SOIL SATURATION DETERMINATION FOR WETLAND MITIGATION MONITORING USING "RUSTY RODS" - A CASE STUDY

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Abstract. Monitoring the success of wetland mitigation sites over a period of several years is required as a condition of some permits granted by the U.S. Army Corps of Engineers (USACE) under Section 404 of the Clean Water Act (33 CFR 320-330). The "Rusty Rod" methodology is an inexpensive, unobtrusive and versatile technique applicable to monitoring hydrology for wetland mitigation sites in the less well drained soils of the Georgia piedmont. It is an indirect technique which determines water level depth in soil. When used in combination with soil and vegetation data, the rusty rods provide a reliable estimate of wetland hydrologic conditions.

BACKGROUND

The Section 404 (b) (1) Guidelines (40 CFR 230) of the U.S. Environmental Protection Agency (USEPA) and the Memorandum of Agreement between the USEPA and the USACE (February 7, 1990) state that wetland mitigation should be offered to compensate for unavoidable impacts to wetlands. Following the Guidelines, the establishment of wetland mitigation sites is frequently required to compensate for unavoidable impacts to wetlands from various types of development permitted under Section 404 of the Clean Water Act.

Mitigation Monitoring. The success of the mitigation effort is determined through a monitoring schedule which may vary from two to six, or more years. Mitigation monitoring typically involves recording annual or seasonal information on maintenance of wetland hydrology, development of wetland vegetation, hydric soil conditions, water quality, and erosion/sedimentation. With the exception of wetland hydrology, these parameters can be sampled at a point in time. By comparison, wetland hydrology is typically monitored over a period of time due to fluctuations in the water table and storm/flooding events. Positive wetland hydrology is considered to be present when the soil is saturated to within certain depths from the soil surface or when an area is inundated, depending upon soil type and the applicable regulatory criteria. In addition, the regulatory criteria as presented in the delineation manuals (Environmental Laboratory, 1987; Federal Interagency Committee for Wetland Delineation, 1989) include specific hydroperiods based upon the duration of the soil saturation and the season in which the saturation occurs. This degree of saturation is assumed to be required for successful growth of hydrophytic vegetation.

Advantages of Rusty Rods. There are a variety of sophisticated techniques and measuring devices available to determine soil saturation and water table depths. Such instrumentation can be expensive to purchase, install and maintain. As a result, it is frequently not feasible for long term applications in wetland mitigation monitoring. In comparison, the rusty rod methodology is very inexpensive, requires no maintenance and can provide an extensive and flexible sampling of site conditions.

Additionally, the rusty rods are inconspicuous in the field and are therefore not prone to disturbance by animals or to vandalism. These issues are a major consideration when designing compliance monitoring. The majority of wetland mitigation areas are located adjacent to development sites in urban/suburban areas and damage to or loss of monitoring equipment is frequently encountered. It is highly unlikely rusty rod stations would be identified, let alone damaged/stolen by persons trespassing in these mitigation sites. In contrast, piezometer wells, with or without recording instrumentation, are much more visible and are likely targets for disturbance/vandalism.

Accuracy of Rusty Rods Method. For comparison purposes, twelve piezometers were installed for the 1992-1993 monitoring period. We are currently comparing the data collected from the piezometers and the rusty rods. Preliminary data shows a good correlation between the soil saturation as determined by the rusty rods and the piezometers.

"Rusty Rods" Method. According to the rusty rod method, the depth to saturated soil can be determined by inserting mild steel rods into soil for periods of several weeks (Hook et al., 1987; Carnell et al., 1986; McKee,

1978). In soils which are not saturated, the mild steel rods rust due to the presence of oxygen in the soil pores. In saturated soils, water fills the soil pores and the soil becomes anaerobic. The lack of available oxygen in such saturated soils prevents rusting of the mild steel rods. The point on the rod at which rusting ceases reflects the depth to the saturated soil conditions. Saturated soils which are also inundated will yield rust-free rods.

CASE STUDY

Study Site. We have been successfully monitoring soil saturation over a three year period for a wetland mitigation site permitted under Section 404 of the Clean Water Act. The applicability of the rusty rod methodology to wetland mitigation monitoring was reviewed and approved by the USACE, the USEPA, the U.S. Fish and Wildlife Service and the Georgia Department of Natural Resoures. The mitigation site encompasses approximately 54 acres of flood plain along 6,100 feet of Honey Creek in DeKalb and Rockdale Counties, Georgia. The creek had previously been channelized to reduce flooding for agricultural purposes. Gradient and spreader weirs have been constructed along Honey Creek to restore wetland hydrology to the flood plain area by raising the water table and flooding the flood plain during storm events.

Field Monitoring. A series of 16 transects has been established across the flood plain along the length of Honey Creek. Depending upon location, two to eight rusty rod sampling stations have been located along each transect to give a total of 98 sampling stations. At each station, two mild steel rods (welding rods - 36 inches long and 3/32 inch diameter) are inserted to monitor soil saturation. The depth to soil saturation (length of rod showing no rust) is recorded for each station at eight-week intervals during the wet season when there is least fluctuation in the water table.

The network of information from the rusty rod stations provides quantitative data for the degree of (depth to) soil saturation (or the period of inundation if flooding has occurred), the lateral extent of soil saturation over the flood plain and the overall location of soil saturation throughout the mitigation area. The data collection period during the wet season (November - May) corresponds to the dormant and early growing seasons for vegetation. Although the concern for survival of wetland vegetation is the maintenance of wetland hydrology during the spring/summer growing seasons, the rusty rod method provides an indication of the site hydrology. If soil saturation sufficient to meet the hydrologic wetland criteria is not detected during the wet season, then it can be concluded that site hydrology will be insufficient to maintain wetland vegetation through the year.

Monitoring Results. From the rusty rod data collected at the Honey Creek mitigation site, saturation is occurring to within 18 inches of the soil surface over the entire flood plain. After the first monitoring year (1990-1991), the data collected indicated that saturated soil conditions were occurring beyond the limits of the established transects. As a result, the full positive impact of the restored hydrology under the influence of the weirs was not being documented. The rusty rod method is very flexible and can be readily amended to accommodate changing site conditions.

For the second monitoring period (1991-1992), we extended the transects by installing an additional 29 rusty rod stations to collect soil saturation information beyond the limits of the previously established transects. Data collected for the 1991-1992 monitoring period indicates that approximately 96 percent of the rusty rod stations are in saturated soils and/or are inundated (no rust on rods). The remaining 4 percent of rusty rod stations not showing saturated soil conditions for the monitoring period are located at the extremes of the transects where the site grades into upland areas. These non-wetland transitional areas were not expected to show saturated soil conditions as they are outside of the influence of the flooding caused by the mitigation weirs and are above the influence of the water table.

SUMMARY

We have been successful in applying the rusty rod method to monitor wetland hydrologic conditions for a wetland mitigation site in DeKalb and Rockdale Counties, Georgia. Although indirect, the method provides a reliable indication of site hydrologic conditions during the wet season (winter/early spring) which can be extrapolated to the growing season (spring/summer). Due to the low-cost, low-maintenance and flexibility of the method, it is particularly useful in wetland mitigation monitoring. Also, it is not prone to disturbance by animals or vandalism.

The low-cost of installation and sampling of the rusty rods allows a mitigation site to be more intensively sampled than by more conventional methods of hydrologic monitoring. The long, narrow configuration of the Honey Creek mitigation site (the flood plain along Honey Creek and its tributaries) required monitoring over an extensive area. It was not feasible to install a sufficient number of piezometers at the Honey Creek mitigation site. It was relatively easy, however, to install, maintain and sample the 98 rusty rod stations. Typically, at the start of a monitoring period, the 98 stations can be established in two days, and sampling can be completed in one day.

The rusty rod method is suitable for monitoring site hydrology for typical wetland mitigation sites encountered in the Georgia piedmont. The approach provides an alternative to monitoring site hydrology using conventional methods. For compliance monitoring purposes, a mitiga-

tion site can be intensively sampled using rusty rods due to the low-cost, low-maintenance and flexibility of the method.

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