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Predictive Techniques: Wetland Sedimentation Due to Surface Water Flow

PURPOSE: This Technical Note presents conditions for which existing sedimentation technology can be used in wetland areas. Although the term sedimentation embodies the processes of erosion, entrainment, transportation, deposition, and compaction of sediment, this technical note addresses waterborne sediments.

BACKGROUND: Sedimentation processes should be grouped into the broad categories of "local" and "general" processes. Local processes are those occurring over a relatively small space resulting in driving mechanisms that are highly three dimensional in space and dynamic in time. General sedimentation processes are those occurring over relatively large-scale space resulting in driving mechanisms, and response of sediment particles, that can be adequately predicted using one-dimensional dynamic or analytic steady state equations. General sedimentation processes will be discussed below.

SEDIMENTATION PROCESSES: Sediment investigations to date have focused on inorganic material. Particle size has been the key parameter in classifying sediment behavior. The Subcommittee on Sediment Terminology of the American Geophysical Union proposed the classification system in use today (Lane, 1947).

Particle Size, mm	Classification
< 0.004	Clay
0.004 to 0.0625	Silt
0.0625 to 2.0	Sand
2.0 to 64.0	Gravel
64.0 to 256.0	Cobbles
> 256.0	Boulders

Because the behavior of sediment particles is so sensitive to their size, Lane partitioned these broad ranges into class intervals using a geometric progression of 2.

The emphasis in existing reservoir sedimentation studies was on volume depletion in the reservoir pool. Research attention was focused on the deposition and compaction processes involving the finer sediment particles characterized as sand, silt, and clay. Hydrodynamic forces systematically decreased as flow entered the reservoir and once deposited, sediments remained immobile.

In riverine sedimentation, however, the historical research interest has included the processes of erosion, entrainment, transportation, and deposition. The research emphasis has focused on sand and gravel size particles because the forces in riverine systems do not permit the finer silt- and clay-sized particles to deposit.

Estuarine sedimentation studies require a more complete treatment of the problem since the hydrodynamics are complicated by both baroclinic (buoyancy) forces and barotropic (other) forces.

WETLAND SEDIMENTATION PROCESSES: In wetland studies, analysis is complicated by the hydrodynamic diversity in the system as well as by the difference in behavior of sand, silt, and clay particles. The cohesive characteristics of the clay and fine silt particles further complicate the analysis. Vegetation complicates the physical analysis of the deposition and erosion processes, as well as the transport process by altering the turbulent structure of flow when compared to "normal" boundary roughness dominated flows. In addition, the new "organic" sediment class is introduced. Organic sediments have both physical and chemical influences on sedimentation processes. Turbidity is a condition to be reckoned with in wetland systems and it has not received a great deal of attention analytically in existing sedimentation studies. Aquatic life in the wetland system can introduce turbidity, affecting light penetration and aquatic plant growth. The additional energy source due to aquatic life is one not commonly addressed in sedimentation studies. Finally, the presence of aquatic life may make boundary sediments more difficult to erode compared with the more biologically sterile riverine and flume systems which provided the coefficients for erosion functions currently in use.

APPLICATION IN WETLANDS: These and other factors complicate sedimentation investigations in the wetland environment. However, by carefully identifying goals and objectives, existing technology can give valuable insight into the longevity of a wetland as it responds to the inflowing sediment material. Also, existing technology can give valuable insights into the performance of project features as man attempts to work with and manage the wetland systems.

The Waterways Experiment Station is presently developing and distributing a system of PC based computer programs which calculate hydraulic parameters, sediment transport rates, and long term sediment yields. This application package will be useful for studying the finer silt and clay sediments commonly found in wetland environments, as well as coarser sand and gravel size sediments which occur in the inflowing or exiting channels. The package is called "Hydraulic Design Package for Channels (SAM)" (Thomas, *et. al.*, 1993).

CONCLUSIONS: Sedimentation studies have traditionally focused on riverine, reservoir, or estuarine systems. By recognizing the controlling physical similarities and differences between wetland and other hydrologic systems, application of the appropriate physical description of erosion, entrainment, transport, deposition, and compaction processes is possible.

REFERENCES:

Lane, E. W. "Report of the Subcommittee on Sediment Terminology," Transaction, American Geophysical Union, Vol. 28, No. 6, Washington D.C., 1947, pp 936-938.

Thomas, William A., Ronald R. Copeland, Nolan K. Raphelt, and Dinah N. McComas. "Hydraulic Design Package for Channels (SAM)," U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS, April 2, 1993 (DRAFT).

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