areas are not required.

Long-Term Remedy

Wetlands located within contamination zones will be left undisturbed, unless contaminants are removed using other technologies. Wetlands removed or disturbed by application of other technologies will be restored to pre-remediation conditions. A floodplain location several acres in size, downstream of the contamination zones, can be utilized for the construction of treatment wetlands. One or more cells will be constructed adjacent to the river channel.

Process Residuals Management

Wetland restoration would be undertaken in areas remediated by other technologies, and therefore process residuals are not expected. Contaminated sediments trapped within the constructed treatment wetland will remain in place. Organic and inorganic contaminants will be primarily incorporated within the wetland substrate.

Site Closure Requirements

Unless other remedial technologies are used to extract or remove these metals from sediments within the contaminant zones, the concentrations of copper, silver, and mercury will remain at present levels within the Peconic River sediments. The constructed wetlands will retain mobilized Peconic River sediments and adsorbed contaminants. The metals will be stabilized primarily within the wetland organic and inorganic substrates.

Need for Site-Specific Testing

Restoration of Peconic River wetlands would not require a pilot study prior to implementation. A pilot study, however, would provide valuable information regarding the parameters for effective contaminant treatment within constructed treatment wetlands. It will take about one year to conduct the pilot study. The unique aspects of the site, including hydrology, water chemistry, contaminants of concern, and suitable plant species, make a pilot study desirable to test and refine design criteria prior to construction.

Need for Long-Term Monitoring

Following wetland restoration or construction, a monitoring program will be maintained. Restored wetlands in sediment removal areas will be monitored to identify changes in wetland quality or functions, such as erosion, insufficient growth of wetland species, or introduction of invasive species. If other technologies are not utilized to remove contaminants from Peconic River sediments, a monitoring program will identify continued contaminant effects. Wetlands constructed for treatment of mobilized contaminants will be monitored periodically for effectiveness of contaminant retention.

Synergy with Other Technologies

Short of no action, wetland restoration will be implemented in coordination with other remediation technologies, such as phytoremediation or sediment and contaminant removal. Wetland restoration will restore Peconic River wetlands disturbed during sediment removal operations, or planting and harvesting, to pre-disturbance conditions. Restored wetland communities, including habitat structure, plant and animal species, and hydrology, are expected to reflect undisturbed regional wetland types. Wetlands constructed for water quality improvement will be designed to retain sediments transported from upstream areas or for longer-term protection against inadvertent releases.

Resources

USEPA, 1993, *Constructed Wetlands for Wastewater Treatment and Wildlife Habitat*
http://www.epa.gov/owow/wetlands/construc/

USEPA *Guiding Principles for Constructed Treatment Wetlands: Providing Water Quality and Wildlife Habitat*
http://www.epa.gov/owow/wetlands/constructed/guide.html

USEPA River Corridor and Wetland Restoration Webpage
http://www.epa.gov/owow/wetlands/construc/
http://www.epa.gov/owow/wetlands/restore/

U.S. Army Corps of Engineers, Environmental Laboratory, Wetlands Publications
http://www.wes.army.mil/el/wetlands/wlpubs.html

Natural Resource Conservation Center, Wetland Science Institute, Wetlands Restoration Webpage
http://www.pwrc.usgs.gov/wli/wetres.htm

Contact

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