

**National Stormwater BMP Database
Master BMP Bibliography Used to Develop the Database**

This file contains bibliographic references for studies in the following categories:

- 1.3 Detention
 - 1.3.1 Dry & Wet Ponds
 - 1.3.2 Wetlands
 - 1.3.3 Oil/Grit Separators / Catch basins

Files for the other categories are available for downloading from the ASCE web site. The complete topic category structure is provided below.

- 1.0 Structural BMPs
 - 1.1 Infiltration
 - 1.1.1 Infiltration Trench / Basin
 - 1.1.2 Porous Pavement
 - 1.2 Filtration
 - 1.2.1 Vegetated Filter Strips / Buffers
 - 1.2.2 Grassed Swales
 - 1.2.3 Sand Filters / Filtration Basins
 - 1.3 Detention
 - 1.3.1 Dry & Wet Ponds
 - 1.3.2 Wetlands
 - 1.3.3 Oil/Grit Separators / Catch basins

- 2.0 Nonstructural BMPs
 - 2.1 Planning / Land Use
 - 2.2 Post-Development
 - 2.2.1 Urban Housekeeping
 - 2.2.2 Lawn Maintenance
 - 2.2.3 Street Sweeping
 - 2.2.4 Road Deicing
 - 2.2.5 Road Maintenance

3.0 BMP and Water Quality Monitoring Programs

4.0 Water Quality Models

5.0 Non-Point Source Pollution Sources / Loads

6.0 Both Structural and Nonstructural BMPs (both 1.0 and 2.0)

7.0 Unknown If Contains Information For Items 1.0 through 6.0

24-Apr-98

TOPIC: 1.2.3

AUTHOR(S): Schueler, Thomas

DATE: 1995

TITLE: Performance Of Delaware Sand Filter Assessed

ORGANIZATION:

SOURCE: Watershed Protection Techniques 2(1): 291-293

ABSTRACT:

TOPIC: 1.2.3

AUTHOR(S): Shaver, E.

DATE:

TITLE: Sand Filter Design For Water Quality Treatment

ORGANIZATION:

SOURCE: In E.E. Herricks, ed. Urban Runoff and Receiving Systems. Am. Soc. Civil Eng., New York, NY

ABSTRACT:

TOPIC: 1.2.3

AUTHOR(S): W and H Pacific

DATE: 1992

TITLE: Compost Storm Water Filter System: Technical Summary, Methods and Results

ORGANIZATION:

SOURCE: Portland, OR

ABSTRACT:

TOPIC: 1.3

AUTHOR(S): Bitter, S.D. and J. K. Bowers

DATE: 1994

TITLE: Bioretention As A Water Quality Best Management Practice

ORGANIZATION:

SOURCE: Watershed Protection Techniques 1(3):114-116

ABSTRACT:

TOPIC: 1.3

AUTHOR(S): Chan, E.

DATE: 1979

TITLE: Treatment of Stormwater Runoff by a Marsh/Flood Basin

ORGANIZATION: Assoc. of Bay Area Govts.

SOURCE: Association of Bay Area Governments. Oakland, CA.

ABSTRACT: Effectiveness data on the removal of TSS, metals, TN, and TN provided. No cost data./The flood basin functions as a marsh/wetlands. The first year's results of the study show that pickleweed dominates the lower elevation marsh areas that are subject to daily and seasonal inundation. Pickleweed also tends to concentrate heavy metals to a greater extent than the mixed marsh or upland grass vegetation sampled. The aerial plant parts of pickleweed demonstrates the ability to concentrate heavy metals - particularly Zn and Cd - at significant levels beyond soil and stormwater concentrations.

24-Apr-98

TOPIC: 1.3

AUTHOR(S): Cullen, P., R. Rosich, and P. Bek.

DATE: 1978

TITLE: A Phosphorus Budget for Lake Burley and Management Implications for Urban Lakes.

ORGANIZATION:

SOURCE: Australian Water Resource Council Technical Paper 31, 220 pp.

ABSTRACT: The urban lakes constructed in Australia for aesthetic and recreational purposes can also be used to control runoff and to remove sediment, nutrient and toxic pollutants from the water. Sources of pollutants in Lake Burley Griffin include storm runoff and sewage effluent. Phosphorus levels were used to measure the degree of contamination because phosphorus promotes algal and plant growth and because it is one of the most cost-effective nutrients to control. The authors recommend that herbicidal treatment of emergent vegetation be limited to critical access points to allow emergents to filter out incoming pollutants. Harvesting the macrophytes is the recommended control method. If the rate of vegetative and algal growth is unacceptable, the incoming nutrient load should be decreased. This can be accomplished by preserving the adjacent wetlands and diverting incoming water sources through the wetlands or agricultural areas (to be used for irrigation). The use of phosphorus fertilizers should be controlled to prevent rainwater runoff from carrying off newly applied fertilizer. Sediment loads should also be controlled.

A total nutrient budget of Lake Burley Griffin is given. The value of emergent and submerged plants for erosion control, fish habitat, and sediment and nutrient trapping is discussed with reference to phosphorus input from sewage and agriculture. The most appropriate method suggested for reducing input was to develop wetlands to the east of the lake as a biological filter for normal and drought flows.

TOPIC: 1.3

AUTHOR(S): Gearheart, R.A., and B.A. Finney.

DATE: 1981

TITLE: Use of Vascular Plants for Treatment and Reclamation of Oxidation Pond Effluent and Nonpoint Source Pollution Loads.

ORGANIZATION:

SOURCE: Presented at the Water Reuse Symposium II. Washington, DC. August 23-28, 1981.

ABSTRACT: The City of Arcata is presently funding an alternative wastewater pilot project by the State Water Resources Control Board, which will 1) evaluate the feasibility of using secondarily treated wastewater to enhance the productivity of a freshwater marsh, and 2) to test the effectiveness of marshes to reliably treat stabilization pond effluent to tertiary standards. Twelve 0.11 acre (22 feet by 200 feet) experimental marshes have been operated with varying flow rates, types and density of vegetation, and depth of flow. The experimental design requires testing and evaluation of the optimum aquatic composition, water level control, hydraulic loading rate, organic and nutrient loading rates, and management practices for use as a wastewater reclamation process. Nutrients such as ammonia nitrogen, Kjeldahl nitrogen, nitrates, nitrites, and phosphate forms as well as other water quality parameters such as BOD, COD, total and fecal coliform, and fecal streptococcus. A balance of the biomass production and its associated nitrogen content will be made. A thorough sampling program of the aquatic plants, including roots and rhizomes, phytoplankton, zooplankton, heavy metals, pH, temperature, and specific conductivity. have been monitored on a regular basis.

TOPIC: 1.3

AUTHOR(S): Holler, J.D.

DATE: 1989

TITLE: Water Quality Efficiency of an Urban Commercial Wet Detention Stormwater Management System at Boynton Beach Mall in south Palm Beach County, FL.

ORGANIZATION: Smith and Gillespie Eng., Inc., 7406 Manatee St., Suite 1, Sarasota, FL, USA

SOURCE: Florida Scientist. Orlando FL, vol.52, no.1, pp.48-57

ABSTRACT: Urban wet detention system investigations were conducted at a commercial shopping mall in Boynton Beach, FL. This study site possessed a permitted drainage area of 25.4 ha (62.8 ac), which was approximately 90 percent impervious. The water management area consisted of three interconnected ponds, each approximately 1.2 ha (3 ac), totaling 3.5 ha (8.7 ac). This site was instrumented with automatic water quality samplers to collect storm-generated runoff samples. In addition, digital stage measurement equipment continually monitored and recorded both surface and ground water elevation. The results were collated with previous results in the literature and comparisons indicated superior treatment efficiencies.

24-Apr-98

TOPIC: 1.3

AUTHOR(S): Horner, R.R. and S.R. Wonacott

DATE: 1985

TITLE: Performance Evaluation Of A Detention Basin and Coalescing Plate Oil Separator For Treating Urban Stormwater Runoff

ORGANIZATION:

SOURCE: Report to State of Washington Water Research Center and U.S. Geological Survey

ABSTRACT:

TOPIC: 1.3

AUTHOR(S): Horner, R.R. and Wonacott, S.R.

DATE: 1985

TITLE: Performance Evaluation of a Detention Basin and Coalescing Plate Oil Separator for Treating Urban Stormwater Runoff.

ORGANIZATION:

SOURCE: Prepared for the State of Washington Res. Center, Dept. of Civil Engineering, Univ. of Washington. Seattle, WA.

ABSTRACT:

TOPIC: 1.3

AUTHOR(S): Kinnetic Laboratories, Inc.

DATE: 1996

TITLE: Best Management Practice Effectiveness Test of the Jensen High Velocity Stormwater Interceptor (Preliminary Draft Report)

ORGANIZATION: San Meteo Countywide Stormwater Pollution Prevention Program

SOURCE: June, 1996. KLI, 307 Washington St., Santa Cruz, CA 95060 (Contact Mary Stevenson 808-661-1110)

ABSTRACT:

TOPIC: 1.3

AUTHOR(S): Kulzer, L.

DATE: 1990

TITLE: Water Pollution Control Aspects of Aquatic Plants: Implications for Stormwater Quality Management.

ORGANIZATION:

SOURCE: Municipality of Metropolitan Seattle (METRO), Office of Water Quality, Seattle, WA.

ABSTRACT: In this paper, a number of studies from the research literature are presented which deal with the pollutant amelioration and uptake properties of aquatic plants.

Aquatic plants have been found effective in treatment of a number of types of pollution problems, including nutrient removal, uptake of metals and organics, reductions of pathogenic bacteria, and in neutralizing extremes of pH. Potential exists for use of these properties of aquatic plants in stormwater quality applications.

Some interesting highlights about pollutant removal patterns are as follows:

- Metal concentrations are higher in plants growing in higher environmental exposure situations.
- Metal concentrations are generally higher in the roots and rhizomes than in the shoots, or leafy parts, of aquatic plants.
- Older tissues tend to accumulate higher metal concentrations than young tissue except in the case of mercury, which tends to accumulate at higher levels in new growth.
- Heavier metals such as mercury and lead seem to accumulate more readily in plant tissue.
- Plants which grow from a basal meristem, such as rushes (*Juncus* spp) show particularly good ability to take up organics, especially oils.
- Dramatic reductions in pathogenic bacteria have been documented in several emergent species which occur locally.

Although no local studies outside the Puget Sound Wetlands and Stormwater Management Research Program have been found, many of the plants studied in other regions occur in the Puget Sound area, or have close relatives here. A list of plants which occur in the area and their likely pollutant removal properties is presented.

Limited information is presented on availability of wetland plants from local sources. considerations for use of plants which tend to be pesty, food chain effects, and disposal of potentially contaminated plant material are also briefly explored.

24-Apr-98

TOPIC: 1.3

AUTHOR(S): Maristany, A.E.; Bartel, R.L.

DATE: 1989

TITLE: Wetlands and Stormwater Management: A Case Study of Lake Munson. Part I: Long-Term Treatment Efficiencies.

ORGANIZATION:

SOURCE: IN: Wetlands: Concerns and Successes. Proceedings of a Symposium held September 17-22, 1989, Tampa, Florida. American Water Resources Association, Bethesda, Maryland. 1989. p 215-229, 7 fig, 6 tab, 8 ref.

ABSTRACT: The use of wetlands or wet detention ponds for stormwater management represents a relatively new approach that has been successfully applied in recent years to address water quality problems in urban areas. Since most systems have been in operation for only a few years, questions have been raised concerning their long-term performance. It has been speculated that once these systems reach a state of dynamic equilibrium, nutrient removal may decline due to the reduced nutrient uptake of a mature ecosystem. A recent study was conducted by the Northwest Florida Management District of a 255 acre wetland/lake system which has received wastewater effluent and storm water discharges for over 30 years. Nutrient and pollutant removal rates were estimated for a wide range of parameters based on concurrent sampling of stormwater inflows, outflows and lake water quality. Long-term removal rates for Lake Munson, Florida, compared favorably with rates reported for relatively new facilities. An important conclusion from this study is that wet detention systems designed for minimum treatment storage capacity and which are not properly maintained, will experience significant water quality problems due to eutrophication. It would be advisable to increase storage capacity beyond the point of diminishing returns by either deepening the pond or expanding its surface area to prevent the pond from being overwhelmed by typical storm events as is the case with Lake Munson. The average storm event replaces the entire wet detention volume in the lake. A better design criteria would be to provide twice the volume if the average storm event in order to reduce the impact of any one storm on pond water quality. Drawdowns should also be implemented on a periodic basis as part of the over all maintenance program in order to stabilize bottom sediments and reduce the amount of orthophosphorous released from the sediments to the water column.

TOPIC: 1.3

AUTHOR(S): Martin, E.H.

DATE:

TITLE: The Effectiveness of a Detention Pond and Wetlands System in Reducing the Amounts of Lead Transported by Urban Stormwater Runoff.

ORGANIZATION:

SOURCE: U.S. Geological Survey, Orlando, Florida

ABSTRACT: The construction of different types of in-line temporary storage devices to reduce constituent loads carried by urban stormwater runoff is becoming more prevalent. The results of a study to determine the effectiveness of a detention pond - wetlands system to reduce the amount of lead in urban stormwater runoff are presented. The detention pond and wetlands receive drainage from a 42 acre urban area. The pond area is 9,000 square feet and the depth of water is about 8 feet during rainstorm periods. The wetlands is about 34,000 square feet in size and the depth of water ranges from 0 to 2 feet during nonstorm periods.

Total lead loads entering the system ranged from 0.021 to 1.7 pounds. Data were collected for the pond and wetlands for nine storms, and the pond only for an additional three storms. System inlet data only were collected for one storm.

The detention pond and wetlands are generally effective in reducing the amount of lead being transported by the urban runoff. In 8 of 12 storms, the detention pond reduced the amount of total lead in the runoff. The maximum reduction observed in the pond was 73 percent. For four storms, an increase of total lead load, ranging from 26 to 190 percent, was observed through the pond. This increase may be due to short circuiting (flow moving directly from pond inlet to outlet), scouring, resuspension of pond bottom materials, high concentrations of lead in the pond water before the storm, analytical error, or other factors. The wetlands reduced the total lead load for each of the nine storms an average of about 75 percent. The combined system (pond and wetlands in series) reduced total lead loads for each of the monitored storms. The system retained an average of 72 percent of the total lead load that was introduced.

24-Apr-98

TOPIC: 1.3

AUTHOR(S): Martin, E.H., and J.L. Smoot.

DATE: 1986

TITLE: Assimilative Capabilities of Retention Ponds (Final Report).

ORGANIZATION:

SOURCE: Available from the National Technical Information Service, Springfield, VA 22161, as PB88-180153 Report no., FHWA/DOT/BMR-303/86.

ABSTRACT: The efficiency of a detention pond and wetlands temporary storage system to reduce constituents loads in urban runoff was determined. The reduction efficiencies for 22 constituents, including dissolved, suspended, and total phases of many of the constituents were investigated. A new method not previously discussed in technical literature was developed to determine the efficiency of a temporary storage system unit such as a detention pond or wetlands. The method provides an efficiency, called the regression efficiency, determined by a regression made of loads-in against loads-out of unit with the intercept of the regression constrained to zero. The regression efficiency of the treatment unit is defined as unity minus the regression slope. The system (ponds and wetlands) achieved appreciable reductions of loads for most constituents.

TOPIC: 1.3

AUTHOR(S): Martin, E.H.; Smoot, J.L.

DATE: 1986

TITLE: Constituent-load changes in urban stormwater runoff routed through a detention pond-wetlands system in central Florida.

ORGANIZATION:

SOURCE: Tallahassee, Fla. : U.S. Dept. of the Interior, Geological Survey; Denver, Colo. : Open-File Services Section, Western Distribution Branch, 1986./U.S. Geol. Surv. Wat. Res. Inv. Rept. 85-4310.

ABSTRACT: No abstract available

TOPIC: 1.3

AUTHOR(S): Martin, Edward H.

DATE: 1988

TITLE: Effectiveness of an Urban Runoff Detention Pond - Wetlands System

ORGANIZATION: ASCE

SOURCE: Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 114, No. 4, p 810-827, August 1988. 4 fig, 5 tab, 11 ref.

ABSTRACT: The effectiveness of a detention pond and wetlands in series in reducing constituent loads carried in runoff was determined. The detention pond was effective in reducing loads of suspended solids and suspended metals. Suspended-phase efficiencies for solids, lead, and zinc ranged between 42 and 66%. Nutrient efficiencies were variable, ranging for all species and phases from less than 0 to 72%. The wetlands generally were effective in reducing both suspended and dissolved loads of solids and metals. Total (dissolved + suspended) solids, lead, and zinc efficiencies ranged between 41 and 73%. Efficiencies for total nitrogen and phosphorus were 21 and 17%. The system, by combining the treatment of the pond and wetlands, was very effective in reducing loads of most constituents. Total solids, lead, and zinc efficiencies ranged between 55 and 83%. Total nitrogen and phosphorus efficiencies were 36 and 43%. The Stormwater Detention Facility, comprising part of the Orlando, FL, urban drainage system, is composed of a detention pond and wetlands in series. The efficacy of the detention system in reducing constituent loads carried in runoff was evaluated. Measurements show the pond was effective in reducing loads of suspended solids and metals. Suspended-phase efficiencies for solids, lead, and zinc were in the 42-66% range. Nutrient efficiencies were variable, ranging for all species and phases from less than 0 to 72%. The wetlands generally were effective in reducing both suspended and dissolved loads of solids and metals. (3 graphs, 1 map, 11 references, 5 tables).

24-Apr-98

TOPIC: 1.3

AUTHOR(S): Meiorin, E.C.

DATE: 1989

TITLE: Urban Runoff Treatment in a Fresh/Brackish Water Marsh in Fremont, California.

ORGANIZATION:

SOURCE: IN: Constructed Wetlands for Wastewater Treatment: Municipal, Industrial and Agricultural. Lewis Publishers, Chelsea, Michigan. 1989. p 677-685, 3 fig, 2 tab, 8 ref.

ABSTRACT: A temporary stormwater detention system for improvement of water quality was constructed in Fremont, California, in 1983. The wetland system and its control structures receive water from approximately 1200 ha: 66% low-density residential, 28% agricultural open space, 5% high-density residential, and 1% commercial and urban road. The marsh was monitored during the wet seasons of 1984-85 and 1985-86 to document marsh development and treatment effectiveness. The wetland system covers approximately 22 ha and consists of three separate subsystems: (A) a lagoon flow-through system with 1:4 slope on lagoon margins and depth ranging from 1.8 to 2.4 m; (B) an overflow area (0.5% slope, dry between storms), which leads to a pond with underwater sills vegetated with cattails and (C) a system of braided channels into which the other systems drain (4.7 ha open water, 4.2 ha vegetated with bulrushes and cattails). Measured stormwater runoff volumes from 11 storms entering the marsh ranged from 13,400 to 69,200 cu m, with calculated peak flows of 0.22 to 1.2 cu m/sec. Static capacity of the DUST (Demonstration of Urban Stormwater Treatment) marsh is 71,700 cu m. Trap efficiency for suspended constituents was 42-45% for solids, 30-83% for Pb, 40-53% for Cr, 12-34% for Ni, 6-51% for Zn, and 5-32% for Cu. For total dissolved solids, BOD5, and manganese, trap efficiencies were negative. Bioaccumulation of heavy metals was apparent in both plants and fish. Heavy metal concentrations in fish (carp, *Gambusia*) tissues generally were below the ambient soil and sediment concentrations for Cr, Pb, Mn, and Ni. The source of the metal contamination appears to be the sediments, but other factors than stormwater input may be involved. Overall, the DUST marsh was effective in reducing total suspended solids and inorganic N, P, and Pb, regardless of the system. Because the degree and significance of bioaccumulation of pollutants in the food chain is as yet unclear, use of wetlands to treat urban stormwater runoff should be limited to constructed wetlands.

TOPIC: 1.3

AUTHOR(S): Meyer, J.L.

DATE: 1985

TITLE: A Detention Basin/Artificial Wetland Treatment System to Renovate Stormwater Runoff From Urban, Highway, and Industrial Areas

ORGANIZATION: Wetland Management Specialists Inc., 70 Bath St., Providence, Rhode Island 02908

SOURCE: Wetlands 5: 135-146. (Journal of the Society of Wetland Scientists).

ABSTRACT: Stormwater runoff from urban, highway, industrial, residential, and commercial areas has become recognized as an important non-point source pollutant. Many nutrients and toxic substances present in stormwater run-off are strongly associated with particulate material and are removable by sedimentation. Design criteria for a detention basin/artificial wetland treatment system (DBAWTS) to renovate stormwater runoff from urban, highway, and industrial areas have been developed. A detention basin with an underdrain filter coupled to an artificial wetland consisting of a shallow marsh planted with *Typha* spp. is used to filter and absorb nutrients and contaminants in stormwater runoff. Phosphorus, heavy metals, hydrocarbons, and toxic refractory organic substances will be removed through sedimentation and absorption within the wetland. Anaerobic sediments in the *Typha* marsh will remove nitrates through denitrification. This system will provide effective, low-cost, low-maintenance treatment of stormwater runoff from urban, highway, and industrial areas.

TOPIC: 1.3

AUTHOR(S): Michelbach, S; Woehrle, C; Marsalek, JC; Torno, HC. (eds)

DATE: 1994

TITLE: Settleable solids from combined sewers: Settling, stormwater, treatment, and sedimentation rates in rivers

ORGANIZATION: Fa. Umwelt- und Fluid-Technik, Dr. Brombach GmbH, D-97980 Bad Mergentheim, FRG

SOURCE: URBAN STORM DRAINAGE., 1994, pp. 95-102, WATER SCI. TECHNOL., vol. 29, no. 1-2

ABSTRACT: Settleable solids are an important pathway for pollutants found in river sediments. To study settling behaviour of settleable solids, settling velocity was measured by a settling apparatus. Special measurements were undertaken to determine the relationship between the settling distribution of settleable solids and their pollutant load - organic mass, chemical oxygen demand, heavy metals and organic micropollutants. To calculate where settleable solids from combined sewer systems will settle in receiving waters, the settling distribution is also useful. The results of a three-year research indicate that stormwater treatment by settling is effective in preventing adverse environmental impacts of combined sewage pollutants.

24-Apr-98

TOPIC: 1.3

AUTHOR(S): Oberts, G.L., and R.A. Osgood.

DATE: 1988

TITLE: The Water Quality Effectiveness of a Detention/ Wetland Treatment System and its Effect on an Urban Lake.

ORGANIZATION:

SOURCE: Metropolitan Council, St. Paul, MN. Presented at the 8th Annual International Symposium on Lake and Watershed Management, November 15-19, 1988, St. Louis, MO.

ABSTRACT:

TOPIC: 1.3

AUTHOR(S): Oberts, G; Osgood, R

DATE: 1988

TITLE: The effectiveness of a detention/wetland treatment system and its effect on an urban lake.

ORGANIZATION: Metropolitan Council, St. Paul, MN, USA; North American Lake Management Soc., Arlington, VA (USA)

SOURCE: 8. ANNUAL INTERNATIONAL SYMPOSIUM ON LAKE AND WATERSHED MANAGEMENT., 1988., p. 29

ABSTRACT: A newly installed combined detention/wetland stormwater treatment facility upstream from Lake McCarrons, Roseville, Minnesota, was monitored for 21 months to evaluate its effectiveness and impact on the lake. The treatment facility drains a 250-ha urban water-shed and included a 1.2-ha detention pond that discharges into a series of six constructed wetland "chambers" totaling 2.4 ha. Data from snowmelt and rainfall events will be presented for sediments, nutrients, oxygen-demand, and lead. Continuous flow and precipitation were also recorded. Results show substantial reductions for all constituents measured except dissolved phosphorus, which showed very little removal. Discussion of system operation will be presented, as well as recommendation on improving the design relative to the response of the lake. Results for the lake show very little change in its water quality throughout the study; the lake's phosphorus and chlorophyll may have actually increased.

TOPIC: 1.3

AUTHOR(S): Oberts, G; Wotzka, P

DATE: 1988

TITLE: Water Quality Performance of a Detention Basin-Wetland Treatment System in an Urban Area

ORGANIZATION: Metropolitan Council

SOURCE: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 237-247 . 8 fig, 3 tab, 9 ref.

ABSTRACT: The McCarrons Treatment System is a surface water management facility consisting of a detention pond followed by six 'chambered' wetlands designed to improve the water quality of Lake McCarrons in Roseville, Minnesota. The system is located at the bottom of a 243 hectare urban watershed. Most of the reduction in pollutants occurs in the detention pond. Performance conclusions are based on results from 21 of the 57 rainfall events and 4 periods of snowmelt. Climatic conditions and the precipitation during the 21 months of study were not 'normal,' but rather reflective of a mild, dry period with a major rainfall event and two very wet months. The detention pond is considered to be currently performing at the best level that can be expected. Attributes thought to contribute positively to treatment levels in the pond include diffuse inflow from three separate tributaries, a low dissolved phosphorus to total phosphorus (DP:TP) ratio, and newly exposed peat soils with a high affinity for attracting TP. Changes in the design of the outlet structure could improve the effectiveness of the detention pond in treating snowmelt. The post-detention wetland system was intended to 'polish' outflows from the detention pond before the water discharged to the lake. The wetland continues the process of settling solids begun in the pond, but is less effective in removing soluble nutrients. This situation is partially related to additional inputs to the wetlands from another tributary, overland runoff, and atmospheric deposition. Even though nutrient removal in the wetland is not high, there is a net reduction so the wetland is performing as expected. (See also W91-03704) (Author's abstract)

TOPIC: 1.3

AUTHOR(S): Oberts, Gary L. , Wotzka Paul, Hartsoe, Judith

DATE: 1989

TITLE: The Water Quality Performance of Select Urban Runoff Treatment Systems

ORGANIZATION: Metro Coun.

SOURCE:

ABSTRACT: Presents findings of a Metropolitan Council study of the water quality effectiveness of five (5) urban runoff treatment facilities - e.g. detention/wetland system and double detention ponds; including water quality analysis/sediments/load reductions; site specific findings and lake and receiving waters improvement levels from sites located in the Ramsey - Washington Metro watershed and Lake McCarrons' areas in Roseville, Minnesota.

24-Apr-98

TOPIC: 1.3

AUTHOR(S): Oberts, GL; Osgood, RA

DATE: 1991

TITLE: Water-quality effectiveness of a detention/wetland treatment system and its effect on an urban lake.

ORGANIZATION: Metropolitan Council, Mears Park Cent., 230 E. 5th St., St. Paul, MN 55101, USA

SOURCE: ENVIRON. MANAGE., vol. 15, no. 1, pp. 131-138, 1991.

ABSTRACT: A newly installed combined detention/wetland stormwater treatment facility upstream from Lake McCarrons, Roseville, Minnesota, was monitored for 21 months to evaluate its effectiveness and the response of the lake to decreased phosphorus loads. The treatment facility consists of a 1.0-ha detention pond that discharges into a series of six constructed wetland "chambers." Data from snowmelt and rainfall events are presented for several pollutants. Results show good reductions for most pollutants. Discussion on the facets of the system's operation are presented.

TOPIC: 1.3

AUTHOR(S): Poertner, H.G.

DATE: 1974

TITLE: Practices in Detention of Urban Stormwater Runoff, an Investigation of Concepts, Techniques, Applications, Costs, Problems, Legal Aspects.

ORGANIZATION:

SOURCE: APWA, Special Report No. 43.

ABSTRACT: On-site detention of runoff was investigated as an alternative to other methods of urban stormwater runoff management. It was found that this method, which involves collecting excess runoff before it enters the main drainage system, can often be applied as an effective and economical means of reducing peak runoff flow rates to lessen or eliminate problems of flooding, pollution, soil erosion and siltation. The captured runoff sometimes can be used to augment water supplies for potable or non-potable uses, and the detention facilities can be designed to serve multiple-purpose uses, especially recreation.

The use of on-site detention facilities has been given emphasis in those urban areas where flooding is a frequent problem. A 1972 survey of selected local jurisdictions in urban areas of the United States and Canada revealed that more than 1,400 facilities were operational in about 100 local jurisdictions reporting applications. Because only about 500 jurisdictions were contacted, the actual number of such facilities in existence is thought to be many times more. Most of the representatives of the 230 public agencies and 40 engineering firms that responded to the survey questionnaire consider on-site detention of runoff in urban areas to be a useful stormwater management method that is worthy of study and implementation.

Many applications of the method were identified in which substantial cost savings over a conventional urban stormwater drainage system had been realized by incorporating on-site detention into the system. The use of on-site detention facilities in managing runoff in urban communities can be expected to increase as the techniques involved become better developed and understood and as the benefits become better documented and publicized.

TOPIC: 1.3

AUTHOR(S): Randall, C.W., K. Ellis, T.L. Grizzard, and W.R. Knocke.

DATE: 1982

TITLE: Urban Runoff Pollutant Removal by Sedimentation.

ORGANIZATION:

SOURCE: p. 205-219 in: W. DeGroot (ed.), Proceedings of the Conference on Stormwater Detention Facilities: Planning, Design, Operation and Maintenance. 1-6 August, Henniker, NH. Society of Civil Eng., NY.

ABSTRACT: A laboratory study of the efficacy of sedimentation for the removal of pollutants from urban stormwater runoff was conducted. Settling tubes with four foot water column depths were used and the removals of total suspended solids (TSS), COD, BOD, total organic carbon, phosphorus forms, nitrogen forms, and six heavy metals, lead, zinc, copper, nickel, chromium and cadmium, were analyzed. The runoff samples used in the five inch diameter settling columns were collected from culverts draining three different shopping mall parking lots. The particle size distribution in each sample was also determined. A total of seven experiments was run using a settling period of 48 hours for all but the initial experiment.

The results showed that substantial reductions of the pollutants in urban runoff can be achieved by sedimentation and that the particulates can be categorized as flocculate particles for analysis and design purposes. The best reductions were obtained for TSS, lead and BOD with average removals of 90, 86, and 64%, respectively, while removals of 33% or greater were obtained for all major categories of pollutants present in detectable concentrations. Nonetheless, several of the pollutants in urban runoff may still be present in the liquid column in concentrations too high to meet water quality goals after settling is complete.

24-Apr-98

TOPIC: 1.3

AUTHOR(S): Roesner, Larry A; Burgess, Edward H; Aldrich, John A

DATE: 1991

TITLE: Hydrology of urban runoff quality management

ORGANIZATION: Camp Dresser & McKee Inc, Maitland, FL, USA

SOURCE: WATER RESOUR PLANN MANAGE URBAN WATER RESOUR, ASCE, NEW YORK, NY, (USA), 1991, pp. 764-770

ABSTRACT: Recent regulatory requirements to reduce pollutant discharges from municipal storm sewer systems have intensified the need for approaches to developing design parameters, such as the selection of a design storm, which can be applied to urban stormwater quality management facilities. Examination of six U.S. cities in areas with widely varying climatic conditions reveals that most rainfall occurs during small storms. Hydrologic simulations using long-term rainfall records of these areas indicate that a reasonable design storm is on the order of the 1-month to 4-month storm, and a unit storage volume of roughly 0.2 to 0.9 inches will provide effective pollutant capture. Detention basins which capture these smaller storms can be provided to control urban stormwater pollutants. It may be possible to retrofit existing flood control basins for this purpose; however, water quality control basins employ a significantly different storage strategy and should serve relatively large (typically over 50 acres) areas.

TOPIC: 1.3

AUTHOR(S): Rushton, B.T. and C.W. Dye

DATE: 1993

TITLE: The effectiveness of permitted surface water management systems

ORGANIZATION:

SOURCE: In Dean Barber (ed), Proceedings of Florida Lake Management Society: Fourth annual symposium, 203 Lake Pansy, Winter Haven, FL 33881

ABSTRACT:

TOPIC: 1.3

AUTHOR(S): Scherger, D.; Coleman, J.

DATE: 1983

TITLE: Nationwide Urban Runoff Program, USEPA (United States Environmental Protection Agency), Lansing, Michigan. Evaluation of Urban Stormwater Runoff and Management Practices for Controlling Urban Stormwater Runoff

ORGANIZATION: Performer: Tri-County Regional Planning Commission, Lansing, MI.

SOURCE:

ABSTRACT: This volume documents assessment of an on-line retention basin, two in-line up-sized storm drain pipe reaches, and an off-line detention basin as treatment techniques in mitigating the pollutant impacts of urban runoff, as well as the operating costs associated with such installations. The on-line retention basin was found to be very effective in treating a wide range of rainfall amounts and pollutant loads. The in-line up-sized stormdrain pipes displayed variable effectiveness depending on rainfall amount and runoff volume. The off-line detention basin had little or no effect on water quality.

TOPIC: 1.3

AUTHOR(S): Scherger, D.A., J.A. Davis, and J.L. Bruestle.

DATE: 1983

TITLE: Evaluation of Urban Stormwater Runoff and Management Practices for Controlling Urban Stormwater Runoff: Summary Report.

ORGANIZATION:

SOURCE: U.S. EPA Office of Water Program Operations, Washington, D.C. NTIS PB83-199075.

ABSTRACT: Evaluation of nonpoint source pollution generated by stormwater runoff in an urban environment, and best management practices to control it. Those practices studied by this project included (1) a wetland detention basin, (2) a wetland, and (3) an off-line dry detention basin.

24-Apr-98

TOPIC: 1.3

AUTHOR(S): Scherger, D.A.; J.A. Davis.

DATE: 1982

TITLE: Control of Stormwater Runoff Pollution Loads by a Wetland and Retention Basin.

ORGANIZATION:

SOURCE: p. 109-123, International Symposium on Urban Hydrology, Hydraulics, and Sediment Control, University of Kentucky, Lexington, KY, July 27-29, 1982.

ABSTRACT:

TOPIC: 1.3

AUTHOR(S): Scherger, DA; Davis, JA; Bruestle, JL

DATE: 1983

TITLE: Nationwide urban runoff program - USEPA (United States Environmental Protection Administration), Washtenaw County, Michigan. Evaluation of urban stormwater runoff and management practices for controlling urban stormwater runoff.

ORGANIZATION: Environmental Control Technology Corp., Ann Arbor, MI (USA)

SOURCE: ECTC, ANN ARBOR, MI (USA) , 1983., 517 pp

ABSTRACT: Evaluation of nonpoint source pollution generated by stormwater runoff in an urban environment, and best management practice to control it. Those practices studied by this project included (1) a wet detention basin, (2) a wetland, and (3) an off-line dry detention basin.

TOPIC: 1.3

AUTHOR(S): Schueler, T.R.

DATE: 1994

TITLE: Review Of Pollutant Removal Performance Of Stormwater Ponds And Wetlands

ORGANIZATION:

SOURCE: Watershed Protection Techniques 1(1):17-19

ABSTRACT:

TOPIC: 1.3

AUTHOR(S): Schueler, T.R.

DATE: 1993

TITLE: Performance Of Stormwater Pond And Wetland Systems

ORGANIZATION:

SOURCE: Engineering Hydrology. C. Kuo (editor) ASCE. pp 747-753

ABSTRACT:

TOPIC: 1.3

AUTHOR(S): Schueler, Thomas

DATE: 1994

TITLE: Performance Of A Stormwater Pond/Wetland System In Colorado

ORGANIZATION:

SOURCE: Watershed Protection Techniques 1(2): 68-69

ABSTRACT:

24-Apr-98

TOPIC: 1.3

AUTHOR(S): Smith, W.G.

DATE: 1982

TITLE: Water Quality Enhancement Through Stormwater Detention.

ORGANIZATION:

SOURCE: p. 236-244 in: W. DeGroot (ed.), Proceedings of the Conference on Stormwater Detention facilities: Planning, Design, Operation and Maintenance. 1-6 August, Henniker, NH. Society of Civil Eng., NY.

ABSTRACT: Urban stormwater is emerging as a significant source of surface water pollution in the United States. Temporary storage of urban stormwater runoff and combined sewer overflows is being applied as a means of reducing pollution discharges. The most common problem pollutants include suspended solids, oxygen demand material, eutrophic nutrients, pathogenic bacteria and viruses, and toxic substances. Water quality enhancement techniques include sedimentation, infiltration/percolation, biological treatment, and disinfection.

TOPIC: 1.3

AUTHOR(S): Taylor, H.N.

DATE: 1991

TITLE: Enhancing Effluent Water of Sedimentation Basins Using Constructed Wetlands Technology.

ORGANIZATION:

SOURCE: In ASCE Hydraulic Engineering : Proc. 1991 Natl. Conf. R.M. Shane, (ed.) Nashville, TN,.

ABSTRACT:

TOPIC: 1.3

AUTHOR(S): The Center For Watershed Protection

DATE: 1994

TITLE: Review Of Pollutant Removal Performance Of Stormwater Ponds And Wetlands

ORGANIZATION:

SOURCE: Watershed Protection Techniques 1(1): 17-18

ABSTRACT:

TOPIC: 1.3

AUTHOR(S): The Center For Watershed Protection

DATE: 1994

TITLE: Pond/Wetland System Proves Effective In New Zealand

ORGANIZATION:

SOURCE: Watershed Protection Techniques 1(1): 10-11

ABSTRACT:

TOPIC: 1.3

AUTHOR(S): U.S. EPA

DATE: 1983

TITLE: NURP-USEPA - Washtenaw County, MI - Evaluation of Urban Stormwater Runoff and Mgmt. Practices for Controlling Urban Stormwater Runoff

ORGANIZATION: USEPA

SOURCE: Prepared by Env. Control Technology Corp. for EPA

ABSTRACT: Cost/effectiveness data for two retention basin systems. Also wetland cost/effectiveness data.

24-Apr-98

TOPIC: 1.3

AUTHOR(S): Wanielista, M.P., et al.

DATE: 1981

TITLE: Detention of Effluent Filtration for Stormwater Management.

ORGANIZATION:

SOURCE: Second International Conference on Urban Storm Drainage, Urbana, IL, June 14-19, 1981.

ABSTRACT: Detention systems for stormwater hydrograph attenuation have been used to reduce hydrograph peak discharges. Recently, some improvement for water quality has been noted and documented in some designs. This improvement is primarily due to the removal of suspended particulates in the water column. Removal efficiencies have not been significant for other water quality species, i.e., nitrogen and phosphorus. In fact, only that phosphorus, nitrogen, and others attached to the suspended loads have been partly removed. However, removals by sedimentation during one storm event may be resuspended during another storm event.

Designs of detention facilities have a detention time ranging from a few hours to a few days and are based on various storm volumes. There does not appear to be a standardized design based on water quality. Current designs are primarily based on water quantity. Field examination of influent/effluent quality mass balances on detention facilities have resulted in near zero removal efficiencies for low detention times (hours). Frequently, larger facilities (longer detention times) are not practical from a cost and land availability viewpoint. Thus, filtration systems for the effluent have been designed and laboratory tested. Results indicate increased removal of both the suspended and dissolved fraction of the different water quality species. Results of tests with various filtration media are presented. Preliminary design criteria are reported.

TOPIC: 1.3

AUTHOR(S): Whipple, Jr., W; Hunter, J.V.

DATE: 1981

TITLE: Settleability of Urban Runoff Pollution.

ORGANIZATION:

SOURCE: Journal of the Water Pollution Control Federation, Vol 53, No 12, p 1726-1731, December, 1981. 9 Fig, 14 Ref.

ABSTRACT: The possibility of using dual purpose detention basins for the removal of particulate pollution from urban runoff is currently under investigation. Tests of urban runoff were conducted to measure the removal of different types of pollutants by sedimentation. Sampling was conducted in five intensively developed areas. Analyses were conducted to determine total phosphate, fecal coliform counts, suspended solids, 5 and 20 day biochemical oxygen demand, nitrates, heavy metals, hydrocarbons, and ammonia. These studies showed that detention of runoff in an undisturbed environment with a water depth of 6 feet for 32 hours resulted in removal of substantial quantities of the common pollutants associated with urban runoff. The settleability data for pollutants showed more scatter than data for total suspended solids. The data for suspended solids, hydrocarbons, and lead indicated that most of the sedimentation of these pollutants was accomplished in 16 hours, but results for other pollutants, particularly copper, were more irregular. Considerable variation was found in the settleability of runoff from different sites. The results of this study did not support the common assumption that pollutants will settle out in amounts proportionate to their respective particulate concentrations.

TOPIC: 1.3

AUTHOR(S): Whipple, W. Jr.

DATE: 1981

TITLE: Dual Purpose Detention Basins in Stormwater Management.

ORGANIZATION:

SOURCE: Water Resources Bulletin 17(4): 642-646.

ABSTRACT: Storm water management contributes to flood hazard mitigation; but new approaches now being developed consider also the reduction in particulate pollution and stream erosion. Such approaches involve retardation of storm runoff, or detention programs of some kind, and detention basins are usually required if large storms are to be controlled. The usual concept is that future storms occurring after development should have no more adverse effect than similar storms would have had before development; but a number of different criteria are being used. If control of storms of different sizes is required, only a small amount of additional capacity is required to obtain retention of particulate pollution in the same basin. In at least three different parts of the country, such dual purpose detention basins are being required of developers. In such programs the developers bear the cost, the governmental contributions are not involved.

24-Apr-98

TOPIC: 1.3

AUTHOR(S): Whipple, W. Jr., and Joseph V. Hunter.

DATE: 1980

TITLE: Detention Basin Settleability of Urban Runoff Pollution.

ORGANIZATION:

SOURCE: New Brunswick, New Jersey: Rutgers University, Water Resources Research Institute, 29 pp. NTIS: PB81-170474.

ABSTRACT: Because of the growing interest in stormwater management, and particularly of the possibility of using detention basins for removing particulate pollution, it is important to determine the effectiveness of such basins for removal of various polluting substances. In a first phase of the present study samples of urban runoff were allowed to settle in a large tube, and the quantity of each pollutant settling in a given time period determined. There was more variability in rate of settlement of specific pollutants than for total suspended solids. Lead and hydrocarbons settled out 60-65% in 32 hours, only slightly slower than total suspended solids. BOD and copper were removed at somewhat lower rates, and zinc even lower. These results confirm the effectiveness of retention of stormwater in removing particulate pollutants.

In the second phase of the study two detention basins were modified by constructing outlets so as to provide prolonged retention of stormwater; and observed trap efficiency of various pollutants was compared to computed trap efficiency and to the results of laboratory settleability of the same pollutants. Results indicate that laboratory settleability may be a useful tool in estimating probable effectiveness of dual purpose detention basins for retention.

TOPIC: 1.3

AUTHOR(S): Wilde, F

DATE: 1989

TITLE: Effect of storm runoff on the chemistry of ground water at three storm-water-impoundment sites in Maryland.

ORGANIZATION: U.S. Geol. Surv., 208 Carroll Build., 8600 LaSalle Rd., Towson, MD 21204, USA

SOURCE: GROUND WATER ISSUES AND SOLUTIONS IN THE POTOMAC RIVER BASIN/CHESAPEAKE BAY REGION., 1989., pp. 43-44

ABSTRACT: Concern over nonpoint-source pollution of the Chesapeake Bay has resulted in the enactment of legislation in Maryland requiring the discharge of urban storm runoff to impoundment structures, where storm water is allowed to infiltrate into and percolate through the unsaturated zone of native sediments. However, the effect of storm water on ground-water quality has not been evaluated. Two types of impoundment structures are being monitored: infiltration basins and porous-asphalt pavement. A sampling program has been implemented to (1) determine the chemical composition of native precipitation, storm water, and ground water, and (2) monitor changes in the chemical composition of soil water and ground water that are caused by percolating storm water.

TOPIC: 1.3

AUTHOR(S): Wilde, FD

DATE: 1989

TITLE: Effect of Storm-Water Impoundments on Major-Ion Ratios in Ground Water

ORGANIZATION:

SOURCE: IN: Ground Water Issues and Solutions in the Potomac River Basin/Chesapeake Bay Region. National Water Well Association, Dublin, Ohio. 1989. p 287-311. 16 fig, 2 tab, 17 ref.

ABSTRACT: Concern over nonpoint source pollution of the Chesapeake Bay has resulted in the enactment of legislation in Maryland requiring the discharge of urban storm runoff to impoundment structures, where storm water is allowed to percolate through the unsaturated zone. However, the effect of storm water on groundwater quality has not been well studied in Maryland. A 5-year project to monitor storm and groundwater quality is underway at three stormwater management facilities. Two types of impoundment facilities are being monitored: infiltration ponds and porous asphalt pavement. A sampling program has been implemented to (1) determine the chemical composition of storm water and background groundwater, and (2) monitor changes in the chemical composition of groundwater being recharged by infiltrating storm water. Analysis of data collected over 2 years indicates a significant change in the major ion chemistry of groundwater receiving infiltrate from the stormwater impoundments. Calcium:magnesium and magnesium:sodium ratios and ratios of chloride to other anions reflect mixing of background groundwater with the stormwater infiltrate. However, mechanisms other than simple mixing are involved. The pH of impounded stormwater ranges from 7.0 to greater than 9.0, but groundwater pH is less than 6.0 and tends to decrease downgradient. Moreover, although elevated chloride concentration in stormwater occur during the winter season only, chloride levels in underlying groundwater are highest during the summer and fall and remain above background throughout the year. (See also W91-09628) (Author's abstract)

24-Apr-98

TOPIC: 1.3

AUTHOR(S): Wotzka, P. and G. Oberts

DATE: 1988

TITLE: The Water Quality Performance of a Detention Basin - Wetland Treatment System in an Urban Area

ORGANIZATION: AWRA

SOURCE: p.237-247 In: Nonpoint Pollution: 1988- . Policy, Economy, Management, and Appropriate Technology. American Water Resources Association, November 1988.

ABSTRACT: Effectiveness data for detention ponds and wetlands. / The McCarrons Treatment System is a surface water management facility consisting of a detention pond followed by six "chambered" wetlands designed to improve the water quality of Lake McCarrons in Roseville, Minnesota. The system is located at the bottom of a 243 hectare urban watershed. Previous to construction, the treatment area was a long, narrow wetland where surface water moved rapidly through a well-entrenched channel without vegetative contact.

Water quality monitoring of the McCarrons Treatment System has shown the system to be very effective in the removal of solids-associated pollutants and moderately effective in removing soluble nutrients. Most of the reduction in pollutants occurs in the detention pond. Performance conclusions are based on results from 21 of the 57 rainfall events and 4 periods of snowmelt. Climatic conditions and the precipitation during the 21 months of study were not "normal", but rather reflective of a mild, dry period with a major rainfall event and two very wet months.

The detention pond is considered to be currently performing at the best level that can be expected. During the 21 month study, the pond lost 18 percent of its permanent pool volume and 5 percent of crest volume. Attributes that are thought to contribute positively to treatment levels in the pond include diffuse inflow from three separate tributaries, a low DP:TP ratio, and newly exposed peat soils with a high affinity for attracting TP. The pond did not respond well to snowmelt loading during the melt of 1988 because of an ice layer that forced flow either under the ice in a turbulent manner or over the ice where settling depth was minimal. Changes in the design of the outlet structure could improve the effectiveness of the detention pond in treating snowmelt.

The post-detention wetland system was intended to "polish" outflows from the detention pond before the water discharged to the lake. The wetland continues the process of settling solids begun in the pond, but is less effective in removing soluble nutrients. This situation is partially related to additional inputs to the wetlands from another tributary, overland runoff, and atmospheric deposition. Even though nutrient removal in the wetland is not high, there is a net reduction so the wetland is performing as expected.

TOPIC: 1.3.1

AUTHOR(S): Akan, A.O.

DATE: 1993

TITLE: Pollutant removal efficiency of detention basins.

ORGANIZATION:

SOURCE: Water Resour Plann Manage Urban Water Resour. Isbn 0872629120 -- [S.L.]Asce, New York, NY, 1993 p. 134-136. (MdBcS)0056189

ABSTRACT: A simple method is presented for quick estimates of pollutant removal efficiency of detention basins under dynamic conditions. The method is based on the generalized solutions to the reservoir routing problem and the settling velocities of pollutants in urban runoff.

TOPIC: 1.3.1

AUTHOR(S): APWA Research Foundation

DATE:

TITLE: Costs of Stormwater Management Systems

ORGANIZATION: APWA

SOURCE: From Urban Stormwater Management

ABSTRACT: Individual costs for 30 constructed ponds and cost for localities for SWM programs.

24-Apr-98

TOPIC: 1.3.1

AUTHOR(S): Baxter, E. and G. Mulamoutti

DATE: 1985

TITLE: A Study of Residential Stormwater Impoundment- Perceptions and Policy Implications

ORGANIZATION: AWRA

SOURCE:

ABSTRACT: This article presented community acceptance on the retention ponds. They generally agreed that the lakes are a good feature for a community; they agreed that stormwater lakes could be recommended for other suburbs.

Perceived benefits - provided aesthetic and recreational functions, attraction of lakes for potential resident, lakes encouraged a neighborhood - community atmosphere, officials and 49% of residents felt that the presence of the lakes increased the value of their home.

TOPIC: 1.3.1

AUTHOR(S): Chambers, G.M.; Tottle, C.H.

DATE: 1980

TITLE: Evaluation of Stormwater Impoundments in Winnipeg.

ORGANIZATION:

SOURCE: Canada Mortgage and Housing Corp., Ottawa, Canada K1A OP7. Mortgage and Housing Corporation and Environment Canada. Sewage Collectin and Treatment Report SCAT-1, April 1980. 90p, 6 Fig, 24 Tab, 14 Ref, 3 Append. NHA 5352 80/04.

ABSTRACT: Storm water management by the use of impoundments (artificial lakes) was investigated in two urban developments in the Winnipeg, Manitoba, area. Impoundments are an attractive alternative to conventional storm sewers because they are economical, easy to maintain, and provide recreation and aesthetic appeal. The Southdale area with eight interconnected impoundments and the Fort Richmond area with two interconnected impoundments were studied from 1975 to 1978. Influent and effluent storm water, plankton, fish, algae, and sediment samples were collected and analyzed to give an indication of the water quality and treatment efficiencies of the impoundments. The impoundment systems were found to remove a large amount of pollution loading from urban storm water runoff. Although the amount of fecal coliform bacteria was high in the sediments, the impoundments were found suitable for boating and fishing, but not for swimming. Most of the game fish (pike, perch, and suckers) were in poor condition and there was an abundance of bullheads and fathead minnows (good for mosquito control). Algae control was a problem during the summer months. Benthic and fish surveys indicated a less than ideal level of water quality in both impoundment areas. A system of permanent wet bottom impoundments were deemed the most economical and attractive land drainage system for Winnipeg.

TOPIC: 1.3.1

AUTHOR(S): City of Austin

DATE: 1988

TITLE: Environmental Criteria Manual

ORGANIZATION: City of Austin

SOURCE:

ABSTRACT: Design guidelines for water quality control basins. Some effectiveness data provided.

TOPIC: 1.3.1

AUTHOR(S): Cunningham, J.

DATE: 1993

TITLE: Comparative water quality data of a deep and a shallow wet-detention pond

ORGANIZATION:

SOURCE: In Proceedings of the third biennial stormwater research conference, October 7 - 8, 1993. Environmental Section, Southwest Florida Water Management District, Brooksville, FL 34609

ABSTRACT:

24-Apr-98

TOPIC: 1.3.1

AUTHOR(S): Dally, L.K., D.P. Letterman, S.J. Burges, and M.M. Benjamin

DATE: 1983

TITLE: Operation of Detention Facilities for Urban Stormwater Quality Enhancement.

ORGANIZATION:

SOURCE: Water Resources Series Tech. Report 79, University of Washington, Department of Engineering, Seattle, WA.

ABSTRACT: The efficiencies of two existing urban stormwater detention facilities in reducing pollutant loadings to receiving waters was investigated. The study utilized two field sites in King County, Washington: a 76-acre residential subdivision in the Vasa Creek/ Lake Sammamish drainage basin, and the other a transit operating base in the Kelsey Creek/ Lake Washington drainage basin.

Inflow and outflow hydrographs were estimated for a total of twelve storms, along with pollutant concentrations ranging from 3.75 minutes to 1 hour. The principal water quality concern at the residential site was solids transport. Resuspension of sediment in this dry pond was a major problem, and resulted in negative pollutant removal efficiencies for most storms. Multiple inflow concentration peaks during lengthy winter storms appeared to be related to sediment generation from residential construction activity.

The principal water quality concerns at the transit site, which largely consists of paved transit storage and maintenance areas, were oil and grease, cadmium, lead, zinc, phosphorus and solids. This facility, which is a wet pond, had a significant effect in transforming cadmium and lead from particulate to soluble phase. For this reason, the pollutant removal efficiencies for modest storms appeared to be negative, while for lesser storms, and for particulate pollutants, removal efficiencies were generally positive. Additional experiments utilizing "synthetic" storms generated from fire hydrant releases, indicated that pipe flushing can be an important source of pollutants during intense storms.

The so-called first flush effect, the tendency of a disproportionately large fraction of the pollutant loading from a storm to occur in the early stages of the rising limb of the hydrograph, was apparent for grease and oil, particulate lead, particulate cadmium, and total suspended solids at the transit site. First flush was not generally exhibited at the residential site. The peak concentrations and loadings did not appear to be related to traffic volume or antecedent conditions. In addition, selected base flow sampling indicated that dry weather runoff, considered on an annual basis, may contribute a total pollutant loading similar to that resulting from stormwater runoff over a year.

TOPIC: 1.3.1

AUTHOR(S): DeGroot, W. (ed.).

DATE: 1982

TITLE: Stormwater Detention Facilities: Planning, Design, Operation, and Maintenance.

ORGANIZATION:

SOURCE: Proceedings of the Conference, 1-6 August, Henniker, NH. American Society of Civil Engineers, New York.

ABSTRACT: This proceedings contains over forty papers that focus on stormwater quantity and quality and institutional issues. The presentations predominantly concern detention basins, such as wet and dry ponds, with a few papers on small lakes. General experiences with detention facility use in various parts of the world, planning considerations, empirical results, and modelling are discussed in relation to stormwater quantity and quality. The presentations on institutional issues discuss public acceptance, law and administration, and drainage planning problems. One paper, "Wildlife Enhancement in Urban Stormwater Control," specifically discusses the creation of detention facilities possessing wetland characteristics as a viable means of attaining quantity control, pollutant reduction, and wildlife habitat.

TOPIC: 1.3.1

AUTHOR(S): Dierberg, FE; Cullum, MG

DATE: 1988

TITLE: Evaluation of dry detention/filtration stormwater management system receiving runoff from a mixed urban land use.

ORGANIZATION: Florida Inst. Technol., Melbourne, FL 32901, USA

SOURCE: 8. ANNUAL INTERNATIONAL SYMPOSIUM ON LAKE AND WATERSHED MANAGEMENT., 1988., p. 29

ABSTRACT: The South Florida Water Management District's Resource Planning Department has initiated a series of applied research projects to aid the Resource Control (Regulatory) Department in refining criteria for the permitting of surface water management systems. This project was designed utilizing criteria developed by the Florida Department of Environmental Regulation to compare respective regulatory criteria. Surface runoff from six discrete storm events was sampled at the Lake Tohopekaliga Demonstration site in Kissimmee, Florida. Parameters included turbidity, specific conductance, pH, soluble reactive phosphorus, and total phosphorus. Samples were taken at the critical depth inflow flume, at the infiltration berm, and at the outfall of the underdrains. Because of the use of native soils containing organic material and clay, the infiltration berm became clogged early in the study, preventing drainage of the basin as designed.

24-Apr-98

TOPIC: 1.3.1

AUTHOR(S): Driscoll, E.D.

DATE: 1986

TITLE: Detention and Retention Controls for Urban Runoff

ORGANIZATION: ASCE

SOURCE: In "Urban Runoff Quality-Impact and Quality Enhancement Technology: ASCE Conference Proceedings" Urbonas, B. and L. Roesner (editors), 1986 (pp 381-393)

ABSTRACT: 1) 50 to 60% of the particulates have settling velocity 1 to 2 ft/hr. (the particulate fractions of heavy metals and P behave very much like TSS in terms of settling characteristics).

2) Percent of removal of pollutants by retention basin as compared by size of basin, percolation rate and basin depth. Retention basin that has the highest percolation rate and highest pond depth requires the least area to reach high efficiency rate on pollutant removal (pg 391).

TOPIC: 1.3.1

AUTHOR(S): Driscoll, E.D.

DATE: 1986

TITLE: Performance of Detention Basins for the Control of Urban Runoff Quality.

ORGANIZATION:

SOURCE: International Symposium on Hydrology, Hydraulics, and Sediment Control. Lexington, Kentucky.

ABSTRACT:

TOPIC: 1.3.1

AUTHOR(S): Driscoll, E.D.

DATE: 1986

TITLE: Methodology for Analysis of Detention Basins for Control of Urban Runoff Quality

ORGANIZATION: Woodward-Clyde

SOURCE: Office of Water, U.S. Environmental Protection Agency, Washington, D.C. EPA 440/587-001. September.

ABSTRACT: The report describes an analysis methodology and presents graphs and example computations to guide planning level evaluations and design decisions on two techniques for urban runoff quality control. The control techniques addressed, recharge or infiltration devices, and wet pond detention devices, were shown to be the most consistently effective methods of pollutant reduction of any of the Best Management Practices (BMP) approaches evaluated in the recent Nationwide Urban Runoff Program study./ Design criteria for detention basins. Also some effectiveness data is provided.

TOPIC: 1.3.1

AUTHOR(S): Economic and Engineering Services, Inc. and R.R. Horner

DATE: 1995

TITLE: Wetpond Restoration For Water Quality Enhancement

ORGANIZATION:

SOURCE: Report to City of Bellevue, Washington and Washington Department of Ecology

ABSTRACT:

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TOPIC: 1.3.1

AUTHOR(S): Felstul, DR; Montgomery, JM; Mayes, MA; Barron, MG. (eds)

DATE: 1991

TITLE: Modeling the reduction of sediment-bound toxics by detention basins

ORGANIZATION: Consulting Engineers, Inc., Wayzata, MN 55391, USA

SOURCE: AQUATIC TOXICOLOGY AND RISK ASSESSMENT: FOURTEENTH VOLUME., AMERICAN SOCIETY FOR TESTING AND MATERIALS, PHILADELPHIA, PA (USA), 1991, pp. 294-304, AQUAT. TOXICOL. RISK ASSESS.

ABSTRACT: A spreadsheet-based computer model was developed to estimate the removal of sediment-bound toxics from stormwater runoff by a detention pond. The model calculates both dynamic and quiescent settling for nine different sediment grain sizes and up to seven toxics associated with them. Since the model tracks each particle size separately, it allows for the increasing proportion of fine particles as stormwater flows through a series of basins. The detention basin's effectiveness at decreasing toxic mass and aqueous concentration, while increasing sediment concentrations, is examined. Based on the modeling results, the METSET model should have wide applicability in testing toxicity reduction strategies for stormwater runoff.

TOPIC: 1.3.1

AUTHOR(S): Ferrara, R.A.

DATE: 1983

TITLE: Role of Detention Basins for Stormwater Quality Control.

ORGANIZATION:

SOURCE: IN: Dissolved Loads of Rivers and Surface Water Quantity/Quality Relationships, Proceedings of a Symposium Held During the XVIII General Assembly of the International Union of Geodesy and Geophysics at Hamburg, West Germany, August 15-27, 1983. IAHS

ABSTRACT: A comprehensive analysis of the effectiveness of detention basins for storm water quality control is reported. The study consisted of three phases: (a) a field monitoring program identifying influent and effluent water quality; (b) laboratory storm water pollutant settleability tests, and (c) mathematical modelling of detention basins. The first phase provided data on time-variable influent and effluent concentrations, and therefore yielded a measure of the actual pollutant reduction obtained via detention. Phase two identified the appropriate detention time to achieve maximum particle removal through sedimentation. Phase three developed a methodology for design and analysis of storm water detention basins for both quantity and quality control.

TOPIC: 1.3.1

AUTHOR(S): Fish, W.

DATE: 1988

TITLE: Behavior of Runoff Derived Metals in a Well Defined Paved - Catchment/Retention Pond System

ORGANIZATION: WRRI-OSU

SOURCE:

ABSTRACT: Removal of heavy metals (copper) using detention ponds. Effectiveness data.

TOPIC: 1.3.1

AUTHOR(S): Galli, F.J.

DATE: 1988

TITLE: A Limnological Study for an Urban Stormwater Management Pond and Stream Ecosystem.

ORGANIZATION:

SOURCE: Unpublished Master Thesis, George Mason Univ. Fairfax , VA.

ABSTRACT:

24-Apr-98

TOPIC: 1.3.1

AUTHOR(S): George, Thomas S; Hartigan, John P

DATE: 1992

TITLE: Regional planning for stormwater management.

ORGANIZATION: Camp Dresser & McKee, Annandale, VA, USA

SOURCE: NATL CONF ENVIRON ENG., ASCE, NEW YORK, NY (USA), 1992., pp. 492-497

ABSTRACT: Over the past decade, municipal stormwater management regulations throughout the U.S. have promoted the use of regional stormwater detention facilities in lieu of many small onsite detention basins. Recent statewide stormwater management regulations (e.g., State of Virginia) are also encouraging regional stormwater management planning through the use of regional stormwater management facilities. Regional stormwater detention basins can be located and designed to reduce the peak flow from areas of new development and also from existing developed areas. The major advantage of this regional approach over the onsite control approach is the need for fewer structural facilities for new development, making long-term maintenance more affordable and increasing the reliability of the stormwater detention system.

TOPIC: 1.3.1

AUTHOR(S): Gietz, R.J.

DATE: 1981

TITLE: Stormwater Runoff Treatment by Impoundment: Barrhaven Pilot Study.

ORGANIZATION:

SOURCE: Report SCAT-8, 1981. Canada Mortgage and Housing Corporation, Ottawa, Ontario. 72 p, 27 fig, 7 tab, 2 app, 17 ref.

ABSTRACT: This report presents the findings of a two-year study of stormwater runoff treatment by impoundment in an open basin. The treatment system was operated as a batch process for one summer and as a continuously overflowing pond for another. Runoff from 866 ha of agricultural and residential suburban lands partly under construction entered the treatment system. Impoundment reduced pollutant loadings by over 90% for suspended solids, 75%-90% for bacteria (total and fecal coliform and fecal streptococcus) and 25%-50% for organic nitrogen and total phosphorus compounds when the runoff could be stored for more than 12 hr. At least 5 mm of rainfall were required to produce measurable runoff. The ratio of runoff to rainfall was used to estimate the runoff volumes that would be generated by up to 25-year return frequency storms of one and two-hour durations. From this, a storage volume of 40,000 to 47,000 cu m was indicated, on the basis of containment of runoff from a ten-year storm. It was determined that the most effective method of operating the treatment system was to keep the reservoir drawn down to a shallow pond. When runoff entered the pond, the drain valve was closed and the treatment system filled. Where possible, the runoff volume would be contained until its quality was suitable for discharge. For runoff volumes exceeding the treatment system storage volume, discharge took place over the spillway with limited pollutant removal. When the effluent quality became satisfactory, the reservoir was drained to the original shallow pond, and dry weather flow allowed to pass through. Other factors that govern the choice of treatment system storage volume are the runoff event frequency and the allowable discharge rate. It was found that of the approximately 30 events that could be expected from May to September about half took place within four days of one another. Allowing one day to fill and one day for storage, the reservoir should require two days to empty.

TOPIC: 1.3.1

AUTHOR(S): Grizzard, T.J., C.W. Randall, B.L. Weand, K.Ellis

DATE: 1986

TITLE: Effectiveness of Extended Detention Ponds

ORGANIZATION: ASCE

SOURCE: In "Urban Runoff Quality-Impact and Quality Enhancement Technology: ASCE Conference Proceedings" Urbonas, B. and L. Roesner (editors), 1986 (Pp 323 - 337)

ABSTRACT: Data for the effectiveness of extended detention pond systems to remove pollutants.

24-Apr-98

TOPIC: 1.3.1

AUTHOR(S): Hampson, P.S.

DATE: 1986

TITLE: Effects of Detention on Water Quality of Two Stormwater Detention Ponds Receiving Highway Surface Runoff in Jacksonville, Florida.

ORGANIZATION:

SOURCE: Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Water Resources Investigations Report 86-4151. 1986. 69p, 20 fig, 16 tab, 34 ref, 2 append.

ABSTRACT: Water and sediment samples were analyzed for major chemical constituents, nutrients, and heavy metals following ten storm events at two stormwater detention ponds that receive highway surface runoff in the Jacksonville, Florida, metropolitan area. The purpose of the sampling program was to detect changes in constituent concentration with time of detention within the pond system. Statistical inference of a relation with total rainfall was found in the initial concentrations of 11 constituents and with antecedent dry period for the initial concentrations of 3 constituents. Based on graphical examination and factor analysis, constituent behavior with time could be grouped into five relatively independent processes for one of the ponds. The processes were (1) interaction with shallow groundwater systems, (2) solubilization of bottom materials, (3) nutrient uptake, (4) seasonal changes in precipitation, and (5) sedimentation. Most of the observed water-quality changes in the ponds were virtually complete within 3 days following the storm event. (Author's abstract).

TOPIC: 1.3.1

AUTHOR(S): Harper, H.

DATE: 1988

TITLE: Effects of Stormwater Management Systems on Groundwater Quality.

ORGANIZATION:

SOURCE: Final Report to Florida Dept. of Environmental Regulation. Tallahassee, FL.

ABSTRACT:

TOPIC: 1.3.1

AUTHOR(S): Hartigan, J.P.

DATE: 1989

TITLE: Basis Of Design Of Wet Detention BMPs

ORGANIZATION:

SOURCE: In L.A. Roesner, B. Urbonas, and M.B. Sonnen, eds. Design Of Urban Runoff Quality Controls. Am. Soc. Civil Eng., New York, NY

ABSTRACT:

TOPIC: 1.3.1

AUTHOR(S): Hunter, J.V.

DATE: 1985

TITLE: Impacts of Detention Basins on Water Quality.

ORGANIZATION:

SOURCE: In: E. Dauerheimer, R. Fresnack, E. Golub, and F. Salek (eds.) Proceedings of the Seminar on Floodplain Hydrology. New Jersey Institute of Technology, Newark, N.J.

ABSTRACT:

TOPIC: 1.3.1

AUTHOR(S): Kantrowitz, I.H. and W.M Woodham

DATE: 1995

TITLE: Efficiency Of A Stormwater Detention Pond In Reducing Loads Of Chemicals And Physical Constituents In Urban Streamflow, Pinellas County, Florida

ORGANIZATION:

SOURCE: U.S. Geological Survey Water Resources Investigations Report 94-4217

ABSTRACT:

24-Apr-98

TOPIC: 1.3.1

AUTHOR(S): Leersnyder, H.

DATE: 1993

TITLE: Performance Of Wet Detention For The Removal Of Urban Stormwater Contaminants In The Auckland Region, M.S. Thesis

ORGANIZATION:

SOURCE: University of Auckland

ABSTRACT:

TOPIC: 1.3.1

AUTHOR(S): Loganathan, GV; Watkins, EW; Small, AB; Kibler, DF

DATE: 1993

TITLE: Utilization of roadway crossings as BMP' in urban areas.

ORGANIZATION:

SOURCE: WATER RESOUR PLANN MANAGE URBAN WATER RESOUR., ASCE, NEW YORK, NY (USA), 1993., pp. 785-788

ABSTRACT: Roadway crossings of natural waterways in the urban setting can be used as Best Management Practices (BMP's) by retrofitting existing outlet structures. Pollutant removal is contingent on inundation of a portion of the flood plain to provide extended detention. The design parameters, namely the detention basin storage and withdrawal rate, should be chosen to maximize the detention time within practical limits. An analytical procedure is formulated for preliminary planning estimates of the design parameters.

TOPIC: 1.3.1

AUTHOR(S): Maristany, A.E.

DATE: 1989

TITLE: Effectiveness of wet detention and retention ponds for improving stormwater quality.

ORGANIZATION:

SOURCE: Ports, M.A. (ed). 1989. Proceedings of Natl. Conf. on Hydraulic Engineering. 14-18 Aug 1989 : New Orleans, LA. pp. 1047-1053. (MdBeCS)2603125

ABSTRACT: The most commonly used structural measures for stormwater quality management and control are retention basins, wet detention ponds, and detention with filtration ponds. This paper explores the different variables which affect the performance of each of these systems for removing nutrients and pollutants from stormwater runoff. The relative performance of wet detention and retention ponds are evaluated, and recommendations made regarding the most effective pond system depending on regional watershed characteristics.

TOPIC: 1.3.1

AUTHOR(S): Marsalek, J; Watt, WE; Henry, D

DATE: 1992

TITLE: Retrofitting stormwater ponds for water quality control.

ORGANIZATION: Natl. Water Res. Inst., P.O. Box 5050, Burlington, ON L7R 4A6, Canada

SOURCE: WATER POLLUT. RES. J. CAN., vol. 27, no. 2, pp. 403-422, 1992.

ABSTRACT: During the last 15 years, many stormwater ponds were built in Canada. These ponds were designed to control runoff flows by peak shaving, and thereby prevent flooding resulting from urbanization, but they are ineffective in protection of water quality in the receiving waters. Thus, one of the emerging challenges in urban water management is the retrofitting of existing stormwater ponds to meet the current environmental concerns. The retrofitting measures proposed include changes in flow regimes, storage pool volumes and flow velocities, achievable by structural changes in inlet, storage and outlet structures; treatment of runoff by sedimentation or filtration; enhancement of biological processes contributing to pollutant removal through longer detentions and introduction of aquatic plants; and, improvement of aquatic life habitat. A case is made for an ecosystem approach where the ponds is one element in the urban stormwater treatment train which controls catchment, pond and receiving waters.

24-Apr-98

TOPIC: 1.3.1

AUTHOR(S): Mesuere, K.; Fish, W.

DATE: 1989

TITLE: Behavior of runoff-derived metals in a detention pond system.

ORGANIZATION: Oregon Grad. Cent., Dep. Environ. Sci. and Eng., 19600 Von Neumann Dr., Beaverton, OR 97006-1999, USA.

SOURCE: Water, air, and soil pollution. Dordrecht 1989, vol. 47, no. 1-2, p. 125-138. (MdBcCS)2427185

ABSTRACT: The removal and fate of runoff-derived heavy metals in a 1- yr old detention pond system were investigated during climatic conditions typical of the U.S. maritime Northwest. The catchment was a medium-sized, suburban parking lot near Portland, Oregon. Water samples from runoff, the detention pond system, and pond effluent were collected and analyzed for dissolved and particulate Cu. Copper was the dominant toxic metal for the study site, while analysis of selected samples for Pb and Cd showed these metals to be minor pollutants. Total Cu in runoff varied among different storm events over a wide range of concentrations (< 2 to 33 micrograms/L), while total Cu levels in pond effluent remained within a fairly narrow range (5 to 12 micrograms/L). Sediment samples collected from the detention pond system were analyzed for Cu in two size fractions (< 63 microns and < 125 microns).

TOPIC: 1.3.1

AUTHOR(S): Minnesota Pollution Control Agency

DATE: 1989

TITLE: Protecting Water Quality in Urban Areas

ORGANIZATION: Minn. Pollution Contr. Ag

SOURCE:

ABSTRACT: Some information on cost and effectiveness of wet ponds. Also design criteria for sediment control measures.

TOPIC: 1.3.1

AUTHOR(S): Ney, J. and Mauney, M.

DATE: 1981

TITLE: Impact of a Small Impoundment on Benthic Macroinvertebrates and Fish Communities of a Headwater Stream in the Virginia Piedmont.

ORGANIZATION:

SOURCE: The Warm Water Stream Symposium: A National Symposium on Fisheries Aspects of Warm Water Streams. Southern Div. American Fisheries Society.

ABSTRACT:

TOPIC: 1.3.1

AUTHOR(S): Nightingale, H.

DATE: 1987

TITLE: Water Quality Beneath Urban Runoff Water Management Basins

ORGANIZATION: AWRA

SOURCE: Water Resources Bulletin, AWRA, vol. 23, no. 2, April.

ABSTRACT: These same basins are used on Article (WC-U-005) - Accumulation of As, Ni, Cu and Pb in Retention/Recharge Basin Soils from Urban Runoff (Published in Aug 1987 by Water Resources Bulletin)

This article gives a "good" support in showing that no significant contamination of percolating soil water/ground water underlying any of the 5 basins (pg 197) abstract

The clay/silt ratio of the soil profile beneath the basins are reviewed and the rate indicates the order of increasing suitability for recharge basins were also listed (on Page 198).

24-Apr-98

TOPIC: 1.3.1

AUTHOR(S): Nightingale, H.

DATE: 1987

TITLE: Accumulation of As, Ni, and Pb in Retention/Recharge Basins Soils From Urban Runoff

ORGANIZATION: AWRA

SOURCE: WATER RESOUR. BULL., vol. 23, no. 4, pp. 663-672, 1987.

ABSTRACT: The accumulation of arsenic, nickel, copper, and lead in the soil profile was determined beneath five urban storm-water retention/recharge basins used by the Fresno Metropolitan Flood Control District, California. Soils were sampled from the surface to the first zone of saturation and compared with soils from an adjacent uncontaminated control site. These elements were found to be accumulating in the first few centimeters of basin soil and are important to the effectiveness of a specific best management practice. The practice of removing excess flood runoff water from two basins by pumping apparently is a factor in reducing the accumulation rate of these elements in the surface soils of the basins.

Note: For details on the amount of metals found in the soil of retention basins. Will serve as good support for using retention/recharge basin as BMP w/proper management.

TOPIC: 1.3.1

AUTHOR(S): Northeastern Illinois Planning Commission

DATE: 1986

TITLE: Stormwater Detention for Water Quality Benefits

ORGANIZATION: Illinois EPA

SOURCE: IL. EPA, Chicaco, IL.

ABSTRACT: Includes detailed design considerations for wet and dry ponds. Sediment removal efficiency of wet pond. A little information on infiltration basins. 25 pages.

TOPIC: 1.3.1

AUTHOR(S): O'Loughlin, Geoffrey; Beecham, Simon; Lees, Stephen; Rose, Lawrence; Nicholas, Douglas

DATE: 1995

TITLE: On-site stormwater detention systems in Sydney

ORGANIZATION: Univ of Technology, New South Wales, Aust

SOURCE: WATER SCI TECHNOL, vol. 32, no. 1, pp. 169-175, 1995

ABSTRACT: On-site stormwater detention (OSD) requirements are applied by most municipalities in Sydney, Australia. Persons redeveloping properties served by existing drainage systems must provide storages for stormwater, to compensate for increased runoff from the new development. While OSD is widely accepted, procedures differ considerably between municipalities. Many designers criticize guidelines and design methods, and express doubts about the maintenance and economy of OSD systems. This paper surveys the application of OSD in Sydney, describes typical installations, and reviews their effectiveness. It sets out the main arguments for and against OSD systems, discusses alternatives, and indicates how systems and procedures will evolve in the future.

TOPIC: 1.3.1

AUTHOR(S): Occoquan Watershed Monitoring Lab

DATE: 1987

TITLE: Final Report, London Commons Extended Detention Facility Urban BMP Research and Demonstration Project

ORGANIZATION: NVA SWCD

SOURCE:

ABSTRACT: Nutrient removal efficiency for extended detention dry ponds. No cost data.

24-Apr-98

TOPIC: 1.3.1

AUTHOR(S): Oliver, L. J., and S. G. Grigoropoulos

DATE: 1981

TITLE: Control of Storm-Generated Pollution Using a Small Urban Lake.

ORGANIZATION:

SOURCE: Journal WPCF 53(5): 594-603.

ABSTRACT: Storm-generated pollution, recently identified as the "greatest offender" in the area of water pollution, has been primarily associated with large metropolitan communities. It is not limited to these areas, however, and the run-off from small urban areas has been found similar in character and significant in polluting receiving streams.

The pollution contribution of stormwater is becoming more significant as secondary treatment of point-source discharges is accomplished. Calculations developed by Sartor et al. for a typical city of 100,000 population with a 5,670-ha area would indicate that the first-hour run-off from a moderate-to-heavy storm (peaks to at least 1.27 cm/h) would contribute 50, 100, 4,300, 44 and 180 times the 5-day biochemical oxygen demand (BOD₅), chemical oxygen demand (COD), total suspended solids (TSS), total Kjeldahl nitrogen, and ortho phosphate load that would be discharged in the city's secondary plant effluent during the corresponding period. Further, Whipple et al. have suggested that once secondary treatment of recorded wastes has been effected, unrecorded wastes (mainly stormwater run-off) will account for more than 50% of the pollution in receiving streams.

The management of storm-generated pollution may involve source or collection system control, storage or treatment of the run-off, or an integrated system of control and treatment alternatives. Source control is accomplished within the drainage basin before the run-off enters the sewer system or the receiving body, and collection system control aims at the improvement or alteration of the sewer system. Storage depends on a holding structure to provide flow attenuation and equalization either upstream or at the treatment plant. Finally, treatment of the run-off may utilize physical, chemical, or biological processes, although biological treatment is difficult because of the intermittency of this discharge.

This paper presents research on source control storm-generated pollution in a small urban area involving the detention and natural treatment of run-off by a small recreational lake. Quality and quantity of inflow and outflow of a 2.3-ha lake draining a 45-ha area were monitored over a 6-month period (April to October 1975). The results were evaluated to establish the short- and long-range benefits of the lake as a source control measure for abating storm-generated pollution.

TOPIC: 1.3.1

AUTHOR(S): Pitt, R.E.

DATE: 1987

TITLE: Wet Detention Ponds

ORGANIZATION:

SOURCE: Univ. of Alabama, UAB Station, Birmingham, AL..

ABSTRACT:

24-Apr-98

TOPIC: 1.3.1

AUTHOR(S): Randall, C.W.

DATE: 1982

TITLE: Stormwater detention ponds for water quality control.

ORGANIZATION:

SOURCE: p. 200-204 in: W. DeGroot (ed.), Proceedings of the Conference on Stormwater Detention Facilities: Planning, Design, Operation, and Maintenance. 1-6 August, Henniker, NH. Society of Civil Eng., NY.

ABSTRACT: The water quality aspect of stormwater runoff should be considered during stormwater management planning. Quality management can be easily incorporated into flood management strategies such as the utilization of detention ponds, and, in a few cases, the protection of water quality may be the most critical need. The Ocoquan Watershed of Northern Virginia is an area where water quality was concluded to be the primary reason for stormwater runoff management.

The streams in the Ocoquan basin form a reservoir that supplies drinking water for more than 650,000 people, and is an essential source of water for the greater Washington, D.C. area. A few years after formation of the reservoir, severe water quality problems were occurring, and a 1969 study indicated that point source discharges from 12 upstream sewage treatment plants were primarily responsible. As a response, a control strategy requiring the replacement of the treatment plants with a single, highly advanced, wastewater treatment plant was implemented, along with basin-wide water quality monitoring. However, rapid urbanization occurred in parts of the watershed and by 1976 monitoring had demonstrated that stormwater runoff was having a greater impact on reservoir water quality than the still existing, but upgraded, sewage treatment plants. This demonstrating resulted in - the enactment of stormwater runoff management ordinances throughout the Washington, D.C. area, most notably in Fairfax County, Virginia, part of which is the Ocoquan Watershed.

Enactment of the ordinance resulted in the installation of a wide variety of stormwater management procedures in new developments including porous and pervious pavements, swale drainage, elimination of curbs and gutters, narrowing of paved roads, median strip storage of parking lot runoff and dual purpose detention ponds, both wet and dry. Unfortunately, while it seemed obvious that such facilities would reduce stormwater runoff pollution, the actual effectiveness of the various procedures was not known and, therefore, procedure selection and extensiveness of utilization could not be rationally related to the water quality goals. To obtain the needed information, extensive monitoring of small sites, in addition to basin-wide monitoring was implemented, and has continued to the present time.

TOPIC: 1.3.1

AUTHOR(S): Rushton, B.T. and C.W. Dye

DATE: 1993

TITLE: An in-depth analysis of a wet detention storm water system: Final Report

ORGANIZATION:

SOURCE: Southwest Florida Water Management District, 2379 Broad Street, Brooksville, FL 34609. 125 pp

ABSTRACT:

TOPIC: 1.3.1

AUTHOR(S): Rushton, B.T., C.H. Miller, and H.C. Hull

DATE: 1995

TITLE: The effect of residence time on the efficiency of a wet detention stormwater treatment pond

ORGANIZATION:

SOURCE: Water Management in Urban Areas. 31st Annual Conference & Symposia, November 10 - 12, 1995, Houston, Texas

ABSTRACT:

TOPIC: 1.3.1

AUTHOR(S): Rushton, B.T., C.H. Miller, and H.C. Hull

DATE: 1995

TITLE: Residence time as a pollutant removal mechanism in stormwater detention ponds

ORGANIZATION:

SOURCE: In Proceedings of the 4th biennial stormwater research conference, October 18 - 20, 1995, Clearwater, FL. Southwest Florida Water Management District, 2379 Broad Street, Brooksville, FL 34609.

ABSTRACT:

24-Apr-98

TOPIC: 1.3.1

AUTHOR(S): Rushton, B.T., C.H. Miller, H.C. Hull and J. Cunningham

DATE: 1996

TITLE: Evaluation Of Three Design Alternatives For Stormwater Detention Ponds (In Progress)

ORGANIZATION:

SOURCE: Environmental Section, Southwest Florida Water Management District, Brooksville, FL 34609

ABSTRACT:

TOPIC: 1.3.1

AUTHOR(S): Rushton, B.T., M.J. Kehoe, J. Cunningham, D.W. Carr, and C.W. Dye

DATE: 1993

TITLE: Results documented from wet-detention stormwater studies

ORGANIZATION:

SOURCE: In Proceedings of a conference, Implementation of water quality goals in stormwater management, Florida Water Environment Association

ABSTRACT:

TOPIC: 1.3.1

AUTHOR(S): Schueler, T., and M. Helfrich

DATE: 1988

TITLE: Design of Extended Detention Wet Pond Systems

ORGANIZATION: WASHCOG

SOURCE:

ABSTRACT: Removal efficiency for ED pond system. Also included are design criteria and maintenance information. No cost data.

TOPIC: 1.3.1

AUTHOR(S): Schueler, Thomas

DATE: 1995

TITLE: Performance Of A Dry Extended Pond In North Carolina

ORGANIZATION:

SOURCE: Watershed Protection Techniques 2(1):294-295

ABSTRACT:

TOPIC: 1.3.1

AUTHOR(S): Schueler, Thomas

DATE: 1995

TITLE: Performance Of Two Wet Ponds In The Piedmont Of North Carolina

ORGANIZATION:

SOURCE: Watershed Protection Techniques 2(1): 296-297

ABSTRACT:

TOPIC: 1.3.1

AUTHOR(S): Shields, D. and E. Thackston

DATE: 1991

TITLE: Designing Treatment Basin Dimensions to Reduce Cost

ORGANIZATION:

SOURCE:

ABSTRACT: Mathematical models for designing runoff basins with cost considerations included.

24-Apr-98

TOPIC: 1.3.1

AUTHOR(S): Southwest Florida Water Management District

DATE:

TITLE: Survey Of Twenty-four Wet Detention Ponds Permitted Between 1983 and 1987

ORGANIZATION:

SOURCE: Resource Projects Department, Brooksville, FL

ABSTRACT: Study in progress

TOPIC: 1.3.1

AUTHOR(S): Southwest Florida Water Management District

DATE:

TITLE: A Case Study Of A Small Wet Detention System For A Commercial Building In Tampa, Florida

ORGANIZATION:

SOURCE: Resource Projects Department, Brooksville, FL

ABSTRACT: In depth study in progress

TOPIC: 1.3.1

AUTHOR(S): Spence, J.A. and Haynes, H.B.N.

DATE: 1971

TITLE: Differences in Benthos Upstream and Downstream of an Impoundment.

ORGANIZATION:

SOURCE: Journal of Fish. Res. Bd. Can., 28: 35-43

ABSTRACT:

TOPIC: 1.3.1

AUTHOR(S): Stahre, P. and Urbonas, B.

DATE: 1990

TITLE: Stormwater Detention for Drainage, Water Quality, and CSO Management.

ORGANIZATION:

SOURCE: Prentice Hall, Inc.

ABSTRACT:

TOPIC: 1.3.1

AUTHOR(S): Stallard, W; Smith, WG; Crites, RW

DATE: 1980

TITLE: Design of Storage/Sedimentation Facilities to Control Urban Runoff and Combined Sewer Overflows.

ORGANIZATION: Metcalf & Eddy, Inc. Sacramento, CA

SOURCE: IN "RESTORATION OF LAKES AND INLAND WATERS", 1980., pp. 294-297

ABSTRACT: Urban stormwater runoff and combined sewer overflows are potentially significant sources of water pollution. Storage/sedimentation facilities have been recognized, both in the United States and Europe, as cost-effective measures for stormwater treatment and control. This paper summarizes a manual currently being prepared for the U.S. Environmental Protection Agency, detailing procedures for planning and design of various storage/sedimentation techniques. Such techniques as upland attenuation, inline storage, and end-of-pipe storage and treatment are detailed. Pollutants and watershed characteristics of stormwater management are discussed, including the range of water quality expected in urban stormwater runoff and combined sewer overflow. Data for the specific study area must be used. Models to evaluate the runoff problem and select effective solutions are listed. European practice in stormwater storage and sedimentation is described.

24-Apr-98

TOPIC: 1.3.1

AUTHOR(S): Striegl, R.G.

DATE: 1987

TITLE: Suspended Sediment and Metals Removal from Urban Runoff by a Small Lake.

ORGANIZATION:

SOURCE: Water Resources Bulletin WARBAQ, Vol. 23, No. 6, p 985-996, December 1987. 10 fig, 11 tab, 21 ref.

ABSTRACT: A small lake in the Chicago Metropolitan Area was from 91 to 95 percent efficient in removing suspended solids and from 76 to 94 percent efficient in removing copper, iron, lead and zinc from urban runoff. Sediments accumulated in the lake in the form of an organic-rich mud at an average rate of 20 millimeters per year; this reduced lake storage and covered potential habitat for aquatic organisms. Copper, lead, and zinc concentrations were closely associated with suspended-sediment concentrations and with silt- and clay-sized fractions of lake sediment. Although concentrations of mercury and cadmium were near detection limits in runoff, measurable concentrations of these metals accumulated in the lake sediments.

TOPIC: 1.3.1

AUTHOR(S): Striegl, R.G.; Cowan, E.A.

DATE: 1987

TITLE: Relations Between Quality of Urban Runoff and Quality of Lake Ellyn at Glen Ellyn, Illinois.

ORGANIZATION:

SOURCE: Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2301, 1987. 59p, 27 fig, 20 tab, 60 ref.

ABSTRACT: Comparison of flow and chemical data collected at the principal inlet and at the outlets of Lake Ellyn--an urban lake in the Chicago metropolitan area shows that detention storage alters the discharge and the quality of urban runoff. Peak water discharge and variation in the concentration of constituents transported by the runoff are usually reduced. Mass balance relations based on comparison of measured constituent loads at the inlet and the outlets show that the lake is very efficient in trapping suspended solids, suspended sediment, and sediment-associated metals. Calculated trap efficiencies for many dissolved constituents were negative. However, negative efficiencies appear to be influenced mostly by insufficient sampling in winter. Trap efficiencies for nitrogen and phosphorus are intermediate to those determined for other constituents. Solids accumulate on the lake bottom as organic-rich muds that reduce lake storage and cover potential habitat for aquatic organisms. Lake sediments, particularly fine-grained sediments, have elevated concentrations of metals associated with them. Several organic compounds, not detected in inlet or outlet water samples, were detected in a lake sediment sample collected near the inlet. Concentrations of many constituents dissolved in lake water are seasonally cyclic, with annual concentration peaks occurring during the winter. Establishment and maintenance of desirable benthic invertebrate and fish populations appear to be inhibited by sediment deposition.

TOPIC: 1.3.1

AUTHOR(S): U.S. EPA

DATE: 1991

TITLE: Snowmelt Literature Review

ORGANIZATION:

SOURCE: Region V - Water Quality Section (5WQS-TUB)

ABSTRACT: Document presents a compilation of publications defining and addressing water quality problems related to snowmelt from urban areas, i.e. associated pollutants, environmental impacts, snow mgt strategies, BMPs for snowmelt runoff control and quality.

TOPIC: 1.3.1

AUTHOR(S): U.S. EPA

DATE: 1986

TITLE: Methodology For Analysis Of Detention Basins For Control Of Urban Runoff Quality

ORGANIZATION:

SOURCE: EPA-440/5-87-001

ABSTRACT:

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TOPIC: 1.3.1
AUTHOR(S): U.S. EPA
DATE: 1988
TITLE: National Conference on Enhancing State's Lake Management Program
ORGANIZATION: NIPC/NALMS
SOURCE:
ABSTRACT: Effectiveness information provided. No cost data available.

TOPIC: 1.3.1
AUTHOR(S): Unknown
DATE:
TITLE: Feasibility and Design of Wet Ponds to Achieve Water Quality Control
ORGANIZATION:
SOURCE:
ABSTRACT: Effectiveness data for TSS, TN, TP and metal removal. No cost data.

TOPIC: 1.3.1
AUTHOR(S): Urbonas, B., and W. Ruzzo.
DATE: 1986
TITLE: Standardization of Detention Pond Design for Phosphorus Removal.
ORGANIZATION:
SOURCE: In: H. Torno, J. Marsalek and M. Desbordes (eds.), Urban Runoff Pollution. NATO ASI series G. Vol. 10, Springer-Verlag
ABSTRACT:

TOPIC: 1.3.1
AUTHOR(S): Walker Jr., W.
DATE: 1987
TITLE: Phosphorous Removed by Urban Runoff Detention Basins
ORGANIZATION:
SOURCE: In: Lake and Reservoir Management: Influences of Nonpoint Source Pollutants and Acid Precipitation. 6th Annual International Symposium, North American Lake Management Society, Nov. 5-8, 1986. North American Lake Management Society, Portland, Oregon, 3:
ABSTRACT: Comparison dry and permanent pool (pg 315)
Maintenance cost (pg 324) (Schueler, 1986) pg 324
Volume losses (0.5 to 1% yearly) pg 324
Public opinion on wet pond, pg. 324
Conclusion (pg 325) removal rate, criteria to improve performance, increase size for sediment accumulation.
Note: Maine - phosphorus control in lake watershed (WC-U-001) is based on this study by William Walker, Jr./An empirical model previously developed for predicting phosphorus retention in reservoirs is tested against the urban lake/detention pond data set. Detention pond design criteria developed under the EPA's Nationwide Urban Runoff Program (NURP) are evaluated using the model. For summer precipitation and runoff quality typical of St. Paul, Minnesota, a basin designed according to NURP criteria is estimated to have a long-term average phosphorus removal efficiency of 47-68 percent. For a given loading regime, phosphorus removal is shown to be more sensitive to pond depth than to surface area. Specific design features for enhancing phosphorus removal (deepening, promoting infiltration, promoting plug flow, and chemical treatment) are discussed. The methodology can be used to evaluate wet detention pond design criteria in other regions, with substitution of appropriate precipitation and runoff quality characteristics.

24-Apr-98

TOPIC: 1.3.1

AUTHOR(S): Wanielista, M.; Charba, J.; Dietz, J.; Russell, B.

DATE: 1991

TITLE: Evaluation of the Stormwater Treatment Facilities at the Lake Angel Detention Pond, Orange County, Florida. Final rept. 2 Jan 90-1 Jul 91.

ORGANIZATION: Performer: University of Central Florida, Orlando. Dept. of Civil Engineering and Environmental Sciences.

SOURCE:

ABSTRACT: This is the final report on the use of Granulated Active Carbon (GAC) beds of Filtrasorb 400 in series to reduce the Trihalomethane Formation Potential (THMFP) concentrations at the Lake Angel detention pond, Orange County, Florida. The detention pond accepts runoff from an interstate highway and a commercial area. Breakthrough time was estimated from laboratory analyses and used to design two beds in series at the detention pond. Breakthrough occurred in the first bed after treating 138,000 liters of water. Exhaustion of the first bed was reached after treating 1270 bed volumes with a sorption zone length of 1.70 feet. The TOC adsorbed per gram of GAC was 6.3 mg. The liquid flow rate averaged 0.0011 cfs. Similar breakthrough curves for Total Organic Carbon (TOC) and color were also reported. The used GAC can be disposed of by substituting it for sand in concrete mixes. An economic evaluation of the GAC system at Lake Angel demonstrated an annual cost of \$4.39/1000 gallons to treat the stormwater runoff after detention and before discharge into a drainage well. The cost could be further reduced by using the stormwater to irrigate right-of-way sections of the watershed. An alternative method of pumping to another drainage basin was estimated to be more expensive. The underdrain network for the GAC system initially became clogged with the iron- and sulfur-precipitation bacteria *Leptothrix*, *Gallionella* and *Thiothrix*. These bacteria were substantially reduced by altering the influent GAC system pipeline to take water directly from the lake. An alternate pipe system used a clay layer to reduce ground water inputs and did not exhibit substantial bacterial growth.

TOPIC: 1.3.1

AUTHOR(S): Wu, J.S.

DATE: 1988

TITLE: Modeling and Field Evaluations of Urban Wet Detention Ponds

ORGANIZATION:

SOURCE: IN: Proceedings of Stormwater and Water Quality Model Users Group Meeting. October 3-4, 1988, Denver, CO. EPA Report No. EPA/600/9-89/001, January 1989. p 129-141, 1 fig, 8 tab,

ABSTRACT: An extensive stormwater sampling program was conducted on three existing urban wet detention ponds in the Piedmont region of North Carolina, and an EPA model was examined and verified for its usefulness in analyzing the water-quality improvement performance of urban wet detention ponds. By analyzing the pollutant removal data collected from eleven runoff events, a performance relationship was observed, permitting the incorporation of water quality improvement requirements into the proper sizing of wet detention ponds. To achieve a minimum level of urban runoff pollution control, the surface area ratio of detention ponds must be greater than 0.5%. Approximately 1% to 2% of the watershed area is needed for developing detention ponds to control 70% or more of the sediment load.

TOPIC: 1.3.1

AUTHOR(S): Wu, J.S.; Holman, B.; Dorney, J.

DATE: 1988

TITLE: Performance of urban wet detention ponds.

ORGANIZATION: Dep. Civ. Eng., UNCC, Charlotte, NC 28223, USA

SOURCE: Lyke, W.K.; Hoban, T.J., eds. 1988. Proceedings of the Symposium on Coastal Water Resources. Wilmington, NC, 1988. pp. 333-350. TPS-88-1 (TPS881)

ABSTRACT: The secondary use of detention ponds for water quality improvement has been promoted. This paper summarizes results of a monitoring program conducted on three urban wet detention ponds in the city of Charlotte, North Carolina, USA. Data collected from five storm events were employed to develop a relationship between detention pond performance and pond surface/watershed area ratios. Runoff quality of the study area is generally better and runoff sediment can be characterized by a finer particle size distribution. The attenuation of peak discharge appears unsatisfactory due to short circuiting of local drainage entering the detention ponds from surrounding areas. The observed improvement in water quality justifies the promising use of wet ponds for urban runoff pollution abatement.

24-Apr-98

TOPIC: 1.3.1

AUTHOR(S): Wu., J.S.; Holman, B. and Dorney, J.

DATE: 1988

TITLE: Water Quality Study on Urban Wet Detention Ponds.

ORGANIZATION:

SOURCE: Design of Urban Runoff Quality Controls. Roesner, B. et al., (eds.) . American Society of Civil Engineers

ABSTRACT:

TOPIC: 1.3.1

AUTHOR(S): Yousef, Y.A., et al

DATE: 1985

TITLE: Consequential Species of Heavy Metals [in Highway Runoff]

ORGANIZATION: FL DOT

SOURCE:

ABSTRACT: Result of monitoring pond site to determine effectiveness of pond in nutrient and heavy metal removal from highway runoff.

TOPIC: 1.3.1

AUTHOR(S): Yousef, Y.A., et al

DATE: 1986

TITLE: Effectiveness of Retention/Detention Ponds for Control of Contaminants in Highway Runoff

ORGANIZATION: FL DOT

SOURCE:

ABSTRACT: Retention defined as long-term storage (weeks-months).
Detention defined as short-term storage (hours-days).

TOPIC: 1.3.1

AUTHOR(S): Yousef, Y.A., M.P. Wanielista, H.H. Harper

DATE: 1986

TITLE: Design and Effectiveness of Urban Retention Basin

ORGANIZATION: ASCE

SOURCE: In "Urban Runoff Quality-Impact and Quality Enhancement Technology: ASCE Conference Proceedings" Urbonas, B. and L. Roesner (editors), 1986 (pg 338 to 349)

ABSTRACT: This article talked about on-line retention systems/which may also be classified as wet ponds.

TOPIC: 1.3.1

AUTHOR(S): Yousef, YA; Hvitved-Jacobsen, T; Wanielista, MP; Tolbert, RD

DATE: 1986

TITLE: Nutrient transformation in retention/detention ponds receiving highway runoff.

ORGANIZATION: Dep. Civ. Eng. and Environ. Sci., Univ. Central Florida, Orlando, FL 32816, USA

SOURCE: J. WATER POLLUT. CONTROL FED., vol. 58, no. 8, pp. 838-844, 1986.

ABSTRACT: Highway runoff contains heavy metals, nutrients, and other contaminants which are transported in solution and particulate forms to adjacent floodplains, roadside swales, and retention/detention ponds. The use of retention/detention ponds for storage and attenuation of peak flows is well established, but their effectiveness in removal of highway contaminants has not been fully investigated. The nutrients phosphorus and nitrogen can promote nuisance algal growth. Excessive algal growth and eutrophication problems can be mitigated by efficient nutrient removal.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): ABAG (Association of Bay Area Governments).

DATE: 1986

TITLE: Urban Stormwater Treatment at Coyote Hills Marsh.

ORGANIZATION:

SOURCE: ABAG, Oakland, CA. December 1986.

ABSTRACT: The construction and performance of wetland stormwater treatment system in Fremont, California is described in this publication. The system consists of a debris collection basin which distributes water into two parallel structures. One structure (System A) is a 5 acre lagoon with a central island and shallow shelf area near the outlet to promote wetland vegetation. The other structure (System B) consists of a small initial basin followed by an overland flow area with annual and perennial vegetation and a long, narrow pond divided into three cells by underwater sills that support stands of cattails. Both parallel structures drain into a third stage (System C), a 45-foot wide, one-half mile long, 5.5-6.5-foot deep channel surrounded by a broad, flat overflow area thickly vegetated with cattails and alkali bulrush. Treated storm runoff is then released into a marsh.

Water quality samples were taken to evaluate the effectiveness of the system. Results were probably influenced by incomplete vegetative growth and wetland soil development. Pollutant reduction rates were as follows: total suspended solids - 64%, oil and grease - 11%, nitrate-nitrogen - 15%, orthophosphorus - 56%, chromium - 68%, copper - 31%, lead - 88%, and zinc - 33%. Concentrations of total dissolved solids, biochemical oxygen demand, Kjeldahl nitrogen, and manganese were greater in the outflow. Alkali bulrush (*Scirpus robustus*) and cattail (*Typha latifolia*) demonstrated significant uptake rates of heavy metals. A key recommendation by the authors is that use of wetlands to treat urban storm runoff should be limited to constructed wetlands because the degree and significance of bioaccumulation of pollutants in the food chain is yet unclear.

TOPIC: 1.3.2

AUTHOR(S): Adams, L.W., L.E. Dove, D.L. Leedy, and T.N. Franklin.

DATE: 1983

TITLE: Urban Wetlands for Stormwater Control and Wildlife Enhancement: Analysis and Evaluation. Unpublished final report.

ORGANIZATION:

SOURCE: Urban Wildlife Research Center, 10921 Trotting Ridge Way, Columbia, MD. 21044, 68 pp. (\$11).

ABSTRACT: Stormwater detention basins are designed to reduce flood hazards downstream by temporarily detaining stormwater in the basin and slowly releasing it over an extended period of time. Such basins have been, and still are, effective in flood control. Currently, however, there is increased interest in controlling not only stormwater quantity, but also in controlling the quality of runoff. Retention ponds are receiving increased attention, particularly where pollution control and/or aesthetic values are important. Retention ponds with surface discharge structures are more efficient in settling out particulate matter than are detention basins.

There is growing interest in the use of marshes and other wetlands, both natural and man-made, for water pollution control of urban runoff. Only a few documented studies have been reported, but consistent reductions of BOD (54-89%), suspended solids (94-99%), and heavy metals (up to 97%), have been shown.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Adamus, P.R., and L.T. Stockwell.

DATE: 1983

TITLE: A Method for Wetland Functional Assessment: Volume 1. Critical Review and Evaluation.

ORGANIZATION:

SOURCE: Federal Highway Administration, U.S. Department of Transportation, Washington, DC. 20590. FHWA-1P-82-23. Available from NTIS.

ABSTRACT: The manual presents a state-of-the-art review of wetland functions. This method was prepared for evaluating the effects of highway development on wetlands but has a broader range of applicability. Functions covered include groundwater recharge and discharge, flood storage and desynchronization, shoreline anchoring and dissipation of erosive forces, sediment trapping, nutrient retention and removal, food chain support (detrital export), habitat for fish and wildlife, and active and passive recreation. The manual covers all wetland types in the 48 coterminous states, and uses the U.S. Fish and Wildlife Service definition and classification system. It examines the validity, interactions, and possible significance thresholds for the functions, as well as documenting their underlying processes. With appropriate qualifying information, wetland types are ranked for each function. Wetland types ideal for each function are identified and illustrated. Potential impacts of highways upon each function are described and, where available, possible thresholds are given. Factors which regulate impact magnitude, such as location, design, watershed erodibility, flushing capacity, basin morphology, biotic sensitivity (resistance and resilience), and recovery capacity, are explained. Cumulative impacts and social factors affecting wetland significance are discussed. Effects of the following factors on wetland function are documented: contiguity, shape, fetch, surface area, area of watershed and drainage area, stream order, vegetation form, substrate, salinity, pH, hydroperiod, water level fluctuations tidal range, scouring, velocity, depth, width, circulation, pool-riffle ratio, vegetation density, flow pattern, interspersions, human disturbance, turbidity, alkalinity, dissolved oxygen, temperature, and biotic diversity.

TOPIC: 1.3.2

AUTHOR(S): Adamus, P.R., E.J. Clairain, D.R. Smith, and R.E. Young

DATE: 1987

TITLE: Wetland Evaluation Technique (WET), Vol II: Methodology.

ORGANIZATION:

SOURCE: Department of the Army, Waterways Experiment Station, Corps of Engineers, Vicksburg, Miss. Operational Draft Technical Report Y-87.

ABSTRACT: This manual outlines a Wetland Evaluation Technique (WET) for the assessment of wetland functions and values. WET is a revision of the method developed for the Federal Highway Administration (FHWA) that has often been referred to as the "Federal Highway Method" or the "Adamus Method".

Wetland functions are the physical, chemical, and biological characteristics of a wetland. Wetland values are those characteristics that are beneficial to society. WET evaluates the following functions and values: groundwater recharge, groundwater discharge, floodflow alteration, sediment stabilization, sediment/toxicant retention, nutrient removal/transformation, production export, wildlife diversity/abundance, aquatic diversity/abundance, uniqueness/heritage, and recreation. WET evaluates functions and values in terms of social significance, effectiveness, and opportunity. Social significance assesses the value of a wetland to society in terms of its special designations, potential economic value, and strategic location. Effectiveness assesses the capability of a wetland to perform a function because of its physical, chemical or biological characteristics. Opportunity assesses the opportunity of a wetland to perform a function to its level of capability.

WET evaluates functions and values by characterizing the wetland in terms of predictors. Predictors are simple, or integrated, variables that are believed to correlate with the physical, chemical, and biological characteristics of the wetland and its surroundings. Responses to questions concerning the predictors are analyzed in a series of interpretation keys that reflect the relationship between predictors and wetland functions or values as defined in the technical literature. Interpretation keys assign a qualitative probability rating of HIGH, MODERATE, or LOW to each function and value in terms of social significance, effectiveness, and opportunity.

WET also assesses the suitability of wetland habitat for 14 waterfowl species groups, 4 freshwater fish species groups, 120 species of wetland-dependent birds, 133 species of saltwater fish and invertebrates, and 90 species of freshwater fish. WET does not assess the suitability of wetland habitats for many important wildlife resources (e.g., furbearers, game mammals). Other methods must be used for these species.

WET was designed primarily for conducting an initial, rapid assessment of wetland functions and values. WET can also be applied in a variety of other situations including: (1) comparison of different wetlands, (2) selection of priorities for wetland acquisition or detailed, site-specific research, (3) selection of priority wetlands for Advanced Identification, (4) identification of options for conditioning of permits, (5) determination of the effects of preproject or postproject activities on wetland functions and values, and (6) comparison of created or restored wetlands with reference or preimpact wetlands for mitigation purposes.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Ammon, D.C., W.C. Huber, and J.P. Heaney.

DATE: 1981

TITLE: Wetlands' Use for Water Management in Florida.

ORGANIZATION:

SOURCE: Proceedings ASCE, Journal of the Water Resources planning and Management Division vol 107(WR2), Oct 1981.

ABSTRACT: The Kissimmee River Basin contributes the major portion of surface inflow and a substantial portion of nutrients to Lake Okeechobee, the primary water supply source for south Florida. With the construction of canal C-38 the basin has changed from one characterized by upland/flood plain retention and slow runoff to one of upland/flood plain drainage and rapid runoff. A basin-wide water management scheme has been proposed based on detention of runoff, restrictions on surface water discharge rates, and routing flow through natural or man-made marshes.

Chandler Slough Marsh has been shown to be moderately effective as a quality and quantity control unit. It is representative of other flood-plain marsh areas within the lower Kissimmee River Basin. Although the results here do not apply directly to upland marshes and sand ponds, it is speculated that these areas would be more effective since they are not subject to a severe hydrologic loading. By detaining runoff, these units will increase detention time and change the regime of much of the runoff from direct subsurface pathways, thereby, reducing inflow peaks and nutrient concentrations to downstream marsh.

The flushing of the marsh provides a means by which deposited material (dead vegetation) is removed. By altering the present cycle with an outlet structure, buildup of material may occur. There is no clear answer as to how long a given marsh can be made to assimilate nutrients.

TOPIC: 1.3.2

AUTHOR(S): Andrews, D; Frossard, W; Mancini, JL; Plummer, AH Jr; Mokry, LE

DATE: 1994

TITLE: Use of constructed wetlands to supplement and protect a north central Texas water supply

ORGANIZATION: Tarrant County Water Control and Improvement District Number One, Route 1, Box 1660, Streetman, TX 75859, USA

SOURCE: LAKE RESERV. MANAGE., vol. 9, no. 2, p. 51, 1994

ABSTRACT: The Tarrant County Water Control and Improvement District Number One (TCWCID) supplies raw water to meet the needs of more than 1.2 million people in the North Central Texas area. The TCWCID, in conjunction with the Texas Water Development Board, completed the development of a Regional Water Supply Plan which projects water supply requirements through the year 2050 and identifies a need for a new water supply by the year 2016. The water supply alternative selected for further consideration involves diverting water from the Trinity River at a location about 80 river miles below the Dallas and Fort Worth metroplex into two existing water supply reservoirs to supplement their existing yield. At that location the river is made up of treated effluent, runoff from urban areas, runoff from rural areas, and natural spring flow. It is noted that during summer periods, the Trinity River in the metroplex are is more than 90 percent treated effluent. The TCWCID has undertaken a research project to demonstrate the effectiveness of constructed wetlands to treat the Trinity River water prior to it being introduced into the reservoirs. The specific objective of the project is: to provide removal efficiency data of wetlands cells for nutrients (P and N), Heavy metals, total suspended solids (TSS), fecal coliforms, and toxic organics; to test suitability of aquatic macrophytes plants and communities based on removal efficiencies for contaminates, seasonality of removal efficiencies, and adaptation of aquatic macrophytes to constructed wetland environments; to determine if harvesting is necessary for long-term contaminant removal; and, to determine long-term effectiveness of constructed wetlands contaminant removal. In addition to evaluating the constructed wetlands in treating the river water to supplement the water supply, the constructed wetlands is also being evaluated to determine the effectiveness to serve as a Best Management Practice to treat runoff entering a water supply reservoir.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Athanas, C.

DATE: 1988

TITLE: Wetlands creation for stormwater treatment.

ORGANIZATION:

SOURCE: pp.61-66 In: J. Zelanzny and J.S. Feierabend (eds.) Increasing Our Wetland Resources, National Wildlife Federation. Washington, D.C.

ABSTRACT: There is a good deal of interest these days in using non-tidal wetlands to treat urban stormwater runoff. Much of this interest arises from the recognition that, apart from their possible water quality functions, wetlands can be valuable components of the landscape. Potential functions of wetlands in the landscape include groundwater recharge and discharge, floodflow alteration, and habitat value (Adamus et al., 1987). Since urban areas are important sites for using non-tidal wetlands to treat stormwater runoff, additional wetland functions might include community aesthetics and education.

The wetlands I am discussing are artificial, or created freshwater, non-tidal wetlands. Creating wetlands avoids the potential problem of changing existing wetlands in some way when the hydrologic, sediment, and nutrient regimes are altered by new inputs of stormwater runoff. Before discussing artificial wetlands, however, some background on the treatment of stormwater runoff is necessary. Watershed development, a common occurrence in urban areas, results in increased rates of stormwater runoff. In addition, the urban environment is a source of pollutants which are carried with the runoff into surface waters (US EPA 1983). Increased rates of runoff can result in downstream erosion, while pollutants may impact the biology of downstream areas.

A primary method of treating urban stormwater runoff is to channel the runoff into a basin with an outlet that is smaller than the inlet. This has two results. First, the rate of runoff is reduced. Second, the detention of runoff in the basin may, if of sufficient length, result in the sedimentation of particulate material. Thus these basins can both reduce downstream erosion and remove some of the particulate pollutant load carried by stormwater runoff. Increasing the detention time of the runoff in the basin to 12 hours or more by further reducing the size of the outlet (extended detention) will result in further sedimentation (Metropolitan Washington Council of Governments 1983).

Short-term detention does not seem to affect the dissolved pollutant load of stormwater runoff, however (Metropolitan Washington Council of Governments 1983). Dissolved inorganic and organic nitrogen and phosphorus do not settle out of the detained runoff, but instead must be removed by biological processes.

TOPIC: 1.3.2

AUTHOR(S): Athanas, C. and Shaver, E.

DATE: 1988

TITLE: The Creation and Use of Wetlands for Stormwater Treatment.

ORGANIZATION:

SOURCE: Wetland Hydrology: Proc. of the National Wetland Symposium, Sept. 1987, Chicago, IL. Assoc. of State Wetland Managers, Berne, NY.

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Athanas, C. and Stevenson, C.

DATE: 1991

TITLE: The Use of Artificial Wetlands in Treating Stormwater Runoff.

ORGANIZATION:

SOURCE: Sediment and Stormwater Administration. Maryland Department of the Environment.

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Bartel, R.L. and Maristany, A.E.

DATE: 1989

TITLE: Wetlands and Stormwater Management: A Case Study of Lake Munson. Part II: Impacts on Sediment and Water Quality.

ORGANIZATION:

SOURCE: Proceedings of a Symposium of the American Water Resources Association, Bethesda, Maryland

ABSTRACT:

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Barten, J.

DATE: 1987

TITLE: Nutrient Removal from Urban Stormwater by Wetland Filter: Effects on the Water Quality of Clear Lake

ORGANIZATION:

SOURCE: Lake Line, N.A. Lake Management Society. 3(3):6-7.10-11

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Barten, J.M.

DATE: 1983

TITLE: Nutrient Removal from Urban Stormwater by Wetland Filtration. The Clear Lake Restoration Project.

ORGANIZATION:

SOURCE: Presented at the fourth annual meeting of the Society of Wetland Scientists, June 5-8, 1983, St. Paul, MN.

ABSTRACT: Clear Lake is a 257 ha body of water located in southcentral Minnesota. It is a heavily utilized recreational lake which has become severely eutrophic due to the inflow of nutrient rich urban runoff from the adjacent City of Waseca, Minnesota. In 1981, 50% of the hydraulic load and 55% of the phosphorus load to the lake was diverted into a 21.4 ha peat marsh on the northwest corner of Clear lake. A series of ditches and Dikes were constructed in the marsh to retain stormwater until the P could be removed by percolation through the peat. The filtered water was then pumped into Clear Lake. The filtration system was designed to allow for harvesting of vegetation in the marsh to prevent saturation of the P adsorption sites in the peat. In 1981, 73.3 x 10(4)m³ of water were filtered through the system and 258.6 kg of P removed. In 1982, 89.6 x 10(4)m³ of water were filtered and 526.7 kg of P removed. The primary P removal mechanisms were physical entrapment and plant uptake. The total quantity of P removed in 1982 amounts to 40% of the average load to Clear Lake. Mean a, total P and chlorophyll a concentrations in Clear Lake decreased significantly following diversion of stormwater to the marsh.

TOPIC: 1.3.2

AUTHOR(S): Barten, John

DATE:

TITLE: Stormwater Runoff Treatment in a Wetland Filter: Effect on the Water Quality of Clear Lake

ORGANIZATION:

SOURCE: Stormwater Management and Treatment, Lake and Reservoir Management: Vol III

ABSTRACT: Stormwater runoff was treated using a wetland filter. Phosphorus removal efficiencies provided. No cost data.

TOPIC: 1.3.2

AUTHOR(S): Bastian, R.K. and Benforado, J.

DATE: 1988

TITLE: Water Quality Functions of Wetlands: Natural and Managed Systems.

ORGANIZATION:

SOURCE: The Ecology and Management of Wetlands, vol.1 Ecology of Wetlands, Hook, D.D. et al. (eds.) . Timber Press, Portland, OR.

ABSTRACT:

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Bautista, MF; Geiger, NS

DATE: 1993

TITLE: Wetlands for Stormwater Treatment

ORGANIZATION: Scientific Resources, Inc., Lake Oswego, Oregon

SOURCE: Water Environment & Technology WAETEJ, Vol. 5, No. 7, p 50-55, August 1993. 4 fig, 2 tab.

ABSTRACT: Developers of a residential site on Lacamas Lake (Washington) used a wetland system to treat stormwater runoff from the lake watershed, so that the quality and quantity of stormwater runoff would not exceed predevelopment conditions. Resultant water quality problems in the lakes include severe dissolved oxygen depletion, poor water clarity, and extensive algal growth, particularly during the high-use summer recreational months. Phosphorus is the limiting nutrient controlling the amount of plant growth in the lake. The Lacamas Lake wetlands biofilter was designed to release the collected stormwater to the wetland area at noneroding velocities (<0.304 m/sec). French drains, or bubblers, were designed to direct runoff below grade and create a sheet flow several centimeters deep that enters the upgradient edge of the emergent wetlands. The monitoring plan was designed to obtain baseline water quality data for surface water and groundwater entering and exiting the wetlands, determine the effectiveness of the wetland system as a biofilter for stormwater runoff, and establish criteria for implementing contingency plans if water quality data indicated unacceptable levels. During monitoring, stormwater was collected and distributed to the wetland so that the parameters of concern could be monitored at specific points as the water flowed into and out of the wetlands. Sampling consisted of routine field measurements for temperature, conductivity, pH and groundwater depths, and analyses of nutrient concentrations and total suspended solids (TSS). In the third and fourth years, a trend between the average annual inflow and outflow concentrations was apparent. Primary parameters and secondary TSS measured at outflows were less than inflow concentrations, indicating that the wetlands were removing nutrients and solids from stormflow runoff. The bubbler systems appear to be reducing concentrations of phosphorus from the development to levels below site-specific criteria. Future compliance with water quality criteria may entail alterations of the wetlands to optimize treatment. (Brunone-PTT)

TOPIC: 1.3.2

AUTHOR(S): Bedford, B.L., and E.M. Preston (eds.).

DATE: 1988

TITLE: Cumulative Effects on Landscape Systems of Wetlands. Scientific Status, Prospects, and Regulatory Perspectives.

ORGANIZATION:

SOURCE: Environmental Management Volume 12, Number 5.

ABSTRACT: This entire issue of Environmental Management contains many excellent papers on assessing cumulative impacts on wetland hydrology, water quality and wildlife. Most of the abstracts in the issue are referenced in this bibliography.

TOPIC: 1.3.2

AUTHOR(S): Bedford, B.L., and E.M. Preston.

DATE: 1988

TITLE: Developing the Scientific Basis for Assessing Cumulative Effects of Wetland Loss and Degradation on Landscape Functions: Status, Perspectives, and Prospects.

ORGANIZATION:

SOURCE: Environmental Management 12(5):751-771.

ABSTRACT: The incongruity between the regional and national scales at which wetland losses are occurring, and the project-specific scale at which wetlands are regulated and studied, has become obvious. This article presents a synthesis of recent efforts by the U.S. Environmental Protection Agency and the Ecosystems Research Center at Cornell University to bring wetland science and regulation into alignment with the reality of the cumulative effects of wetland loss and degradation on entire landscapes and regions. The synthesis is drawn from the other articles in this volume, the workshop that initiated them, and the scientific literature. It summarizes the status of our present scientific understanding, discusses means by which to actualize the existing potential for matching the scales of research and regulation with the scales of research and regulation with the scales at which effects are observed, and provides guidelines for building a stronger scientific base for landscape-level assessments of cumulative effects. It also provides the outlines for a synoptic and qualitative approach to cumulative effects assessment based on a re-examination of the generic assessment framework we proposed elsewhere in this volume.

The primary conclusion to be drawn from the articles and the workshop is that a sound scientific basis for regulation will not come merely from acquiring more information on more variables. It will come from recognizing that a perceptual shift to larger temporal, spatial, and organizational scales is overdue. The shift in scale will dictate different--not necessarily more--variables to be measured in future wetland research and considered in wetland regulation.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Benforado, J.

DATE: 1981

TITLE: Ecological considerations in wetland treatment of wastewater.

ORGANIZATION:

SOURCE: Pp. 307-323, In: B. Richardson, (ed.), Selected Proceedings of the Midwest Conference on Wetland Values and Management. St. Paul, MN., June 17-19.

ABSTRACT: The use of natural and artificially created wetlands for wastewater discharge of treatment offers potential to reduce costs, conserve energy, and reclaim wastewater constituents, when compared with conventional "high technology" sewage treatment. Benefits can include preservation of open space, potential for wildlife enhancement, flow stabilization, and more. However, ecological problems should be identified early in the development of wetland/wastewater technology. Technical issues include: health concerns for both humans and wildlife (eg. viral, bacterial, and nuisance insects); food chain effects of toxic substances (eg. biomagnification of heavy metals synthetic organic chemicals, effect of surfactants on invertebrate populations); adverse community changes (eg. accelerated succession, eutrophication, species changes, etc.); effects on fish and wildlife values (eg. shellfish contamination, botulism in waterfowl, effect of chlorine compounds on fish, beneficial effects such as habitat enhancement); effects on other wetland functions and values (eg. flood control, aesthetics, recreation); and long term changes (eg. cumulative effects).

Developing a sound policy on the use of wetland treatment systems is vital. Management guidelines and water quality standards must be developed that will allow for treatment, yet protect wetland functions and values. Four areas of study -- engineering design constraints, impact pathways, ecological effects, and management potential-- provide a framework for developing such a policy. It seems prudent at this time to limit the general application of wetland treatment technology to artificially constructed wetlands and (in appropriate circumstances) to highly degraded natural wetlands; in the latter case, the overall objective should be to restore and enhance the wetland. Management of natural wetlands should optimize a combination of wetland values, rather than maximize sewage treatment capability.

TOPIC: 1.3.2

AUTHOR(S): Blackburn, R., et al

DATE: 1985

TITLE: Treatment of Stormwater Runoff Using Aquatic Plants

ORGANIZATION: NPBC/FL

SOURCE: Palm Beach County Water Control District, West Palm Beach, FL.

ABSTRACT: Man-made wetlands used to treat stormwater runoff. Efficiency data for TSS, TN and TP provided.

TOPIC: 1.3.2

AUTHOR(S): Blackburn, R.D., et. al.

DATE: 1985

TITLE: Proceedings of a Conference on Wetland Restoration and Creation.

ORGANIZATION:

SOURCE:

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Boto, K.G., and W.H. Patrick, Jr.

DATE: 1978

TITLE: Role of Wetlands in the Removal of Suspended Sediments.

ORGANIZATION:

SOURCE: pp. 479-489 in: P.E. Greeson et al. (eds.) 1978, Wetland Functions and Values: The State of Our Understanding. American Water Resources Association, Minneapolis, MN.

ABSTRACT: One of the major functions of wetlands is the removal of suspended sediment from water moving through wetlands. Flow rate is decreased as the water moves more by sheet flow than by channel flow, and the resulting decrease in velocity and the presence of vegetation promote fallout of suspended particles. The effect of salt water in estuaries mixing is to further enhance sediment removal by fluctuation of clay particles. Transfer of the suspended sediment and the associated dissolved materials from the water column to the land surface has important consequences both for the quality of the water and the properties and functions of the wetland. In areas where the land surface is subsiding, sediment removal from water is essential for maintaining the marsh surface. With increase in toxicant load of water reaching wetlands, they are serving more than in the past as a sink for materials of known toxic effects on biota. The long-term consequences of the effect are poorly understood and deserve study.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Bouchard, R.; Higgins, M.J.; Rock, C.A., and Jolley, J.W.

DATE: 1986

TITLE: The Role of Constructed Wetland-Pond Systems in Watershed Management.

ORGANIZATION:

SOURCE: Presented at the N.A. Lake Management Soc. 11th Intl. Symp.

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Boule, M.E., N. Olmsted, and T. Miller.

DATE: 1983

TITLE: Inventory of Wetland Resources and Evaluation of Wetland Management in Western Washington.

ORGANIZATION:

SOURCE:

ABSTRACT: The purpose of this study was threefold: 1) To develop a comprehensive inventory of wetlands and determine the trends in wetlands development during the last 100 years in western Washington; 2) To evaluate the effectiveness of the Shoreline Management Act (SMA) in protecting the wetlands of western Washington; and 3) To identify improvements to SMA and other programs which might increase the effectiveness of wetlands protection efforts.

Existing information in the form of maps, reports, and inventories were used to prepare the inventory and analyze the trends in wetland losses. A questionnaire and interviews with local shoreline planners were the principal information sources used to evaluate the Shoreline Management Act.

The inventory covers approximately 46% of the 12,000,000 acres in the 15 coastal counties of western Washington. Almost 235,000 acres of wetland habitats were identified in that area, of which about 67,000 acres are vegetated wetlands (marshes and swamps); the remainder are open water, unvegetated shore, or aquatic bed habitats. About one-third of the vegetated wetlands of western Washington are estuaries marshes. Another one-third are forested and shrub swamps. Emergent estuaries wetlands tend to be much larger than palustrine emergent wetlands. There are a greater number of palustrine wetlands, however. As a result, the total area of palustrine wetlands is much greater than estuaries wetlands in western Washington.

The jurisdiction of both federal (Section 404) and state (SMA) regulations governing development activities in wetlands is determined by mean annual flows; thus, the size of the watershed supporting a wetland area often determines whether it is protected. Using runoff calculations, it is possible to estimate which wetlands would be regulated under which programs. In King County, for example, 500 distinct wetlands encompassing over 6,600 acres are not protected by either the SMA or Corps 404 jurisdiction. This comprises 76% of the total palustrine wetlands in King County. If this trend holds for all counties, large areas of wetlands are presently unprotected.

The trends analysis indicates several types of development activities have been responsible for decreases in wetlands in western Washington. The rich organic soils of palustrine and tidal freshwater wetlands made them prime areas for conversion to agricultural uses at the time of early settlement. In a few areas (notably, the Duwamish and Puyallup estuaries) the demand for industrial development led to conversion of estuaries -wetlands to port facilities. In the Snohomish Estuary, as much as 150 acres per year were converted to agricultural uses; in Commencement Bay, an average of 75 acres per year were filled. The trend of wetland loss has slowed substantially since 1949 in most areas; however, the wetlands of Commencement Bay and the Duwamish Estuary have been virtually eliminated. The coastal bays, Willapa and Grays Harbor, showed more dramatic changes in wetlands since 1931 with little loss prior to that time. The coastal systems show both increases and losses of wetlands over time, as a result of dredging or filling activities and natural changes altering these areas. Many lake shore wetlands have been dredged or filled as part of residential development around the lakes.

Interviews with over 30 shoreline planners indicated a general satisfaction with Shoreline Master Programs with respect to protection of coastal wetlands. Many of them, however, were interested in expanding the jurisdiction, recognizing that many wetlands were not protected. Other concerns which were raised included difficulties with the definition of "associated wetlands" and coordination problems with state and federal agencies. The planners offered numerous suggestions about improvements they would like in the shoreline management process.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Boule, M.E., R.D. Kranz, and T. Miller.

DATE: 1985

TITLE: Annotated wetland bibliography of the State of Washington.

ORGANIZATION:

SOURCE: Prepared by Shapiro & Associates, Inc., Seattle, for the U.S. Army Corps of Engineers, Seattle District.

ABSTRACT: This book contains a bibliography of 351 references with detailed annotations and an index that organizes the references by key words. The Corps of Engineers commissioned the work in order to organize the substantial amount of information they use in processing permit applications for activities in wetlands. The bibliography contains a wealth of references on wetland inventories in Washington, delineation of wetland boundaries, wetland legislation, and wetland values; there are also references concerning wetland issues on the national level.

TOPIC: 1.3.2

AUTHOR(S): Bowmer, K.H.

DATE: 1987

TITLE: Nutrient removal from effluent by an artificial wetland - influence of rhizosphere aeration and preferential flow studies using bromide and dye tracers.

ORGANIZATION:

SOURCE: Water Research 21(5): 591-599.

ABSTRACT: Sewerage and effluents from rural industry can be treated by percolation through the root zones of emergent macrophytes growing in a gravel substratum. The hydrology of these systems is complex, being driven by both gravity and transpiration, and so measurements of nutrient transformations within the systems are complicated by incomplete mixing. Pulse addition of dye and bromide tracers concurrently with nutrients, has been used in one such experimental artificial wetland to investigate the rates and processes of nutrient removal. The tracer was used for comparison to compensate for incomplete mixing and concentration caused by evapotranspiration. Nitrogen removal efficiency is dependent on sequential mineralization of organic nitrogen to ammonium-nitrogen, followed by nitrification of the ammonium to nitrate or nitrite and denitrification of nitrate or nitrite to gaseous nitrogen products. The effluent from a rendering plant was dominated by organic and ammonium-nitrogen, and efficiency of nitrogen removal was probably impaired by inadequate rates of mineralization and nitrification. Aeration is required for the latter process. Apparently the macrophytes were not introducing sufficient oxygen into the effluent for nitrification to be complete. This may reflect an inadequate outward radial diffusion of oxygen into the rhizosphere, or the effects of channelling of the effluent in preferential flow paths around the aerating root masses, requiring changes in system design.

TOPIC: 1.3.2

AUTHOR(S): Bowmer, KH

DATE: 1993

TITLE: Wetlands in Urban Water Systems--Feasible or Fashionable

ORGANIZATION: CSIRO, Griffith Lab., Australia. Div. of Water Resources

SOURCE: CSIRO, Griffith Lab., Australia. Div. of Water Resources. Technical Memorandum 93/12, June 1993. 9p, 1 fig, 7 ref.

ABSTRACT: For the Commonwealth Scientific and Industrial Research Organization (CSIRO) Urban Water Systems Research Program Scoping Workshop, held in Adelaide, March 1993, the features of various types of wetlands were described. These include: natural systems; constructed wetlands with floating or emergent plants; sewage lagoons; buffer strips and vegetated waterways; urban lakes and gross pollutant traps; and a levee system to divert a whole river system. Potential functions of wetlands would include controlling flow regime and improving water quality through the removal of biochemical oxygen demand, P, N, metals, toxic compounds, pathogens, and organic compounds. Generally, wetlands are not effective alone, and need to be integrated with other methods of treatment and storage (for example, for treating effluent from intensive rural industry). Monitoring physico-chemical parameters will be very demanding because of the potential variation in performance with season, flow, and changes to management. Good management practice will also be very difficult to assess and implement because of the large range of site-specific and effluent-specific considerations. (Lantz-PTT)

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Boyt, F.L., S. Bayley, and J. Zoltek, Jr.

DATE: 1977

TITLE: Removal of nutrients from treated municipal wastewater by wetland vegetation.

ORGANIZATION:

SOURCE: Journal WPCF 49: 789-799.

ABSTRACT: treated wastewater from Wildwood for 20 years, was examined to determine the effectiveness of the swamp in removing nutrients from wastewater. After flowing through the experimental swamp, the nutrient concentration of the water was less than the concentration of nutrients found in the control swamp and in Lake Panasoffkee, the final receiving body. Water samples throughout the experimental and control swamp were examined for pathogenic bacteria. Wetlands may be used as an alternative to tertiary treatment especially to increase nutrient removal.

TOPIC: 1.3.2

AUTHOR(S): Brinson, M.M.

DATE: 1988

TITLE: Strategies for Assessing the Cumulative Effects of Wetland Alternation on Water Quality.

ORGANIZATION:

SOURCE: Environmental Management 12(5):655-662.

ABSTRACT: Assessment of cumulative impacts on wetlands can benefit by recognizing three fundamental wetland categories: basin, riverine, and fringe. The geomorphological settings of these categories have relevance for water quality.

Basin, or depressional, wetlands are located in headwater areas, and capture runoff from small areas. Thus, they are normally sources of water with low elemental concentration. Although basin wetlands normally possess a high capacity for assimilating nutrients, there may be little opportunity for this to happen if the catchment area is small and little water flows through them.

Riverine wetlands, in contrast, interface extensively with uplands. It has been demonstrated that both the capacity and the opportunity for altering water quality are high in riverine wetlands.

Fringe wetlands are very small in comparison with the large bodies of water that flush them. Biogeochemical influences tend to be local, rather than having a measurable effect on the larger body of water. Consequently, the function of these wetlands for critical habitat may warrant protection from high nutrient levels and toxins, rather than expecting them to assume an assimilatory role.

The relative proportion of these wetland types within a watershed, and their status relative to past impacts can be used to develop strategies for wetland protection. Past impacts on wetlands, however, are not likely to be clearly revealed in water quality records from monitoring studies, either because records are too short or because too many variables other than wetland impacts affect water quality. It is suggested that hydrologic records be used to reconstruct historical hydroperiods in wetlands for comparison with current, altered conditions. Changes in hydroperiod imply changes in wetland function, especially for biogeochemical processes in sediments. Hydroperiod is potentially a more sensitive index of wetland function than surface areas obtained from aerial photographs. Identification of forested wetlands through photointerpretation relies on vegetation that may remain intact for decades after drainage. Finally, the depositional environment of wetlands is a landscape characteristic that has not been carefully evaluated nor fully appreciated. Impacts that reverse depositional tendencies also may accelerate rates of change, causing wetlands to be large net exporters rather than modest net importers. Increases in rates as well as direction can cause stocks of materials, accumulated over centuries in wetland sediments, to be lost within decades, resulting in nutrient loading to downstream aquatic ecosystems.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Brinson, M.M. and F.R. Westall.

DATE: 1983

TITLE: Application of Wastewater to Wetlands.

ORGANIZATION:

SOURCE: Water Resources Research Institute Report No. 5, Land Treatment Series. North Carolina State University, Raleigh, NC. 27 pp. PB84190388

ABSTRACT: The fifth of a series of five reports dealing with land (and wetland) treatment of wastewater and sludge under the general guidance of a task force representing North Carolina regulatory agencies and universities. Draft reports were critiqued by other specialists and practitioners at a regional conference before publication. This report reviews the status of wetland treatment technology and examines its potential application in North Carolina and similar areas. Wetlands are viewed as valuable natural resources whose use for wastewater treatment should be limited to careful treatment in the context of water quality improvement and not disposal. The report differs considerably from the other reports in this series in a more incomplete state of the art and the fact that wetlands contribute to water quality improvement in their natural state, provide valuable wildlife habitat, and function as important buffer zones between upland runoff and down stream receiving waters. Part I (Natural Wetlands) covers wetland types, hydrology, functional properties, and mechanisms of water quality improvement; Part II (Regulation, Planning and Engineering) deals with regulatory issues, planning and design considerations, and artificial wetlands. An appendix lists references and additional readings.

TOPIC: 1.3.2

AUTHOR(S): Brinson, M.M., A.E. Lugo, and S. Brown.

DATE: 1981

TITLE: Primary Productivity, Decomposition and Consumer Activity in Freshwater Wetlands.

ORGANIZATION:

SOURCE: Ann. Rev. Ecol. Syst. 12:123-61.

ABSTRACT: This review discussed energy flow through freshwater wetland ecosystems, including forested and nonforested types. Findings from studies of a variety of wetland types around the United States were incorporated. In addition to solar energy, auxiliary energy sources considered were water flow, water level fluctuation, and nutrient inputs. Biological activities discussed include primary productivity, decomposition of organic matter, consumer activity, and export of organic materials for consumption in other ecosystems. Among the findings of the review were that while both forested and nonforested wetlands exhibit similar rates of gross primary productivity, forested wetlands have lower rates of net biomass production. Wetlands appear to respond quickly to changes in water level, temperature, and salinity, and are tightly coupled to upstream and downstream ecosystems. They contain many complex pathways of energy flow and feedback mechanisms involving nutrient recycling and interspecific relationships.

TOPIC: 1.3.2

AUTHOR(S): Brodrick, S. J., P. Cullen, and W. Maher.

DATE: 1988

TITLE: Denitrification in a Natural Wetland Receiving Secondary Treated Effluent.

ORGANIZATION:

SOURCE: Water Research 22(4):431-439.

ABSTRACT: The potential of a natural wetland as a site for nitrogen removal from secondary treated effluent was examined by investigating the distribution of denitrification rates and activity in soils and decaying plant material. Field measurements of soil Eh, pH and temperature showed that the effluent inflow favours denitrification by lowering Eh, maintaining pH 6.4-6.7, and raising soil temperature. Analysis of soil concentrations of nitrate plus nitrite and ammonium ions shows that the effluent inflow increased the concentrations of inorganic nitrogen in the soil, and encouraged higher rates of denitrification. Denitrification rates measured by acetylene blockage technique were highest in soil samples from downstream of the effluent inflow, with the maximum rates being recorded in soils from 0 to 60 cm and in decaying plant material lying on the soil surface. Both nitrate plus nitrite concentration and denitrification activity declined rapidly below 6 cm in upstream and downstream soil samples. Denitrification rates in the natural wetland are increased by the addition of secondary treated effluent, and make a year-round contribution to the removal of nitrogen from the wastewater. Rates of nitrogen removal in the wetland could be increased by encouraging greater spatial and temporal interaction of the effluent amended water with the sites of highest denitrification activity.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Brooks, R.P.; Croonquist, M.J.; D'Silva, E.T.; Gallagher, J.E.; Arnold, D.E.

DATE: 1991

TITLE: Selection of Biological Indicators for the Integrating Assessments of Wetland, Stream, and Riparian Habitats.

ORGANIZATION:

SOURCE: Biological Criteria: Research and Regulation. pp. 81-89

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Brown, R.G.

DATE: 1985

TITLE: Effects of Wetlands on Runoff Entering Lakes in the Twin Cities Metropolitan Area.

ORGANIZATION:

SOURCE: Freshwater Wetlands, Urban Stormwater, and Nonpoint Pollution Control : A Literature Review and annotated Bibliography. Washington State Dept. of Ecology.

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Brown, R.G.

DATE: 1984

TITLE: Effects of an Urban Wetland on Sediment and Nutrient Loads in Runoff.

ORGANIZATION:

SOURCE: Wetlands 4: 147-158.

ABSTRACT: An urban wetland in the Minneapolis-St. Paul Metropolitan Area was found to retain sediment and nutrient loads in runoff routed through the wetland. Sediment and nutrient loads in runoff were measured during 1982 at the inlet and outlet of the 6.4-hectare urban wetland. Comparison of annual loads entering and leaving the wetland showed that retention of incoming loads in the wetland was 97 percent of nonvolatile suspended solids, 76 percent of volatile suspended solids, 48 percent of total phosphorus, 4 percent of dissolved phosphorus, 3 percent of dissolved nitrite plus nitrate nitrogen, 1 percent of total ammonia nitrogen, and 47 percent of total organic nitrogen. Flow volume was increased on an annual average basis by 5 percent between the wetland inlet and outlet. Most retention of sediment and nutrient loads occurred between late April and mid-July.

Retention of sediment and nutrient loads in the wetland was associated with sedimentation processes. Dissolved nutrients generally were not retained in the wetland because the residence time of water passing through was not long enough for removal by biological processes. Effectiveness of the wetland in retaining sediment and nutrient loads in runoff varies annually. Long-term and short-term impacts of the retention of sediment and nutrients in the wetland on wetland flora and fauna are unknown.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Brown, R.G.

DATE: 1985

TITLE: Effects of Wetlands on Quality of Runoff Entering Lakes in the Twin Cities Metropolitan Area, Minnesota.

ORGANIZATION:

SOURCE: U.S. Geological Survey, Water Resources Investigations Report 85-4170.

ABSTRACT: Four wetlands were compared with respect to their effectiveness in decreasing suspended solids and nutrient concentrations in runoff to lakes immediately downstream from the wetlands. An artificial impoundment in one of the wetlands increased settling of suspended solids. A decrease of nutrients in this wetland was probably the result of high assimilation rates associated with a dense stand of cattails.

Two of the other three wetlands consist of open water and land areas, both of which contain abundant vegetation. Drainage from land areas within the wetlands may have lowered the overall effectiveness of the wetlands in decreasing sediment and nutrient concentrations.

The third wetland was a constructed wetland that was ineffective in decreasing sediment or nutrient concentrations, because its storage capacity was too small to prevent flushing of accumulated sediment. Sediment concentrations in discharge from this wetland were as much as 22 times greater than the already high sediment concentrations in the inflow.

Further investigations of mineral cycling and sedimentation processes in the wetlands are needed to substantiate these conclusions and to understand the long-term effects of accelerated inputs of suspended solids and nutrients on wetland flora and fauna.

TOPIC: 1.3.2

AUTHOR(S): Burns, L.A., and R.B. Taylor.

DATE: 1979

TITLE: Nutrient-uptake Model in Marsh Ecosystems.

ORGANIZATION:

SOURCE: ASCE Proceedings, vol 105, No. TC1, April 1979.

ABSTRACT: The impact of flood-control projects and construction works on wetlands is a nationwide issue. Wetlands are valuable as wildlife habitat, and their ability to sequester nutrients offers cost advantages over tertiary treatment of waste loadings. This study investigates the water-quality benefits that could accrue from careful management of wetlands in Florida's Kissimmee River basin.

It appears that natural flood-plain marshes can sequester approx 50% of peak wet season nutrient loadings and approx 75% of total yearly load, at least when the load is primarily in dissolved inorganic forms. Equivalent benefits could be expected from extant marshes in the Kissimmee basin if operated under a prechannelization hydrologic regimen, with a reduction of total P exports from the basin to Lake Okeechobee.

TOPIC: 1.3.2

AUTHOR(S): Burton, T.M., and K.E. Ulrich.

DATE: 1983

TITLE: Establishment and Management of Freshwater Marshes for Maximum Enhancement of Water Quality Reuse.

ORGANIZATION:

SOURCE: Michigan State Univ., East Lansing Dept. of Zoology. OWRT-B-055-Mich(1).

ABSTRACT: The objective of this study was to provide information (1) on growth and nutrient uptake responses of marsh plants to variable loading rates of N, P, and K and (2) on the response of these plants to various harvest regimes as background information for the design, maintenance, and operation of natural or artificial marshes for water quality enhancement.

Five species of highly productive common marsh plants were grown in large pots with various loading rates of N, P, and K plus an excess of other necessary plant nutrients. The five species were the common reed (*Phragmites australis*), wild rice (*Zizania aquatica*), two species of cattail (*Typha latifolia* and *T. angustifolia*), and burreed (*Sparganium eurycarpum*). In general, all five species responded with increased growth to increases of N and P alone or especially in combination up to a maximum of 468 kg N/ha and 125 kg P/ha. The two species of cattail were the most productive of the five species at higher loading rates. The K contained in the low nutrient sand medium used in these experiments was adequate for growth of all species, and added K caused little or no increase in growth.

Experiments on establishment and harvest of these five species plus prairie cordgrass (*Spartina pectinata*) were attempted. Successful establishment and harvest of the two species of cattail and burreed was achieved. These three species only tolerated one harvest per year; multiple harvesting led to decline in biomass the following year. Nutrient budgets for three artificial marshes indicated excellent removal of N by these marshes, but little P removal occurred.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Carlson, L.

DATE: 1989

TITLE: Artificial Wetlands for Stormwater Treatment: Processes and Design.

ORGANIZATION:

SOURCE: Rhode Island Nonpoint Source Management Program. Providence, RI.

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Carr, D.W. and B.T. Rushton

DATE: 1995

TITLE: Integrating a native marsh into stormwater management: Final Report

ORGANIZATION:

SOURCE: Southwest Florida Water Management District, 2379 Broad Street, Brooksville, FL 34609. 131 pp

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Carr, DW

DATE: 1994

TITLE: Management of stormwater runoff for water quality using an isolated natural wetland

ORGANIZATION: Southwest Florida Water Manage. Dist., Stormwater Res. Program, 2379 Broad St., U.S. 41 South, Brooksville, FL 34609-6899, USA

SOURCE: LAKE RESERV. MANAGE., vol. 9, no. 2, p. 63, 1994

ABSTRACT: The management of stormwater runoff water quality will become increasingly important into the 21st century as more natural lands succumb to development. Wetlands are a valuable resource for they are natural water quality filters and enhance groundwater recharge. Utilizing certain natural wetlands for stormwater treatment was approved by the Florida legislature in 1984 (Chapter 17-25, Florida Statutes). Despite legislative approval, the ability of natural wetlands to treat stormwater as well as the extent to which the wetlands themselves are effected have been questioned. Two objectives of the study were: 1) to assess the effectiveness of a natural wetland to treat stormwater runoff and 2) to document the effect of stormwater treatment on wetland vegetation. Flow-weighted water quality samples were taken at each inflow and outflow as well as rainfall and pollutant load removal efficiencies were calculated. Two detailed vegetation analyses were conducted during the study and results were reported as percent cover. During the two and one-half year study, eighty-three storm events were sampled for water quality. Dry season pollutant removal was better than the wet season. Pollutant removal during the 1992/1993 period (wet & dry seasons) was better than 1991/1992. Negative Fe (-15%) and Mn (-44%) mean removal efficiencies were detected during the wet seasons. Negative TKN (-5%), TON (-12%) and Fe (-8%) mean removal efficiencies were detected during the 1991/1992 period. A total of 34 and 40 plant species were observed during the 1992 and 1993 detailed vegetation analyses respectively. Dominant species (including cover types) were Panicum hemitomon, open water, Pontederia cordata, litter and Nymphaea odorata. Physical alteration to the south edge of the wetland and construction of a sediment basin facilitated establishment of Typha latifolia, Typha domingensis, Ludwigia peruviana and Mikania scandens (nuisance plant species). None of these nuisance species were observed at the natural north edge.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Carter, V., and R.P. Novitzki

DATE: 1988

TITLE: Some comments on the relation between groundwater and wetlands.

ORGANIZATION:

SOURCE: p. 68-86 in: Hook, D.D., et al. (eds.) The Ecology & Management of Wetlands. Volume 1. Timber Press, Portland, OR.

ABSTRACT: One frequently stated myth used as a justification for wetland preservation is that "wetlands are ground water recharge areas". This statement is true for some wetlands but invalid for many others. Actually, the relation between ground water and wetlands can be exceedingly complex. Recharge and discharge are natural processes that occur throughout the landscape (Sather and Stuber, 1984; Carter, 1986). The magnitude and timing of these processes depend upon such variables as the interrelation between local, intermediate and regional ground-water flow systems, position of local water table, geologic setting, ratio of vertical to horizontal hydraulic conductivity in the basin, depth and width of the basin, local slope and relief, and location of ground-water divides.

Calculation of hydrologic and nutrient budgets for wetlands requires serious consideration of ground-water inputs and outputs (Winter, 1978b; LaBaugh, 1986). These inputs and outputs are critical to the existence and maintenance of wetlands, and it is desirable to understand and quantify them because of their importance to water chemistry, water supply, aquifer replenishment and wetland function (Sather and Stuber, 1984). Until recently, there have been relatively few studies made of the relation between ground water and wetlands. In this paper, we briefly summarize the theoretical aspects of recharge and discharge as related to lakes and wetlands and present the results of several recent studies that shed light upon the complex relation between ground water and wetlands. We have not attempted to search out all such studies; those discussed herein are part of ongoing research by us or by our colleagues in the US Geological Survey.

TOPIC: 1.3.2

AUTHOR(S): Chan, E., G. Silverman, and T. Bursztynsky.

DATE: 1982

TITLE: San Francisco Bay Area Regional Wetlands Plan For Urban Runoff Treatment. (Volume I: Plan and Amendments to the Environmental Management Plan).

ORGANIZATION:

SOURCE: Association of Bay Area Governments, Oakland, CA.

ABSTRACT: Surface runoff seasonally contributes 9 percent of the total suspended solids loading to all waters of the San Francisco Bay system and up to 100 percent of the loading to inland waters. A substantial part of the heavy metal load to the bay - up to 63 percent - is primarily associated with this source. The estimated total metals loading is 1.7 million kg/yr (expressed as chronic toxicity equivalent of Chromium) and enters the system in the forms of As, Cd, Cr, Cu, Hg, Ni, Pb and Zn. Estimated concentrations of heavy metals are an order of magnitude higher in surface runoff from urban areas than non-urban areas or Delta outflow. Urban areas are a significant pollutant source of other important urban constituents which include BOD, pesticides, organics and hydrocarbons (oil and grease). In sufficient concentrations, any of these can have damaging effects on aquatic animals and plants in streams, lakes, estuaries and sloughs as well as causing damage to the San Francisco Bay ecosystem.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Chan, E., T.A. Bursztynsky, N. Hantzsche and Y.J. Litwin

DATE: 1981

TITLE: The Use of Wetlands for Water Pollution Control.

ORGANIZATION:

SOURCE: Municipal Environmental Research Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio, 214 pp + appendixes. EPA-6-/S2-82-086, NTIS PB83-107466.

ABSTRACT: An investigation was made of the use of wetlands as treatment mechanisms for urban stormwater runoff. Application of municipal wastewaters and polluted urban runoff to wetlands may potentially provide low-cost water quality protection for many communities. Though the cost of conventional treatment facilities may be difficult to support, development of wetlands for runoff treatment is easy to justify because it meets many community needs (recreation, wildlife and fishery enhancement, recharge of groundwater, and water quality renovation, for example). This report summarizes the current knowledge about the use of wetlands for treating urban stormwater runoff. Wetlands such as marshes, swamps, and artificial wetlands, have been shown to remove selected pollutants from urban stormwater runoff and treated municipal wastewaters. Wetlands have produced reduction in BOD, pathogens, and some hydrocarbons, and excel in nitrogen removal. They have been reported to act as sinks for trace metals, phosphorus, and suspended solids.

Physical pollutant removal mechanisms in wetlands include sedimentation, coagulation, chemical filtration, volatilization, adsorption, and chelation. Vegetative mechanisms include absorption through roots, stems and leaves, filtration and chemical transformations in the plants. Chemical transformations of some water borne pollutants also occur in sediment and the water column as a result of anaerobic or aerobic conditions, the presence of catalysts and reactive substances, and with the aid of microbial action. Although individual plant species have been studied for their pollutant removal properties, the interaction of numerous plant and animal species in pollutant removal in a wetland is not well understood. Management of wetland vegetative systems to optimize pollutant removal requires further investigation.

Further research needs to be conducted on long-term impacts to wetlands, bioaccumulation of trace metals, the interaction of individual pollutant removal mechanisms in various wetland systems, and management techniques for wetlands used as treatment systems.

TOPIC: 1.3.2

AUTHOR(S): Chan, E.; Bursztynsky, T.A.; Hantzsche, N. and Litwin, Y.J.

DATE: 1988

TITLE: The Use of Wetlands for Water Pollution Control.

ORGANIZATION:

SOURCE: U.S. EPA Municipal Environn. Res. Lab.

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Cooke, S.S.

DATE: 1991

TITLE: Wetland Buffers - A Field Evaluation Of Buffer Effectiveness In Puget Sound

ORGANIZATION:

SOURCE: Washington Department of Ecology 150 pp

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Crumpton, W.G.; IsenHart, T.M., and Fisher, S.W.

DATE: 1993

TITLE: The Fate of Nonpoint Source Nitrates Loads in Freshwater Wetlands: Results From Experimental Mesocosms.

ORGANIZATION:

SOURCE: In Constructed Wetlands for Water Quality Improvement, Moshiri, G.A. (ed.), Lewis Publishers.

ABSTRACT:

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Davis, C.B., R.G. Van der Valk, and J.L. Baker.

DATE: 1983

TITLE: The Role of Four Macrophyte Species in the Removal of Nitrogen and Phosphorus from Nutrient Rich Water in a Prairie Marsh, Iowa.

ORGANIZATION:

SOURCE: Madrone 30(3): 133-142.

ABSTRACT: The role of typha glauca, carex atherodes, sparganium eurycarpum and scirpus validus in cycling of nitrogen and phosphorus in a prairie marsh were analyzed at eagle lake which is located in north-central Iowa. Eagle Lake water was analyzed as to influent flow and levels of NH[4], NO[3] and PO[4] and local rainwater was analyzed from N and P content. Shoots were clipped from approximately 300 1 sq.m quadrants over a 10 day period in late July and early August 1976 to compute total standing biomass. Three shoot samples from 50 sq. cm mono-dominant plots for each of the 4 species were collected and analyzed for N and P content. Changes in N and P content and biomass of decomposing litter were studied using standard litter bag techniques between November 1975 and September 1979.

Precipitation contributed 1.5 metric tons of NH[4], .07 of PO[4] and 1.5 of NO[3] while 0.1 of NH[4], .02 of PO[4] and 2.6 of NO[3] reached the influent ditches. The stems of typha contained 8.2 metric tons of N, sparganium 5.8, scirpus 2.2 and carex 1.8 (18.4 metric tons total) and 0.9, 0.4, 0.3 and 0.2 metric tons of P, respectively. During decomposition sparganium litter was less effective than the other 3 in retaining N and P. Carex accumulated N and P while scirpus accumulated N in the first 9 months. All 4 species lost organic matter faster than P and P faster than N. Recovery during the third and fourth years was minimal.

The marsh was a major sink for inorganic N and a minor sink for inorganic P. The dead shoots took several years to decompose fully and N and P were released gradually. The faster loss of biomass was due to microbial uptake of N and P. The litter compartment was the major N and P sink while the major contribution of the shoot compartment was the fresh yearly layer of litter.

TOPIC: 1.3.2

AUTHOR(S): Dawson, B.

DATE: 1989

TITLE: High Hopes for Cattails.

ORGANIZATION:

SOURCE: Civil Engineering CEWRA9, Vol. 59, No. 5, p. 48-50, May 1989.

ABSTRACT: In theory, wetlands are the perfect "wastewater plant" for small communities. In Benton, Kentucky about 1 mgd are cleaned in three different cells, one for cattails, bulrushes, and a mixture of plants. Suspended solids settle to the bottom, creating anaerobic conditions, while aerobic conditions are present around the roots and stalks. Suspended solids, BOD, and fecal coliform counts are all below discharge standards, and nitrogen and phosphorus are also being removed to acceptable standards. Typically, the wetlands consist of shallow, free surface basins with an impermeable liner. In some instances, only one type of plant is sufficient. Other times, combinations of emergent, submerged and floating species are used. The two major problems with man-made wetlands are the large land areas required and concerns about heavy metal accumulation. Wetlands are also being constructed to treat stormwater runoff, refining wastes, polluted rivers, agricultural wastes, and in some cases acid mine wastes. A major advantage of the wetlands system is the low cost when compared with conventional treatment.

TOPIC: 1.3.2

AUTHOR(S): Detenbeck, N.E. and Johnson, C.A.

DATE: 1991

TITLE: Effects of Disturbance on Water-Quality Functions of Wetlands.

ORGANIZATION:

SOURCE: Final Report to Wetlands Water Quality Program, ERL _ Duluth, U.S. EPA. Nat. Resources Res. Institute, Duluth, MN.

ABSTRACT:

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Dickerman, J.A., A.J. Stewart, and J.C. Lance.

DATE: 1985

TITLE: The Impacts of Wetlands on the Movement of Water and Nonpoint Pollutants from Agricultural Watersheds.

ORGANIZATION:

SOURCE: A report to the Soil Conservation Service. USDA ARS Water Quality and Watershed Research laboratory, Durant, Oklahoma.

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Ehrenfeld, J.G.; J.P. Schneider.

DATE: 1983

TITLE: The Sensitivity of Cedar Swamps to the Effects of Nonpoint Source Pollution Associated With Suburbanization on the New Jersey Pine Barrens.

ORGANIZATION:

SOURCE: Rutgers State University, New Brunswick, NJ.

ABSTRACT: Nineteen swamps dominated by *Chamaecyparis thuyoides* were chosen to represent the following gradient of increasingly severe impacts due to watershed development: isolated sites, far from roads; isolated sites, near roads; suburban sites with indirect runoff; and suburban sites receiving storm sewer input. The sites receiving storm sewer input showed an increased uptake of P and Pb, but no significant changes for N, Cu or Zn; sites with indirect runoff showed no changes in tissue element concentrations. In summary, the presence of direct stormwater input to cedar swamps causes marked changes in community structure, vegetation dynamics, and plant tissue element concentration. Developed watersheds, or even roads proximate to swamps, also cause changes, though less drastic, from conditions in swamps in undisturbed areas.

TOPIC: 1.3.2

AUTHOR(S): Elder, J.F.

DATE: 1988

TITLE: Factors affecting wetland retention of nutrients, metals, and organic materials.

ORGANIZATION:

SOURCE: In, J.L. Kusler and G. Brooks (eds.), Proceedings of a National Symposium: Wetland Hydrology. Association of State Wetland Managers, Berne, New York. pp 178-184

ABSTRACT: This paper summarizes current information regarding the factors that can affect the chemical quality of natural and effluent waters during transport through wetlands. Most work in this area has been limited to studies of nitrogen and phosphorus; hence the emphasis of this paper is on those particular elements. However, additional studies of uptake and release effects on metals and organic materials are also included in the review.

TOPIC: 1.3.2

AUTHOR(S): Esry, D.H., and D.J. Cairns.

DATE: 1989

TITLE: Overview of the Lake Jackson Restoration Project with Artificially Created Wetlands for Treatment of Urban Runoff.

ORGANIZATION:

SOURCE: p. 247-257 in: D.W. Fisk (ed.), Wetlands, Concerns and Successes. Proceedings, American Water Resources Association Symposium in Tampa, FL., Sept. 17-22, 1989.

ABSTRACT: The Northwest Florida Water Management District engaged in a federally funded Clean Lakes Restoration Project for Lake Jackson in Tallahassee, Florida, during the late seventies. Construction on this experimental \$2.6 million stormwater treatment facility was begun in 1981 with completion in 1983. The design employed a three step process to remove sediment and nutrients from urban runoff prior to entering the lake. The first two steps entail the detention of the stormwater in a 20-acre impoundment followed by passage through a four-acre filter with an underdrain collection system. The final step consists of the partially treated stormwater flowing to a nine-acre artificial marsh for further sediment removal and nutrient assimilation. The entire process has been monitored to determine the effectiveness of the various steps within the project. A recent report concludes that while the stormwater facility works well (>90% removal of solids by the filter/60-65% removal of nutrients by the marsh) there remain operational deficiencies. One of the major deficiencies cited was the exceedance of the total volume of the impoundment by more than half of the large storms monitored. These larger storms also bypass treatment by the created wetlands in the artificial marsh. Several proposed projects address this concern and would implement measures to help alleviate the current burden on the facility.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Fetter, C.W., W.E. Sloey, and F.L. Spangler.

DATE: 1978

TITLE: Use of a Natural Marsh for Wastewater Polishing.

ORGANIZATION:

SOURCE: Journal WPCF 50: 290-307.

ABSTRACT: The improvement in water quality of a highly polluted stream after passing through a natural marsh was measured. Spring creek in Calumet Co., WI, receives several types of industrial effluent before it passes through Brillion Marsh which is dominated by Typha and Sparganium. BOD, total P, turbidity, conductivity, ammonia nitrate, nitrate, nitrogen, pH, coliform bacteria, dissolved solids, and suspended solids were measured upstream and downstream of the marsh and of a treatment plant outfall. The treatment plant caused an increase in most of these factors, but a decrease in dissolved solids and nitrate. After passage through the marsh, the water quality improved significantly as measured by all parameters. As much as one third of the P entering the marsh may be retained by precipitation into organic sediments in stream channels and in organic marsh sediments. Seasonal hydrologic measurements were also made.

TOPIC: 1.3.2

AUTHOR(S): Franklin, K. T. and R.E. Frenkel.

DATE: 1987

TITLE: Monitoring a Wetland Wastewater Treatment System at Cannon Beach, Oregon

ORGANIZATION:

SOURCE: Report prepared for the US EPA Region 10.

ABSTRACT: The City of Cannon Beach uses a seven hectare red alder/slough sedge/twinberry palustrine wetland, divided into two cells in series, to treat chlorinated effluent from a four-cell aerated/facultative lagoon sewage treatment system. Operation began June, 1984. The system has proven to be an effective means of meeting summer wastewater discharge limitations.

The Corps of Engineers 404 permit requires biological monitoring of this system to evaluate future wetland treatment system proposals in the region and for improved wastewater wetland management. Vegetation was sampled in 1984 by permanent plots prior to facility initiation and repeated in 1986. Generally, herb and shrub cover changed little since 1984. In channelized and deeply flooded areas herb cover decreased. Slough sedge cover increased slightly in the shallowly flooded eastern section of cell 2.

By 1986, a complex pattern of flooding stress is exhibited by defoliated, sparsely leaved, and some dead red alder trees in deeper water areas. The hummocky topography complicates prediction of flooding stress effects. Field research in spring and summer, 1986 used a nested frequency sampling plots (0.25 m² nested within 1.0 m²) provides baseline data for vegetation trend analyses. Nested frequency vegetation cover agrees with permanent plot cover; however, nested frequency yields substantially more plots per man-hour than the permanent plot method.

Mean wetland influent and effluent flow rates were 0.40 and 0.06 MGD respectively in 1986. An independent water budget estimate suggests ground water infiltration is at least 65-85% of the water loss.

The Cannon Beach system has met ODEQ water quality discharge standards for three years, reducing BOD₅ and TSS concentrations by 40% and 85% respectively. Phytoplankton constitute most of the influent suspended solids. Within 30-40 meters into treatment cell 1, the phytoplankton concentration is greatly reduced; suspended solids thereafter are mostly composed of plant detritus and humic materials. Settling and resuspension of suspended solids varies complexly throughout the facility.

Tree loss is not likely to adversely affect the water quality treatment; however, long-term nutrient retention may diminish with tree death. With an aging system, passerine bird habitat will decrease in the western section, but waterfowl habitat will increase. Slough sedge cover is likely to remain relatively stable or increase. Monitoring needs to be improved and coordinated with management.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Fries, B.M.

DATE: 1986

TITLE: Fate of Phosphorus from Residential Stormwater Runoff in a Southern Hardwood Wetland.

ORGANIZATION:

SOURCE: Thesis, Master of Science in Engineering, University of Central Florida, Orlando, FL

ABSTRACT: The movement and fate of phosphorus inputs from residential stormwater runoff were investigated in a 1.0 hectare hardwood wetland near Sanford, Florida. This wetland receives stormwater runoff from a large residential community through a small shallow canal and provides treatment prior to discharge to Hidden Lake. Field investigations were begun in 1984 and were divided into the following tasks: (1) assessment of the quantity of nutrients and heavy metals entering the wetland by way of stormwater runoff, (2) measurement of the attenuation of these pollutants during travel through the wetland, (3) monitoring of the concentrations of nutrients and heavy metals in groundwaters, (4) accumulation of nutrients and heavy metals in the sediments of the wetland, (5) examination of the typical chemical associations binding nutrients and heavy metals to the sediments using sequential extraction procedures, and (6) investigation of the importance of redox potential and pH on metal-sediment stability with regard to the release of phosphorus from wetland sediments.

After entering the wetland treatment system, stormwater inputs were observed to exhibit general reductions in pH, specific conductivity, dissolved oxygen, ORP and alkalinity with increasing flow distance.

Concentrations of both dissolved orthophosphorus and total phosphorus increased during flow through the wetland system and were found to be closely correlated to decreases in pH and ORP. A stagnant control area, removed from runoff influence was found to exhibit elevated concentrations of phosphorus when compared to the flowpath area. Water quality characteristics in groundwaters beneath the flowpath were very similar to surface water characteristics, with dissolved oxygen and ORP levels decreasing with depth, whereas phosphorus concentrations increased. Groundwaters in the stagnant control area exhibited significantly elevated concentrations of phosphorus, TOC, color, and iron when compared to groundwaters in other locations.

Patterns of accumulation and deposition of sediment bound phosphorus along the wetland flowpath were investigated and found to increase substantially from the inlet canal to a distance of 50 m after which they declined slightly throughout the remainder of the wetland flowpath. Also apparent was the attenuation of sediment phosphorus concentrations with increasing sediment depth, with the majority of the phosphorus being retained in the top 10 cm.

The removal potential for dissolved orthophosphorus in wetland systems was found to be greatest in flow-through systems with sediment contact based on kinetic rate experiments performed at the study site. The majority of the dissolved orthophosphorus removal, 75 percent was found to occur within the first 24 hours of contact with the wetland sediments after which only slight decreases in concentration occurred. Stagnant systems as well as systems with less sediment contact were not effective in providing attenuation of dissolved orthophosphorus concentrations as well as other water quality parameters.

TOPIC: 1.3.2

AUTHOR(S): Gallagher, J.L., and N.Y. Kibby.

DATE: 1980

TITLE: Marsh Plants as Vectors in Trace Metals Transport in Oregon Tidal Marshes.

ORGANIZATION:

SOURCE: Am. J. Bot. 67: 1069-1074.

ABSTRACT: The role of Pacific coast marsh plants as vectors in the flux of trace metals was studied in natural and perturbed situations. The flux of Cr, Cu, Fe, Mg, Sr, and Zn were studied in natural stands of *Carex Lyngbyei*, *Distichlis spicata*, *Potentilla pacifica*, and *Salicornia virginica*. Seasonal fluxes of trace metals into the shoots of the living plants were measured as was their transfer to the dead plant community through mortality. Disappearance from the latter community (through fragmentation, leaching and excretion) was calculated. Seasonal data were summed to produce annual input-output budgets. The flux varied from 3 mg/m² for Fe in *Carex lyngbyei*.

The uptake of trace metals from contaminated dredged material was compared with that from natural soils using modified buckets placed in the marsh. Four plants (*Carex lyngbyei*, *Distichlis spicata*, *Deschampsia cespitosa*, and *Salicornia virginica*) were tested for Cd, Cr, Cu, Pb and Zn. Copper was the only metal accumulated from contaminated soils in the situations tested.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Gersberg, G.M., B.V. Elkins, and C.R. Goldman.

DATE: 1984

TITLE: Use of Artificial Wetlands to Remove Nitrogen from Wastewater.

ORGANIZATION:

SOURCE: Journal WPCF 56(2): 152-156.

ABSTRACT: Artificial wetlands, when supplemented with methanol to increase the carbon supply and stimulate denitrification, showed very high nitrogen removal efficiencies, 97% of TIN and 94% of TN at application rates of 20 to 25 cm/d.

Plant biomass, mulched and applied to the surface of the wetlands, was a low-cost alternative to methanol. At a wastewater application rate of 8.4 to 12.5 cm/d, the mean nitrogen removal efficiencies for mulch-amended beds were 95% for TIN and 89% for TN. When the application rate was increased to 17 to 20 cm/d, the mean removal efficiencies decreased to 70% for TIN and 65% for TN.

At a wastewater application rate of 8.4 cm/d, endogenous wetland productivity could supply 0.06 kg/m³ carbon, or 67% of the carbon loading value of 0.09 kg/m³ at which there was an 89% removal of TN. Similarly, at the higher application rate of 17 to 20 cm/d, plant productivity could supply more than 100% of the carbon loading value of 0.05 kg/m³ at which there was a 65% removal of TN. This could amount to an equivalent savings of 224 L of methanol per day (3.7 x 10⁶ Btus/d) when compared to a totally methanol-based system.

When primary effluent was blended into the secondary wastewater stream at a ration of 4 cm/d:15 cm/d (1:3.8), the mean nitrogen removal efficiency was 62% for TIN. At the ratio of 6 cm/d:12 cm/d (1:2), the mean removal efficiencies were 79% for TIN and 77% for TN. At the 1:2 ratio the mean removal efficiencies for BOD and suspended solids were high - 89% for both BOD and suspended solids. These data emphasize the utility of the artificial wetlands for integrated biological treatment, to perform secondary treatment and nitrogen removal.

TOPIC: 1.3.2

AUTHOR(S): Gersberg, R.M.

DATE: 1987

TITLE: Survival of Bacteria and Viruses in Municipal Wastewaters Applied to Artificial Wetlands.

ORGANIZATION:

SOURCE: San Diego Region Water Reclamation Agency, Santee, CA

ABSTRACT: Removal of chemical pollutants by wetland treatment is well documented, but there is relatively little information available on the removal of bacterial and viral pollution indicators in wetland ecosystems. In the present study, the survival of indigenous total coliform bacteria and seeded MS-2 bacteriophage was examined in artificial wetlands which received primary municipal wastewaters. At the hydraulic application rate of 5 cm/d, the mean influent total coliform level of 6.75 x 10⁷ MPN 100 mL⁻¹ was reduced 99.1% in the effluent of a vegetated (bulrush) bed, as compared to only 95.7% in the effluent of an unvegetated bed. This significant difference between the vegetated and unvegetated beds shows the important role that higher aquatic plants have in the removal of a bacterial indicator of pollution by wetlands. The concentration of seeded MS-2 bacteriophage, used as a viral indicator, was also greatly reduced by wetland treatment, with the mean influent level of MS-2 virus of 5.35 x 10⁵ PFU mL⁻¹ reduced by 98.3% in the effluent of a vegetated wetland bed. These results demonstrate the artificial wetlands may serve as low-cost alternatives to conventional treatment systems for reducing the load of disease-causing bacteria and viruses to the aquatic environment.

TOPIC: 1.3.2

AUTHOR(S): Gersberg, R.M., S.R. Lyon, B.Y. Elkins, and C.R. Goldman.

DATE: 1984

TITLE: The Removal of Heavy Metals by Artificial Wetlands.

ORGANIZATION:

SOURCE: Report to the US EPA Office of Research and Development, Robert S. Kerr Environmental Research Lab., Ada, OK. EPA600/D-84/258, PB85-116127/REB.

ABSTRACT: Artificial wetlands have been operated successfully for treatment of municipal wastewater for a number of years at several locations in this country. However, the capability of these systems to treat heavy metal laden municipal wastewater had not previously been investigated. The artificial wetland system at Santee, California which is normally used for polishing secondary municipal wastewater was evaluated for treatment of Cd, Zn and Cu. These metals were added to the influent waste stream in high concentrations during a one-year study and wetland effluent was tested to determine their removal efficiency. Their removal efficiency ranges from an average of 97 percent for zinc to over 99 percent for the two other metals.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Gilliam, JW

DATE: 1994

TITLE: Riparian wetlands and water quality

ORGANIZATION: Soil Sci. Dep., North Carolina State Univ., Raleigh, NC 27695-7619, USA

SOURCE: J. ENVIRON. QUAL., vol. 23, no. 5, pp. 896-900, 1994

ABSTRACT: Because of wet soils adjacent to the streams, riparian buffers are frequently present between farming and urban activities on the uplands and small streams. These riparian areas have been shown to be very valuable for the removal of nonpoint-source pollution from drainage water. Several researchers have measured > 90% reductions in sediment and nitrate concentrations in water flowing through the riparian areas. The riparian buffers are less effective for P removal but may retain 50% of the surface-water P entering them. I consider riparian buffers to be the most important factor influencing nonpoint-source pollutants entering surface water in many areas of the USA and the most important wetlands for surface water quality protection.

TOPIC: 1.3.2

AUTHOR(S): Goldstein, A.L.

DATE: 1982

TITLE: Utilization of a Freshwater Marsh to Treat Rainfall Runoff From Upland Pasturelands.

ORGANIZATION:

SOURCE: Presented at Univ. of Florida/et al. Nonpoint Pollution Control Technology in Florida Symposium, Gainesville, FL. March 9-10, 1982, page 106-126.

ABSTRACT: A freshwater wetland system in Osceola County, FL, is being used to detain and store agricultural and stormwater runoff. In this process, some degree of treatment is provided, thereby improving water quality. Monitoring of meteorological and hydrological conditions at the site indicates that a first flush phenomenon of nutrients from pastureland occurs simultaneous with the beginning of rains. Mean concentrations of nitrogen and phosphorus are lower in effluent leaving the marsh than in influent. The marsh acted as a sink for some 3980 kg of total nitrogen and 835 kg of total phosphorus during a nine-month study period.

TOPIC: 1.3.2

AUTHOR(S): Gomez, M.M. and F.P. Day.

DATE: 1982

TITLE: Litter nutrient content and production in the Great Dismal Swamp, Virginia.

ORGANIZATION:

SOURCE: Am. J. Bot. 69:1314-1321.

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Good, R.E., D.F. Whigham, and R.L. Simpson.

DATE: 1978

TITLE: Freshwater Wetlands: Ecology Processes and Management Potential.

ORGANIZATION:

SOURCE: Academic Press, New York, San Francisco, London.

ABSTRACT: Proceedings of the Symposium, "Freshwater Marshes: Present Status, Future Needs," held in February 1977 at Rutgers University, New Brunswick, NJ. Contains six articles on primary processes, five on decomposition processes, six on nutrient dynamics, and six on management potential.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Graetz, D.A., Krottje, P.A. Erickson, N.L., Fiskell, J. G.A., Rothwell, D.F.

DATE: 1980

TITLE: Denitrification in Wetlands as a Means of Water Quality Improvement

ORGANIZATION:

SOURCE: Available from the National Technical Information Service, Springfield, VA 22161 as PB80-222227. Water Resources Research Center, University of Florida, Publication No. 48, May 1980

ABSTRACT: The feasibility of using natural wetlands to remove nitrogen via denitrification from secondarily treated sewage effluent was studied. Nitrification and denitrification occurring in the marsh ecosystem may be an important pollution control treatment for non-point sources such as agricultural runoff. Nitrification and denitrification rates were investigated in the laboratory and in situ. Simulated marsh ecosystems of soil: water columns with artificial aeration were studied. Plants were found to increase the ammonium removal rates. Denitrification did not occur in marsh water or in oxidation pond water without soil. Rapid, first-order denitrification was observed in the soil: water columns and average nitrate removal rates, assuming a floodwater nitrate concentration of 10 milligram N per liter, were about 1.2 kilogram N per hectare per day without plants and 2.0 kilogram N per hectare per day with plants. Denitrification was accelerated by increasing the soil pH with lime. The denitrification and N₂O evolution rates for 15 Florida wetland soils were investigated in the laboratory and first-order rate constants ranging from 0.040 per day to 0.192 per day were found for denitrification. For 90% removal about 12 to 58 days of wetland treatment would be required. More research is needed to determine the effects of water depth, oxygen concentration, plant density, and temperature on denitrification rates.

TOPIC: 1.3.2

AUTHOR(S): Greeson, P.E., J.R. Clark, and J.E. Clark. (eds.)

DATE: 1978

TITLE: Wetlands Functions and Values: The State of Our Understanding.

ORGANIZATION:

SOURCE: Proceedings, National Symposium on Wetlands. Published by the American Water Resources Association, Minneapolis, MN.

ABSTRACT: The purpose of the symposium was to provide a forum for scientists to review the state of knowledge on values of wetlands in the United States, both inland and coastal, and to consider research priorities. The Symposium intensely examined the ecological values of wetlands, particularly such functions as nutrient cycling, decomposition, hydrology, and productivity. These functions were translated into social, health, welfare and safety issues, like flood control, water supply and quality, wildlife habitat and basic life support. The book is an excellent overall text on wetlands functions and processes.

TOPIC: 1.3.2

AUTHOR(S): Grij, E.D.

DATE: 1976

TITLE: The Effects of a Marsh on Water Quality.

ORGANIZATION:

SOURCE: Office of Water Research and Technology no. A-O77-Mich. 188 pp.

ABSTRACT: In an emergent macrophyte community, cattail was studied to determine its effect on water quality. Nitrate-nitrogen and ammonium nitrogen levels were lower downstream below the marsh. Phosphates were lower within the cattail areas, but above and below, data was variable. Nutrient removal seemed to increase with increased residence time at the sediment-water interface. Effects of water level, wind, ice and substrate on nutrient distribution are discussed. Management techniques are discussed, and basic distribution maps presented.

TOPIC: 1.3.2

AUTHOR(S): Hall, F.R., R.J. Rutherford, and G.L. Byers.

DATE: 1982

TITLE: The Influence of New England Wetland on Water Quality and Quantity.

ORGANIZATION:

SOURCE: Water Resource Research Center, Univ. of New Hampshire, Durham. Research report no. 4,

ABSTRACT: This study investigated the influence of an 11 acre pond-wetland in southeastern New Hampshire on water quality and quantity. Hydrologic, meteorologic, and chemical data were collected. Water losses, due mainly to evaporation from vegetative areas was about 1.7 times evaporation from open water. Water chemistry changes reflected atmospheric precipitation and biotic factors. Conclusions include the statement that the wetland appears to be capable of yielding significant quantities of water for use during periods of water shortage through proper management practices, and that the wetland can be valuable with respect to flood control in that they act like reservoirs releasing stored water slowly during low flow periods.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Hall, F.R.; Rutherford, R.J. and Byers, G.L

DATE: 1972

TITLE: The Influence of a New Hampshire Wetland on Water Quality and Quantity.

ORGANIZATION:

SOURCE: New Hampshire Water Resource Center Research Report 4, Univ. of New Hampshire, Durham.

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Hammer, D.E.

DATE: 1989

TITLE: Constructed Wetlands for Wastewater Treatment: Municipal, Industrial and Agricultural. Lewis Publishers, Chelsea, MI.

ORGANIZATION:

SOURCE: Proceedings, Chatanooga, TN. June 13-17, 1988.

ABSTRACT: This volume contains the proceedings from the First International Conference on Constructed Wetlands for Wastewater Treatment held in Chattanooga, Tennessee on June 13-17, 1988. It presents general principles of wetlands ecology, hydrology, soil chemistry, vegetation, microbiology, and wildlife in Chapters 1-7, followed by case histories of specific types of constructed wetlands and applications to municipal wastewater, home sites, coal and noncoal mining, coal-fired electric power plants, chemical and pulp industry, agriculture, landfill leachate, and urban stormwaters in Chapters 8-21. Chapters 22-36 provide construction and management guidelines beginning with policies and regulations through siting and construction and ending with operations and monitoring of constructed wetlands treatment systems. Recent theoretical and empirical results from operating systems and research facilities, including new applications, e.g., nutrient removal from eutrophic lakes and urban stormwater treatment within highway rights-of-way, are included in Chapters 37-42.

TOPIC: 1.3.2

AUTHOR(S): Hantzsche, N.N.

DATE: 1985

TITLE: Wetland Systems for Wastewater Treatment: Engineering Applications.

ORGANIZATION:

SOURCE: p. 7-25 in: P. Godfrey et al.(eds), Ecological Considerations in Wetlands Treatment of Municipal Wastewaters. Van Nostrand Reinhold Company, NY.

ABSTRACT: The use of wetlands for treatment of various wastewaters has attracted considerable interest and research attention during the past 10 to 15 years. What can generally be concluded on the basis of the experience to date is that: 1. Wetland systems can provide measurable renovation of wastewaters and storm waters, but the necessary understanding and criteria to take the best advantage of these processes on a routine basis do not currently exist. 2. Natural wetlands are highly variable in characteristics, making it difficult, if not impossible, to apply study results to different geographical areas. 3. The use of artificial or constructed wetlands appears to have the greatest promise for general application because of better reliability and process control. 4. There is a substantial amount of interest in creating or restoring wetlands simply for environmental enhancement. There are strong desires to couple environmental enhancement with programs for treatment of municipal wastewaters, stormwaters, agricultural return flows, and various types of industrial wastewaters. 5. Pilot demonstration studies are still needed before engineers can confidently proceed with design implementation of full scale wetland-wastewater systems.

TOPIC: 1.3.2

AUTHOR(S): Harper, H.H., M.P. Wanielista, and E.H. Livingston

DATE: 1985

TITLE: Treatment efficiencies of residential stormwater runoff in a hardwood wetland

ORGANIZATION:

SOURCE: Lake and reservoir management proceedings of the fifth annual conference and international symposium on applied lake and watershed management. Lake Geneva, WI

ABSTRACT:

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Harper, H.H., M.P. Wanielista, B.M. Fries, and D.M. Baker.

DATE: 1986

TITLE: Stormwater Treatment by Natural Systems.

ORGANIZATION:

SOURCE: Florida Department of Environmental Regulation, Star Project number 84-026. 331 pages.

ABSTRACT: A study was undertaken to evaluate the feasibility of using wetlands to treat sporadic inputs of stormwater runoff, using a Florida wetland. The following tasks were undertaken: 1. Characterization of rainfall and runoff inputs into the wetland system; 2. Monitoring of hydrological quantities in and out of the wetland; 3. Characterization of surface and groundwaters along the wetland flow path and in isolated control areas; 4. Investigation of the horizontal and vertical migration of nutrients and heavy metals in wetland sediments; 5. Determination of the chemical speciation of phosphorus and heavy metals in the sediments and the effect on the ability of the sediments to retain pollutants; 6. Determination of the influence of pH and redox potential on the chemistry and stability of phosphorus and heavy metals in the sediments; 7. Examination of the rate of uptake and removal of nutrients and heavy metals during flow through the wetland; 8. Examination of the physical mechanisms and characteristics that enhance pollutant removal to aid in development of specific design suggestions; and 9. Examination of changes in algal productivity due to stormwater flow through bioassay experiments.

The report includes a literature review of pollutant removal mechanisms in wetlands, characteristics of urban stormwater drainage, and experiences of wetland treatment of stormwater runoff. The literature review is followed by a site description, experimental methodology, results, and discussion. Among the general results was the finding that nitrate is rapidly removed from the water column under reduced conditions and maximum removal of total nitrogen occurred after 48 hours. Phosphorus uptake is primarily sediment mediated and is optimized at flow rate of one meter per second or less. Phosphorus is rapidly adsorbed by sediments under aerobic conditions, but is released under reduced conditions and pH values of less than 5.5. Flow path sediments clearly retained a large portion of some metals, including nickel, chromium, aluminum, and iron, while lead, cadmium, and copper were not retained to as great a degree.

The authors made the following recommendations concerning the use of wetlands for stormwater treatment: 1. Wetland systems best suited for modification for use as stormwater management systems are those that already exhibit relatively long hydroperiods; 2. Runoff inputs into wetland treatment systems should be attenuated and released slowly into the system to avoid erosion or high flow velocities that reduce opportunities for adsorption; 3. Inflow should be spread evenly over the flow path; 4. Retention times should not exceed 48 hours to avoid reduction in uptake potential of sediments and release of pollutants back into the water column; and 5. Flow velocities should not exceed one meter per second.

TOPIC: 1.3.2

AUTHOR(S): Heliotis, F.D.

DATE: 1982

TITLE: Wetland Systems for Wastewater Treatment: Operating Mechanisms and Implications for Design.

ORGANIZATION:

SOURCE: Institute for Environmental Studies, University of Wisconsin, Madison. IES Report 117, July 1982.

ABSTRACT: A systematic review of nutrient cycling studies in wetlands resulted in the construction of a conceptual model of nutrient dynamics. The response of different wetland types to wastewater addition was evaluated with emphasis on mechanisms for the removal of nutrients. Conclusions were that major long-term removal of phosphorus is incorporated to peat, whereas denitrification is responsible for most of nitrogen removal; that addition of wastewater leads to decreasing diversity and stability with shift toward simpler food chains; that only degraded wetlands should be used; and that the practice should be integrated with overall functions of the landscape.

TOPIC: 1.3.2

AUTHOR(S): Heliotis, F.D., and C.B. DeWitt.

DATE: 1983

TITLE: A Conceptual Model of Nutrient Cycling in Wetlands Used for Wastewater Treatment. A Literature Analysis.

ORGANIZATION:

SOURCE: WETLANDS 3: 134-152. (published by Association of Wetland Scientists).

ABSTRACT: A conceptual model of nutrient dynamics in wetlands used for wastewater treatment provided the basis for reviewing the literature on the subject. Papers were selected in order to describe the storages and transfers of the conceptual model. This approach serves to develop an understanding of wetland systems behavior and allows easy identification of gaps in the literature and of research needs. The consensus of the literature is that incorporation into peat is the major long-term mechanism for phosphorus removal, whereas denitrification is very significant for nitrogen removal. Long term, mass balance studies are required in order to identify and quantify the nutrient removal mechanisms and assess the potential of different wetland types for treating wastewater. Areas particularly lacking mass balance studies include hydrology, decomposition processes, and physiochemical reactions between water and wetland soils.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Helle, S.C.

DATE: 1983

TITLE: Tertiary Treatment of Wastewater Using Flow-Through Wetlands.

ORGANIZATION:

SOURCE: Water/Engineering & Management, May 1983, p. 10-12.

ABSTRACT: Based upon the findings of the Jasper Study, the use of a flow-through wetland system for additional treatment of secondary effluent appears to be a workable and economical alternative to conventional physical-chemical treatment methods if the following criteria are met: a) Wastewater should be domestic, principally non-industrial waste; b) Wastewater should be receiving secondary treatment; c) Phosphorus removal (if required) should be accomplished prior to discharge; d) Effluent should be given sufficient detention time to convert more of the nitrogen to the nitrate form; e) Loading rates should not exceed 1 mgd per 100 acres; f) Detention time in the wetland should average 30 days; g) Length of the most direct flow path should be 1,500 ft; h) Implementation should adhere to applicable regulations.

TOPIC: 1.3.2

AUTHOR(S): Hemond, H.F., and J. Benoit.

DATE: 1988

TITLE: Cumulative Impacts on Water Quality Functions of Wetlands.

ORGANIZATION:

SOURCE: Environmental Management 12(5): 639-653.

ABSTRACT: The total effect of cumulative impacts on the water quality functions of wetlands cannot be predicted from the sum of the effects each individual impact would have by itself. The wetland is not a simple filter; it embodies chemical, physical, and biotic processes that can detain, transform, release, or produce a wide variety of substances. Because wetland water quality functions result from the operation of many individual, distinct, and quite dissimilar mechanisms, it is necessary to consider the nature of each individual process.

Sound knowledge of the various wetland processes is needed to make guided judgements about the probable effects of a given suite of impacts. Consideration of these processes suggests that many common wetland alterations probably do entail cumulative impacts. In addition to traditional assessment methods, the wetland manager may need to obtain appropriate field measurements of water quality-related parameters at specific sites; such data can aid in predicting the effects of cumulative impact or assessing the results of past wetland management.

TOPIC: 1.3.2

AUTHOR(S): Hemond, H.F., T.P. Army, W.K. Nuttle, and D.G. Chen.

DATE: 1987

TITLE: Element cycling in wetlands - interactions with physical mass transport (review).

ORGANIZATION:

SOURCE: Advances in Chemistry Series 216: 519-537.

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Hickock, E.A., M.C. Hannaman, and M.C. Wenck

DATE: 1977

TITLE: Urban Runoff Treatment Methods: Vol. I, Non-structural Wetland Treatment

ORGANIZATION: USEPA, in cooperation with Minnehaha Creek Watershed District

SOURCE: EPA 600/2-77-217

ABSTRACT:

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Hickok, E.A.

DATE: 1979

TITLE: Wetlands and Organic Soils for the Control of Urban Stormwater.

ORGANIZATION:

SOURCE: Lake Restoration, proceedings of a national conference. EPA 440/5-79-001, pp. 153-158.

ABSTRACT: A seven-acre wetland in the Minnehaha Creek Watershed District, Minnesota, was studied during 1974 through 1975 to determine its effect on stormwater runs. Influent and effluent water sources and amounts were monitored to develop water and nutrient balances. Instrumentation used includes 55 parshall flumes, 13 polyvinyl chloride observation wells, and a complete weather observation station. Physical entrapment, microbial utilization, plant uptake, and adsorption were all found to be active mechanisms in the wetland system. The phosphorus adsorptive capacity of the area indicated that the organic soils of the watershed contain between 5 and 17 times the amount of phosphorus expected. Application of study results led to the development of five projects: (1) extensive environmental planning and construction was done for the building of a new shopping center in the study area; (2) a biologically activated soil filtration unit was constructed to filter phosphorus from the hypolimnion water of Wirth lake in Minneapolis; (3) an oil retention basin, a six-acre wetland treatment area, and a filter dyke for drawdown were developed for a watershed at the Minneapolis St. Paul airport; (4) a marsh is being utilized by Annandale, Minnesota, to treat combined urban runoff and treated wastewater; and (5) organic soils and wetlands are being used for the Long lake Restoration Project.

TOPIC: 1.3.2

AUTHOR(S): Hickok, E.A.

DATE: 1980

TITLE: Wetlands for the Control of Urban Stormwater.

ORGANIZATION:

SOURCE: pp. 79-88 in: Downing, W.L. (ed.) 1980, Proceedings, National Conference on Urban Erosion and Sediment Control: Institutions and Technology. U.S. EPA publication 905/9-80-002.

ABSTRACT: A research project was performed to evaluate and assess urban runoff treatment methods using non-structural wetland techniques in the Wayzata Wetland, Minnesota. Over the period studied the wetland water storage was reduced by 3.7 acre-feet of water. Annual P loads ranged from 0.6 lb/ac/yr from single family dwellings on large lots to 2.1 lb/ac/yr from a shopping center. A total of 134.7 lb/yr of P entered the wetland, of which 104.1 lb/yr (77%) was retained. Physical entrapment was a major factor in the retention, as 94% of the suspended solids were retained. Surface microbial activity increased when water level management was effective, but activity decreased when soils were submerged and became anaerobic. No adverse environmental impacts on the wildlife or vegetation were detected within the wetland. The development of effective urban runoff control by wetlands as demonstrated in this project was used in the planning of runoff control for a shopping center and an airport, and in the construction of a biologically activated soil filtration unit to filter P from hypolimnetic bottom of Wirth lake in Minneapolis.

TOPIC: 1.3.2

AUTHOR(S): Hickok, E.A., M.C. Hannaman, and N.C. Wenck.

DATE: 1977

TITLE: Urban Runoff Treatment Methods. Vol I: Non-Structural Wetlands Treatment.

ORGANIZATION:

SOURCE: Minnehaha Creek Watershed District, Wayzata, Minn. EPA-600/2-77-217.

ABSTRACT: A significant impact on Minnehaha Creek (Minn.) watershed lake waters is known to be caused by stormwater runoff; providing control and treatment methods from this pollution source is a large and complex problem. The methods implemented by this project may be implemented as an urban stormwater runoff control practice in many of the urban centers of the country that have unused adjacent wetlands. This project has demonstrated the treatability and effectiveness of non-structural methods to improve the quality of stormwater runoff from urban areas using natural wetlands.

Freshwater wetland enclosures, with mixed grasses, cattails, willow, and dogwood, were monitored for ability to modify storm water runoff water quality. It was found that the storm water was renovated by wetlands through physical entrapment, microbial transformations, and biological utilization. Total phosphorus retention was 156 g/m²-yr (78%), TSS phosphorus retention of 52 kg/m²-yr (94%), and an NH₃ net export of 320 g/m²-yr.

The physical trapping of contaminants by organic soils is the result of the characteristic fine texture of the material. The fine textures permit physical screening of sediment transported to the marsh and also tend to reduce the velocity of groundwater movement. The relatively slow velocity increases the non-structural wetland treatment methods. This report can be used as a guide in the wise and prudent use and management of wetlands, especially in urban and developing areas. A detailed environmental assessment indicated that no impacts were detected on the wildlife or vegetation as a result of this project.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Hook, D.D., W.H. McKee, Jr., H.K. Smith, et al.

DATE: 1988

TITLE: The Ecology and Management of Wetlands. Volume 1: Ecology of Wetlands; Volume 2: Management, Use and Value of Wetlands.

ORGANIZATION:

SOURCE: Timber Press, Portland, Oregon. 986 pages. \$130.

ABSTRACT: This two-volume work presents selected papers from a symposium on wetlands organized by the International Society of Anaerobiosis, held in June 1986 in Charleston, South Carolina. Contributors are international authorities from all over the world, but principally the U.S.A. and Europe.

Volume one covers the general ecology of wetlands. Principal subject areas addressed include how plants are adapted to waterlogged soils, plant-animal interactions, soils and geology of wetlands, hydrology and estuarine ecosystems. Volume two covers more applied topics such as agricultural use, restoration and regulation, use for forestry, fisheries and wildlife, the development of wetlands for agriculture, and evaluation methods. The volumes represent a definitive statement of the current subject and almost everyone that works with wetlands will find topics of interest in each volume. More specifically, ecologists, botanists and soil scientists as well as workers in forestry, fisheries and wildlife management will find much of value in these volumes.

TOPIC: 1.3.2

AUTHOR(S): Horner, R.R.

DATE: 1995

TITLE: Constructed Wetlands For Urban Runoff Water Quality Control

ORGANIZATION:

SOURCE: Proc. National Conf. on Urban Runoff Management; Chicago, Illinois; March 1993, pp.327-340

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Horner, R.R.

DATE: 1992

TITLE: Constructed Wetlands for Stormwater Runoff Water Quality Control.

ORGANIZATION:

SOURCE: Course Material Engineering Cont. Ed., Univ. Wash., Seattle, WA.

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Horner, R.R.

DATE: 1989

TITLE: Long-Term Effects of Urban Stormwater on Wetlands.

ORGANIZATION:

SOURCE: Pp. 451-465, in Roesner, L.A., B. Urbonas, and M.B. Sonnen, (eds), Design of Urban Runoff Quality Controls, proceedings, Engineering Foundation Conference on Urban Runoff, Potosi, Missouri, July 10-15, 1988.

ABSTRACT: In 1986 scientists and managers associated with local, state, and federal agencies that have wetland protection and stormwater management responsibilities in the Puget Trough region of Washington state joined to consider the need for research on the relationships between urban stormwater and wetlands. This paper presents results from a literature review, management needs survey, and research program undertaken by the group to answer the following broad questions: 1) what impacts on wetland ecosystems and their functions could be associated with their use for storing urban stormwater; and 2) what are the potential water quality benefits to downstream receiving waters of draining urban stormwater through wetlands.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Horner, Richard

DATE: 1986

TITLE: A Review of Wetland Water Quality Functions

ORGANIZATION: WA St Dept Ecol

SOURCE: p. 33-50 M.R. Strickland, (ed), Proceedings of the Conference on Wetland Functions, Rehabilitation, and Creation in the Pacific Northwest: The State of Our Understanding. Washington State Department of Ecology, Publication Number 86-14.

ABSTRACT: Views of wetlands and their water quality are changing. Former attitudes of wetlands as worthless lands, poor in water quality, and best converted to other uses, are being replaced by interest in their ecological significance and role in protecting adjacent open water systems from contamination. Numerous quantities define wetland water quality, including pH, solids, oxygen, nutrients, and the various metallic, organic, and pathogenic contaminants Views of wetlands and their water quality are changing. Former attitudes of wetlands as worthless lands, poor in water quality, and best converted to other uses, are being replaced by interest in their ecological significance and role in protecting adjacent open water systems from contamination. Numerous quantities define wetland water quality, including pH, solids, oxygen, nutrients, and the various metallic, organic, and pathogenic contaminants Effectiveness data for wetlands used as a tertiary treatment of wastewater. No cost data.

TOPIC: 1.3.2

AUTHOR(S): Huff, D.D., and H.L. Young.

DATE: 1990

TITLE: The effect of a marsh on runoff: I. A water-budget model.

ORGANIZATION:

SOURCE: J. Environ. Quality 9(4):633-640.

ABSTRACT: A water-budget model was developed to aid the study of transport of nutrients in surface and subsurface flows across a marsh. The model is based on field studies of Wingra marsh adjacent to Lake Wingra in Madison, Wisconsin, and was used to calculate monthly totals of actual evapotranspiration, surface runoff, and subsurface drainage from April 1970 through August 1976. About 90% of the water entering the marsh comes from urban storm runoff. The remainder is precipitation (8%) and deep ground-water inflow (2%). Water leaves the marsh through evapotranspiration (7%), shallow ground-water discharge (8%), and surface outflow (85%). The model was used to estimate the water-table elevation at an observation well where direct measurements were taken (November 1975 through October 1976). The observed depth to the water table ranged from 0 to 150 cm below the surface and the simulated value usually was within + 10 cm. This suggests that the model adequately computes the water budget for the marsh and provides a sound basis for calculating dissolved and suspended material loads transported through the marsh into Lake Wingra.

TOPIC: 1.3.2

AUTHOR(S): Hull, H.C., J.M. Post, M. Lopez, R.G. Perry.

DATE: 1989

TITLE: Analysis of Water Level Indicators in Wetlands: Implications for the Design of Surface Water Management Systems.

ORGANIZATION:

SOURCE: p. 195-204 in " D.W. Fisk (ed), Wetlands, Concerns and Successes. Proceedings, American Water Resources Association Symposium in Tampa, FL, Sept. 17-22, 1989.

ABSTRACT: Zonation of biological indicators of wetland water levels is often used as a basis to establish design water levels in surface water management systems. Commonly recognized indicators were vertically located in six cypress domes of the Green Swamp in Central Florida. Elevations were measured for lower limits of epiphytic mosses and lichens on trees, upper limits of adventitious roots on *Hypericum fasciculatum* and *Lycopus rubellus*, lower limits of epiphytic *Lyonia lucida* and lower limits of *Serenoa repens*. Comparison with water level data recorded daily in each cypress dome since 1981 allows inferences regarding hydrologic relationships for these indicators. Certain indicators appear to be more useful for the efficient design of properly functioning surface water management systems.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Isirimah, N.O., and D.R. Keeney.

DATE: 1973

TITLE: Contribution of Developed and Natural Marshland Soils to Surface and Subsurface Water Quality.

ORGANIZATION:

SOURCE: Wisconsin Univ., Madison; Water Resources Center, 36 pp. NTIS number PB-226 071/9.

ABSTRACT: Preliminary qualitative estimates of the role of natural and developed marshland soils as a nitrogen or phosphorus source or sink were obtained by a limited ground and surface water survey of a marsh adjacent to Lake Wingra, near Madison, Wisconsin and by laboratory investigations of nitrogen and phosphorus transformations in soil samples from this marsh and from an acid bog in northern Wisconsin. Results are presented on rates and pathways of these transformations. The results indicate that the marsh does not act as a significant nutrient sink. Thus while removal of the marsh by draining or filling might result in more N and P entering the lake, its presence does not appear to be a factor in lowering lake productivity. Nutrient input into the lake probably could be lowered by discharging storm sewers on mineral soil rather than on the marsh.

TOPIC: 1.3.2

AUTHOR(S): Jensen, Ric

DATE: 1990

TITLE: How Healthy is the Upper Trinity River? Biological and Water Quality Perspective

ORGANIZATION: TX Christian UN

SOURCE:

ABSTRACT: Some cost and effectiveness data for wetlands.

TOPIC: 1.3.2

AUTHOR(S): Joehengen, T.H., P.A LaRock

DATE: 1993

TITLE: Quantifying Nutrient Removal Processes Within A Constructed Wetland Designed To Treat Urban Storm Water Runoff

ORGANIZATION:

SOURCE: Ecol. Eng. 2:347-366

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Johnson, P.B.

DATE: 1988

TITLE: The Use of Wetlands in Stormwater Management.

ORGANIZATION:

SOURCE: Wetland Hydrology: Proc. of the National Wetlands Symposium, Sept 1987, Chicago. Assoc. of State Wetland Managers, Berne NY.

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Johnston, C.A.

DATE: 1991

TITLE: Sediment and Nutrient Retention by Freshwater Wetlands: Effects on Surface Water Quality.

ORGANIZATION:

SOURCE: Crit. Rev. Environ. Control. 21:491.

ABSTRACT:

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Johnston, C.A.; Johnston, T.; Kuehl, M.; Taylor and Westman, J.

DATE: 1990

TITLE: The Effects of Freshwater Wetlands on Water Quality: Compilation of Literature Values.

ORGANIZATION:

SOURCE: Natural Resources Research Institute Report, NRRI/TR-90/15, Univ. of Minnesota, Duluth, MN.

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Johnston, CA; Detenbeck, NE; Niemi, GJ

DATE: 1990

TITLE: The Cumulative Effect of Wetlands on Stream Water Quality and Quantity: A Landscape Approach

ORGANIZATION: Center for Water and the Environment, Natural Resources Research Institute, University of Michigan, Duluth, MN 55811

SOURCE: Biogeochemistry BIOGEP, Vol. 10, No. 2, p 105-141, 1990. 5 fig, 8 tab, 67 ref. U.S. EPA Grants EPA CR-814083-010 and EPA CR-81548-0102.

ABSTRACT: A method was developed to evaluate the cumulative effect of wetland mosaics in the landscape on stream water quality and quantity in the nine-county region surrounding Minneapolis-St. Paul, Minnesota. A Geographic Information System was used to record and measure 33 watershed variables derived from historical aerial photos. These watershed variables were then reduced to eight principal components which explained 86% of the variance: (1) wetland extent; (2) wetland proximity, watershed area; (3) land use (agricultural/urban); (4) 3rd order streams, watershed diversity, soil pH; (5) forested stream fringe; (6) elongated headwater watersheds; (7) soil erodibility, forest; and (8) herbaceous marsh extent. Relationships between stream water quality variables and the three wetland-related principal components were explored through stepwise multiple regression analysis. The proximity of wetlands to the sampling station was related to principal component two, which was associated with decreased annual concentrations of inorganic suspended solids, fecal coliform, nitrates, specific conductivity, flow-weighted NH₄, flow-weighted total P, and a decreased proportion of phosphorus in dissolved form ($p < 0.05$). Wetland extent was related to decreased specific conductivity, chloride, and lead concentrations. The wetland-related principal components were also associated with the seasonal export of organic matter, organic nitrogen, and orthophosphate. Relationships between water quality and wetlands components were different for time-weighted averages as compared to flow-weighted averages. This suggests that wetlands were more effective in removing suspended solids, total phosphorus, and ammonia during high flow periods but were more effective in removing nitrates during low flow periods. (Author's abstract)

TOPIC: 1.3.2

AUTHOR(S): Jolly, James

DATE: 1990

TITLE: The Efficiency of Constructed Wetlands on the Reduction of Phosphorus and Sediment Discharges from Agricultural Watersheds

ORGANIZATION:

SOURCE: M.S. Thesis. Univ. Maine, Orono, ME.

ABSTRACT: Phosphorus removal efficiency for a constructed wetland, also TSS removal efficiency. No cost data.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Kadlec, J.A.

DATE: 1987

TITLE: Nutrient Dynamics in Wetlands.

ORGANIZATION:

SOURCE: p. 393-419, in: D.R. Reddy and W.H. Smith (eds.), Aquatic Plants for Water Treatment and Resource Recovery.

ABSTRACT: Processes affecting nutrient dynamics in wetlands can be placed in two categories: 1) processes of import and export, and 2) processes within the wetland. For most nutrients, import or export processes involve the movement of water, making a knowledge of hydrology an essential prerequisite. Carbon, O₂ and N enter and leave wetlands as gases, complicating the cycles of those elements. Occasionally, animal movements result in substantial net import or export of nutrients. Processes within wetlands can be physical-chemical, such as adsorption; microbiological such as decomposition; or macrobiological such as plant uptake. Changes in nutrient content of any single component of the wetland ecosystem involve many of these processes. For example, sediments are often suspected of playing a key role in nutrient cycling, but so many of the processes above are involved that careful analysis is needed to elucidate the important dynamics.

Wastewater application to wetlands usually involves substantial quantities of water, thereby altering the hydrology of the system and all aspects of nutrient cycles connected to the hydrological processes. Increased nutrient supplies via wastewater addition can result in increased storage, either temporary or long term, in ecosystem components, or they can increase rates of transfer among components or flow through the system.

TOPIC: 1.3.2

AUTHOR(S): Kadlec, R.H.

DATE: 1988

TITLE: Wetland Hydrology and Water Pollution Control Functions

ORGANIZATION:

SOURCE: p 168-173 In: J. A. Kusler and G. Brooks (eds), Wetlands Hydrology, Proceedings of the National Wetland Symposium, September 16-18, 1987, Chicago, IL. Sponsored by the Association of State Wetland Managers.

ABSTRACT: The purpose of this paper is to describe some less-than-obvious processes involved in the interaction between wetlands and water-borne materials, which include both suspended and dissolved substances. The water budget and water regime of a wetland are known to be the key features to which water quality wetland functions can be connected. The processes of water addition and water removal determine storage status in the wetland as a function of season and environmental factors. The processes of precipitation and evapotranspiration are opposing interactions with atmospheric water. Stream flow in and out of a given wetland ecosystem provides points for ready measurement of incoming and outgoing material. Recharge and discharge phenomena are not visible but do connect the wetland with underlying aquifers. Runoff from surrounding upland areas across the perimeter of the wetland forms another possible input or output for the water pool within the wetland. In some cases the wetland also interfaces with a lake, river or estuary and thus is subject to floods, seiches, and wave action. These interchange processes affect the water chemistry within the wetland and determine the fate of materials which can move with water.

It is important to note that discussion of flows and contents of the water within a wetland must focus upon a defined system. For the purpose of this paper, that system will be taken as the water sheet within the wetland. It is considered separate and distinct from the stationary components of the wetland ecosystem--the soils and vegetation. The seasonal fluctuations of all components of the water budget for a given wetland system are also of great importance. Wet and dry, frozen and unfrozen, and warm and cold seasonal behavior, when coupled with the differences in water regime within the wetland give rise to strong influences on processes involving water-borne substances. These variations influence the vegetative cover, the types and abundance of invertebrates, and the use of the wetland by birds and animals. Most importantly, total inputs and outputs of many materials of interest vary strongly with the above factors. Consequently, samples taken for the determination of water quality are seasonally variable, and total quantities depend on a firm knowledge of the water budget.

It is not enough to simply view the wetland ecosystem as a "black box." The internal structure of a particular wetland strongly influences the pathways, timing, and water movement within that system, and thus affects the opportunity for interaction between dissolved and suspended materials.

This paper selects and illustrates four classes of wetland hydrologic processes which may not be apparent under time constrained observation. First, it is necessary to consider how a material is added to or removed from the water sheet. Second, these localized events combine with water transport to provide a confusing situation at the wetland periphery -- where observations are easiest. Third, many wetlands have dry periods, which cause internal redistributions. Last, northern wetlands experience freezing phenomena, which cause water quality alterations. This list is not intended to be complete, but rather to alert wetland observers to some of the potential influences on water quality.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Kadlec, R.H.

DATE: 1978

TITLE: Wetlands for Tertiary Treatment.

ORGANIZATION:

SOURCE: p. 490-504, in: Greeson, P.E. et al. (eds.) 1978, Wetland Functions and Values: The State of Our Understanding.

ABSTRACT: Current information on the performance of fresh water wetlands in tertiary waste water treatment is reviewed. A significant potential for water quality improvement has been demonstrated at many sites. Different choices of wetland partitioning are examined and illustrated, including the entire ecosystem, transects, and plots. Various derived measures of performance are illustrated, and all have some merit. Time effects are explored on several scales. Diurnally, daily, annual, and geological variations are important. Data are lacking in many categories, but further studies are clearly warranted. Digital computation is necessary to organize the available data and extrapolate to different times, sites, and management strategies. Design criteria are not yet available, but economics appear favorable.

TOPIC: 1.3.2

AUTHOR(S): Kadlec, R.H.

DATE: 1987

TITLE: The Hydrodynamics of Wetland Water Treatment Systems.

ORGANIZATION:

SOURCE: p. 373-392, in: K.R. Reddy and W.H. Smith (eds.) Aquatic Plants for Water Treatment and Resource Recovery.

ABSTRACT: The water budget and water regime of a wetland are the key features to which water quality wetland functions can be connected. The processes of water addition and water removal determine storage status in the wetland as a function of season and environmental factors. The processes of precipitation and evapotranspiration are opposing interactions with atmospheric water. Stream flow in and out of a given wetland ecosystem provides points for ready measurement of incoming and outgoing material. Recharge and discharge phenomena connect the wetland with underlying aquifers. Runoff from surrounding upland areas across the perimeter of the wetland forms another possible input or output for the water pool within the wetland. Within the wetland, there are strong responses to wastewater additions. Overland flow is frequently the mode of interest, and results of several studies are given. Underground flow is discussed and compared to other flow processes. Overall water budgets are presented, and compared to more detailed, spatially distributed, dynamic budgets. The base case is the natural wetland receiving municipal wastewater.

TOPIC: 1.3.2

AUTHOR(S): Kadlec, R.H.

DATE: 1987

TITLE: Northern Natural Wetland Water Treatment Systems

ORGANIZATION:

SOURCE: p. 83-98, In: K.R. Reddy and W.H. Smith (Eds.), Aquatic Plants for Water Treatment and Resource Recovery.

ABSTRACT: The performance of northern natural wetlands in the treatment of secondary municipal wastewater is described. Results from nine systems are compared to the Houghton Lake system, which is presented in greater detail. The hydrology of these systems is shown to be a controlling factor in operation, although wastewater need not seriously disrupt the water regime. Water quality is improved by passage through wetland, but some mechanisms are temporary. Areal requirements are site specific, and increase with time. Winter operation is possible, but at a reduced level, since mechanisms of water and pollutant transport change considerably from summer. Sediments are filtered by the wetlands, but also several-fold, and changes in species composition, usually to cattail-dominant. Animal species composition also changes, and usually becomes less diverse.

TOPIC: 1.3.2

AUTHOR(S): Kadlec, R.H. and Alvord, H. Jr.

DATE: 1989

TITLE: Mechanics of Water Quality Improvements in Wetland Treatment Systems.

ORGANIZATION:

SOURCE: Paper at AWRA Symposium: Wetlands: Concerns and Successes, Tampa, FL.

ABSTRACT:

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Kadlec, R.H. and Kadlec, J.A.

DATE: 1985

TITLE: Wetlands and Water Quality.

ORGANIZATION:

SOURCE: In Wetlands Function and Value. American Water Res. Assc. Minneapolis, Minn.

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Kadlec, R.H., and J.A. Kadlec.

DATE: 1978

TITLE: Wetlands and Water Quality.

ORGANIZATION:

SOURCE: p. 436-456, in: Greeson, P.E. et al. (eds.) 1978, Wetland Functions and Values: The State of Our Understanding.

ABSTRACT: Wetland waters interact strongly with the other biotic and abiotic components of the ecosystem. Every water quality parameter is altered by passage through a wetland ecosystem. Nutrients and other dissolved constituents, heavy metals, suspended solids, and bacteria move into and out of the wetland with entering and leaving waters. Their concentrations can be altered by uptake, cycling, and dilution. Studies have been made of the gross inputs, outputs, and storages within wetlands; as well as more detailed studies of the water, sediment, and floral compartments. To interpret the performance of a wetland in altering any water quality parameter, a knowledge of the hydrology of the wetland is required, along with data on concentrations, mass flow and storage of the constituent of interest. Wetland ecosystems are dynamic, with both stochastic and time varying effects being of great importance. Diurnal, seasonal and historic time patterns are necessary for complete understanding. Nitrogen and phosphorus cycle from the water to the plants to the sediments in the wetland ecosystem, with net storage or release depending upon the site. Dissolved constituents, such as chloride, often pass through the system without much alteration. Heavy metals appear to be immobilized in many situations, as are pesticides and other refractory chemicals. Suspended solids play an important role in wetland functions, both by themselves and as transporters of other components. Although wetlands are microbially active, they appear to be intolerant of human enteric microorganisms. These ecosystems appear to function as dynamic buffers against external upsets. In many cases, they are capable of serving as disposal sites for treated wastewaters. In almost all areas, there is a need to expand the data base in order to gain a better understanding of wetland processes which affect water quality.

TOPIC: 1.3.2

AUTHOR(S): Kelly, J.C., T.M. Burton and W.R. Enslin.

DATE: 1985

TITLE: The Effects of Natural Water Level Fluctuations on N and P Cycling in a Great Lakes Marsh.

ORGANIZATION:

SOURCE: Wetlands 4: 159-175.

ABSTRACT: The water depth in marshes occurring along Lake Michigan is largely controlled by fluctuations of the Lake Michigan water level. The role of water level in controlling the distribution and cycling of N and P in emergent (*Spartanium eurycarpum*, *Scirpus validus*, and *Typha latifolia*) and wet meadow (*Calimagrostis canadensis*, *Carex stricta*, and *Carex aquatilis*) communities of a Lake Michigan river mouth marsh was studied. Nutrient uptake was determined from biomass sampling and tissue analysis. Community distribution at various lake stages was determined from aerial photographs.

Emergent shoot biomass contained 82 kg N/ha and 13.4 kg P/ha while wet meadow vegetation contained 48 kg N/ha and 5.7 kg P/ha. This difference is primarily attributable to the lower mean production of the wet meadow communities. During 1983, the aerial extent of emergent and wet meadow vegetation was 30 ha and 41 ha respectively and the emergent communities contained a total of 22% more N and 45% more P than the wet meadow communities. Decomposition is slower in the wet meadow zone and the large litter biomass in these stands contains as much N and only 14% less P than the shoot biomass of this zone. Between 1965 and 1983 the water level fluctuated over 1.75 m which greatly altered plant zonation. During a period of high water (1975) the area of the emergent and wet meadow zone was 33% below 1983 estimates. At low water (1965) the combined area of the zones was similar to - 1983 values, but a dominance of the wet meadow communities resulted in an overall decrease in production and nutrient uptake, and an increase in nutrient storage by litter biomass. This study demonstrates the role of hydrology in controlling N and P cycling in these marshes by its effect on community structure and mineralization rates.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Kibby, H.V.

DATE: 1978

TITLE: Effects of Wetlands on Water Quality.

ORGANIZATION:

SOURCE: Strategies for Protection and Management of Floodplain Wetlands and Other Riparian Ecosystems. Johnson,

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): King, GM

DATE: 1990

TITLE: Dynamics and Controls of Methane Oxidation in a Danish Wetland Sediment

ORGANIZATION:

SOURCE: FEMS Microbiology Ecology FMECEZ, Vol. 74, No. 4, p 309-324, December 15, 1990. 7 fig, 4 tab, 50 ref. NASA Grant NAGW-1428.

ABSTRACT: The patterns and controls of methane oxidation in a Danish wetland sediment have been determined using a combination of slurry and intact core techniques. Sediments were collected from a small freshwater pond. Results from slurries indicated that methane oxidation was effectively inhibited by low concentrations of nitrapyrin (9 micromoles) and acetylene (0.5 micromoles) but that oxidation was relatively insensitive to pH between 6 and 8; in addition, high concentrations of ammonia (1 millimole) decreased oxidation, especially at alkaline pH. Kinetic analyses of methane oxidation in slurries indicated that Vmax was high relative to values reported for other sediments, that Vmax changed seasonally, that Km was consistently low (2-4 micromoles) and that threshold values were low (3-5 nanomoles) but insufficient to allow consumption of atmospheric methane. Analyses based on intact cores indicated that the extent of methane oxidation was highly dependent on oxygen availability, particularly as affected by benthic photosynthesis or the presence of algal mats. Methane emission and oxidation showed a light saturation response above 400 microEinsteins/sq m/sec. Both core and slurry analyses indicated that even short periods of anoxia resulted in losses of the capacity for methane oxidation after re-exposure to air. On the other hand, the presence of anoxia-insensitive organisms provided for a significant residual post-anoxia activity. Results from addition of nitrapyrin to the surface of intact cores indicated that shifts in methane emissions coincident with short-term changes in the availability of oxygen were the result of changes in methane oxidation, not methanogenesis. (Author's abstract) 35 000008013

TOPIC: 1.3.2

AUTHOR(S): Kings County Resource Planning Section, 1986

DATE: 1986

TITLE: Viability of Fresh Water Wetlands for Urban Surface Water Management and Nonpoint Pollution Control: An Annotated Bibliography.

ORGANIZATION:

SOURCE: State of Washington Department of Ecology

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Knight, R.L., B.H. Winchester, and J.C. Higman.

DATE: 1985

TITLE: Ecology, Hydrology, and Advanced Wastewater Treatment Potential of an Artificial Wetland in North-Central Florida.

ORGANIZATION:

SOURCE: Wetlands 5: 167-180 (Journal of the SWS).

ABSTRACT: Two artificial marsh/pond systems with a combined area of 21 ha were studied during a one-year period. Since their construction in 1978, volunteer plant colonization has resulted in a shifting mosaic of cattails (*Typha* spp.), water pennywort (*Hydrocotyle umbellata*), frog's-bit (*Limnobium spongia*), duckweed (*Lemna* spp.), and other less abundant species. At least 45 bird species were observed to use the wetlands during this study with very dense populations noted for several wetland-dependent species. Alligators, fish, turtles, and snakes were abundant in the ponds. The ponds operate as flow-through systems, receiving an average treated wastewater application of 4.8 cm per week. Mass balances indicated significant percent removals for biochemical oxygen demand (82%), total suspended solids (80%), and total nitrogen (93%). Removal of total phosphorus was lower, averaging 31% over the one-year study.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Knight, R.L., T.W. McKim, H.R. Hohl.

DATE: 1987

TITLE: Performance of A Natural Wetland Treatment System for Wastewater Management.

ORGANIZATION:

SOURCE: Journal Water Pollution Control Federation 59(8): 746-754.

ABSTRACT: The pollutant removal performance of a modified natural wetland used for polishing of sewage effluent from Walt Disney World, Florida, is described in this article. After processing in a wastewater treatment plant, effluent is directed into a 35 hectare swamp forest, flows through a 1680 meter course, and is discharged into a stream. Water quality results from 1978 through 1985 are presented. Pollutant inputs from sources other than the plant itself were not measured, and were considered by the authors to be relatively insignificant. Removals of 80% of biochemical oxygen demand and total suspended solids were achieved from 1978 to 1983. This efficiency decreased in 1984-1985 apparently because inflow concentrations from the plant decreased sharply and microbial organisms responsible for processing these constituents were starved. Over the study period, 70%-95% of total nitrogen was removed. Effluent concentrations of total phosphorus moderately exceeded influent quantities for every year except 1981, possibly due to stormwater inputs. Water temperatures were found to have no significant influence on pollutant removal. Residence time was determined to be the key factor in wetland treatment effectiveness.

TOPIC: 1.3.2

AUTHOR(S): Knuenzler, E.J.

DATE: 1989

TITLE: Value of Forested Wetlands as Filters for Sediments and Nutrients.

ORGANIZATION:

SOURCE: Forested Wetlands of the Southern U.S.. USDA, Forest Service. General Review of Water Quality, Orlando, FL.

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Kobriger, N.P. et al

DATE: 1983

TITLE: Guidelines for the Management of Highway Runoff on Wetlands

ORGANIZATION: TRB NRC

SOURCE: AASHTO, Transportation Research Board, National Research Council, Washington, D.C. Report #264. \$10.80

ABSTRACT: Extensive literature survey. Some data on metals uptake by wetlands flora. Information on wetlands creation and maintenance (p.27). Information on general highway design features; review of field studies with pollutant percent reduction data including: (1) Washington state - grass channel metal removal efficiencies (2) Performance of retention/detention controls, Orange County Florida / The guidelines contained in this report for the management of highway runoff on wetlands cover many functions: wetland creation and maintenance, wildlife considerations, regulatory controls, wetland monitoring, modeling techniques, and highway construction, design, and maintenance practices affecting the relationship between highway runoff and wetlands. The report also addresses the feasibility of using certain wetland types for mitigating the effects of highway runoff on wetlands, and it summarizes a companion agency document, "The Effects of Highway Runoff on Wetlands", that more fully covers the interaction of wetland systems and highway runoff, and the effects of highway runoff on wetlands. Additionally, the report includes an extensive bibliography with entries grouped by major subject area.

TOPIC: 1.3.2

AUTHOR(S): Kramer, Chin, and Mayo, Inc. (consultants).

DATE: 1981

TITLE: Development and Evaluation of Wetlands/Marsh Wastewater Treatment System.

ORGANIZATION:

SOURCE: Prepared for the City of Cannon Beach, Facilities Plan Addendum No.2, October.

ABSTRACT: Paper evaluates wetland/marsh wastewater treatment concept which has not previously been considered during prior efforts. This effort was designed to respond to the concerns of resource agencies questioning the previously considered artificial marsh and artificial marsh/aquaculture alternatives. The alternative recommended was developed utilizing concepts for wetlands and artificial marsh treatment.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Kulzer, L.

DATE: 1989

TITLE: Considerations For the Use of Wet Ponds For Water Quality Enhancement

ORGANIZATION:

SOURCE: Municipality of Metropolitan Seattle (METRO), Office of Water Quality, Seattle, WA.

ABSTRACT: Pollutants in stormwater runoff are associated with both the water itself and with the sediment carried by the water. In the water, dissolved nutrients and metals are pollutants of concern. Sediment also contain nutrients and metals, but in particulate form. Organic pollutants such as hydrocarbons and PAHs are also associated with particulate sediments. Studies done both locally and nationally demonstrate that the very small size fractions of sediment, generally less than a few micrometers, contain the majority of the sediment-bound pollutants.

Wet detention ponds can remove pollutants from stormwater by two distinct processes: (1) biological uptake of dissolved nutrients, and (2) sedimentation of particulate pollutants.

Since very small-sized sediment is of particular concern, conditions which allow for quiescent settling and long water-residence times result in the most effective pollutant removals.

The extent to which wet ponds remove pollutants was investigated by the Nationwide Urban Runoff Program studies (U.S. EPA, 1983), as well as in more recent studies. General conclusions of these studies have been that wet detention ponds, if of sufficient capacity, can effectively reduce the annual mass loading of pollutants to receiving waters.

On the basis of these field studies, as well as laboratory and computer modeling work, key design features are recommended for use of wet detention ponds for water quality improvement. Recommendations are summarized below.

Pond Size

The ratio of pond surface area to drainage area should be greater than 1%.

Pond volume should equal mean annual runoff volume for the catchment area times the development coefficient.

Hydraulic residence times should be in the order of 6-16 days.

Pond Configuration

Ponds should have two cells and long narrow configurations with length-to-width ratios greater than 3:1.

Minimize short-circuiting by use of baffles, maximizing path-length between inflow and outflow or submerging the inflow below the permanent pool level.

Control turbulence by introducing water through a wide swale or a gradually expanding inlet opening, using baffles and submerged weirs within the pond.

Maintenance

In addition to providing adequate pond sizing and reducing turbulence, adequate maintenance is an important concern. Removal of accumulated sediment can be achieved most easily with a two-celled design in which the first cell also acts as a sediment capture forebay, accessible by heavy equipment.

Conclusions

Wet detention basins have been shown, both in field studies and in laboratory and computer modeling efforts, to have considerable water pollution control potential. Questions arise, though, about the applicability of these results to the Northwest, where rainfall patterns differ significantly from the rest of the nation.

Using the EPA model to explore this question, the effectiveness of dynamic settling is seen to be a major design sensitivity in maritime climates where inflow occurs over prolonged periods of time. Based on laboratory modeling by Horner and Kortenof (1978), use of a two-celled pond is strongly recommended as the most effective technique for reducing turbulence.

Further investigation is needed to determine the extent to which dissolved nutrients are removed from wet ponds during low-light conditions typical of the rainy season in the Northwest. Removals may be less than predicted from national models, but specific data are lacking.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Kusler, J. A., and P. Riexinger

DATE: 1986

TITLE: Proceedings: National Wetlands Assessment Symposium

ORGANIZATION:

SOURCE: June 17-20, 1985, Portland, Maine. Sponsored by the Association of State Wetland Managers.

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Kusler, J.A., M.L. Quammen, and G. Brooks.

DATE: 1988

TITLE: Proceedings of the National Wetland Symposium: Mitigation of Impacts and Losses

ORGANIZATION:

SOURCE: New Orleans, Louisiana, October 8-10, 1986. Berne, NY: Association of State Wetland Managers, Inc.

ABSTRACT: Various aspects of wetland assessment are discussed by the papers in this collection, including wetland boundary definition, assessment of functions, and assessment of impacts. Several papers on mitigation and restoration are also included. Federal, state, and judicial perspectives on assessment are covered. Wetland functions discussed are habitat, flood control, sediment control, groundwater recharge/discharge, and aesthetics. Comprehensive assessment methods are examined in a number of papers. Impacts on wetlands, including dredging, pipeline construction, commercial development, and cumulative impacts, are covered. The Appendix contains a collection of paper on wetland protection in Maine.

This collection contains over 100 papers on many aspects of mitigation of impacts on and losses of wetlands. Federal policies and the Section 404 permit process are discussed, as are state policies and approaches. One group of papers discusses approaches for reducing or compensating for the impacts of specific activities, such as petroleum development in the arctic, port dredging and filling, restoration of dredged material disposal sites, agriculture, forestry, coal mining, and highway construction. Other sections cover various aspects of wetland restoration and creation including the mitigation of cumulative impacts, special area management, effectiveness, goals, evaluating wetlands for restoration and creation, succession and stability, physical requirements, large scale projects, and mitigation banking. Also included are case studies of wetland restoration and creation and guidelines for the restoration and creation of regional wetland types. The proceedings close with an identification of research needs and a summary.

TOPIC: 1.3.2

AUTHOR(S): Kusler, J.A., S. Daly, and G. Brooks (eds).

DATE: 1988

TITLE: Urban Wetlands.

ORGANIZATION:

SOURCE: Proceedings of the National Wetland Symposium sponsored by the Association of State Wetland Managers, Inc., June 26-29, 1988, Oakland, CA. (Berne, N.Y. 12023)

ABSTRACT: The papers in this collection address special problems in protection and management of wetlands in urban and urbanizing environments where wetland hydrology is often substantially altered, land values are high, wetlands are not of great value for waterfowl, and wetland protection and management is primarily in the hands of local government. Urban wetland functions are discussed, including wildlife and habitat, flood control and stormwater, and aesthetic and scenic values. The impacts of pollution on urban wetlands are examined. Other sections cover advanced identification of wetlands, special area management, urban planning related to wetlands, and case studies. Legal issues discussed include Section 404 regulation and local regulations. Papers on wetland protection cover acquisition and other nonregulatory approaches, and restoration and creation. Several papers discuss issues related to vernal pools, a California wetland type.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): LaBaugh, J.W.

DATE: 1986

TITLE: Wetland Ecosystem Studies from a Hydrologic Perspective.

ORGANIZATION:

SOURCE: Water Resources Bulletin 22(1):1- .

ABSTRACT: Selected studies from the literature were reviewed to determine the extent of knowledge about the relationship between hydrology and wetland ecosystem studies. Wetland studies of chemical input-output relationships have been the most dependent on hydrologic data of all wetland investigations; yet, very few of these studies have attempted to measure all components of a wetland's water balance. Usually, unmeasured components were calculated as the difference between measured inputs and outputs. Ground water frequently was overlooked. Chemical input-output investigations primarily were concerned with determining the amount of input retained in the wetlands. Few studies also included direct measurement of biogeochemical processes within wetlands of elements that were part of simultaneous input-output investigations. The importance of uncertainties in chemical budgets that are due to uncertainties in hydrologic budgets has been addressed in very few wetland investigations. Although many studies have emphasized the importance of hydrology to wetland ecosystem research, few studies have documented this, so that hydrology remains one of the least understood components of wetland ecosystems.

TOPIC: 1.3.2

AUTHOR(S): Lakatos, D.F. and L.J. McNemar.

DATE: 1988

TITLE: Wetlands and Stormwater Pollution Management.

ORGANIZATION:

SOURCE: pp 214-223 in Kusler, J.A. and Brooks, G. (eds), Proceedings of a National Symposium: Wetland Hydrology. Association of State Wetland Managers, Berne, New York

ABSTRACT: The use of wetlands for stormwater pollution management is discussed in this paper in terms of constituents, management facilities and design, performance and maintenance considerations, research needs, and current opinions on wetland use for stormwater management.

TOPIC: 1.3.2

AUTHOR(S): Landers, JC; Knuth, BA

DATE: 1991

TITLE: Use of Wetlands for Water Quality Improvement Under the USEPA Region V Clean Lakes Program

ORGANIZATION:

SOURCE: Environmental Management EMNGDC, Vol. 15, No. 2, p 151-162, March/April 1991. 5 tab 29 ref. New York Sea Grant Institute, NOAA Office of Sea Grant, US Department of Commerce Grant NA86AA-D-SG045.

ABSTRACT: The United States Environmental Protection Agency (USEPA) Region V Clean Lakes Program employs artificial and modified natural wetlands in an effort to improve the water quality of selected lakes. The use of wetlands at seven lake sites was examined and the physical and institutional means by which wetland projects are implemented and managed, relative to USEPA program goals and expert recommendations on the use of wetlands for water quality improvement, were evaluated. Management practices recommended by wetlands experts addressed water level and retention, sheet flow, nutrient removal, chemical treatment, ecological and effectiveness monitoring, and resource enhancement. Institutional characteristics recommended include: local monitoring, regulation, and enforcement and shared responsibilities among jurisdictions. Institutional and ecological objectives of the National Clean Lakes Program were met to some degree at every site, with social objectives achieved to a lesser extent. Wetland protection mechanisms and appropriate institutional decentralization were present at all sites. Optimal management techniques were employed to varying degrees at each site, but most projects lacked adequate monitoring to determine adverse ecological impacts and effectiveness of pollutant removal and did not extensively address needs for recreation and wildlife habitat. There is evidence that the wetland projects are contributing to improved lake water quality; however, more emphasis needs to be placed on wetland protection and long-term project evaluation. (Author's abstract) 35 000607143

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Larson, J.S., and C. Niell (eds).

DATE: 1987

TITLE: Mitigating Freshwater Wetland Alterations in the Glaciated Northeastern United States: An assessment of the Science Base.

ORGANIZATION:

SOURCE: Publication 87-1, Environmental Institute, University of Massachusetts, Amherst, MA

ABSTRACT: This workshop examined three key biophysical elements of wetlands in the northeastern United States, hydrology, soils, and vegetation, in connection with artificial wetland construction for mitigation purposes. There are several papers that discuss wetland functions, including: Soils Science Base for Freshwater Wetland Mitigation in the Northeastern United States, Vegetation in Freshwater Replacement Wetlands in the Northeast, Hydrology and Construction of a Mitigating Wetland, and Engineering Considerations in Wetlands Mitigation. Each of these papers relates studies of wetlands functions directly to the purpose of replicating these functions artificially. Also included in this document are the reports of working groups on wetland soils, vegetation, and hydrology. The groups evaluated the importance of each of these features to the basic wetland functions described by Adamus and Stockwell (1983), and defined data requirements for assessing the functional significance of these features.

TOPIC: 1.3.2

AUTHOR(S): Lee, C.R., R.M. Smart, T.C. Sturgis, R.N. Gordon, and M.C. Landin.

DATE: 1978

TITLE: Prediction of heavy metal uptake by marsh plants based on chemical extraction of heavy metals from dredged material.

ORGANIZATION:

SOURCE: U.S. Army Engineer Waterways Experiment Station, Vicksburg, Miss. 39180. Technical Report D-78-6.

ABSTRACT: A field and laboratory study was conducted to establish the extent of heavy metal absorption and uptake by marsh plant species from dredged material and to develop a technique using chemical extraction of heavy metals from dredged material to predict the concentration of heavy metals in marsh plants subsequently grown on the dredged material.

TOPIC: 1.3.2

AUTHOR(S): Lee, G.F., et al.

DATE: 1975

TITLE: Effects of Marshes on Water Quality.

ORGANIZATION:

SOURCE: p. 105-127 In: A.D. Hasler (ed.), Coupling of Land and Water Systems. Springer-verlag, New York, NY.

ABSTRACT: Marshes and other wetlands in which there is profuse growth of aquatic plants are common in many parts of the world. Wisconsin contains many thousands of hectares of marsh vegetation, which typically stands from a half meter to several meters above the normal water elevation during the growing season. Water depths range from a few centimeters to several meters.

There is a certain flux of nutrients to the marsh from groundwaters, surface flow, and direct precipitation and gas exchange. The outflow is manifest in deposition of materials in the sediments, gas exchange, and transport in streams draining the marsh. The marsh is a complex hydrologic, chemical, and biochemical system which can transform various elements into compounds that may improve water quality or have a deleterious effect.

Wetlands are often considered low-value land since in their normal condition they cannot be used for most agricultural activities or urban development. There has been increasing pressure to drain marshes to provide higher-value land for suburban development. Also, some farmers have capitalized on the large amounts of nutrients stored within the marsh to develop muck farming after draining the marsh. The drainage of a marsh changes the release of aquatic plant nutrients. This chapter discusses results from the University of Wisconsin Water Chemistry Program on effects of marshes on water quality.

TOPIC: 1.3.2

AUTHOR(S): Lee, L.C.

DATE: 1991

TITLE: Constructed Wetlands for Stormwater Management.

ORGANIZATION:

SOURCE: National Wetland Science Training Cooperative, Seattle, WA.

ABSTRACT:

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Lee, L.C., and J.G. Gosselink.

DATE: 1988

TITLE: Cumulative Impacts on Wetlands: Linking Scientific Assessments and Regulatory Alternatives.

ORGANIZATION:

SOURCE: Environmental Management 12(5): 591-602.

ABSTRACT: This article is an extension and application of Preston and Bedford (1988), especially as relevant to bottomland hardwood (BLH) forests of the southeastern United States. The most important cumulative effects in BLH forests result from incremental forest loss (nibbling) and from synergisms resulting from this nibbling. Present regulatory procedures are ineffective in preventing incremental forest loss because of the focus on permit site evaluation, rather than on large landscapes. Three examples are given to illustrate the need for a landscape focus. This perspective requires pre-planning or goal-setting to establish the desired conditions to be maintained in the regulated landscape unit.

Spatial and temporal scales are of particular concern for landscape impact assessment. Natural drainage basins of about 106 ha, as identified in the U.S. Geological Survey hydrologic units, appear to appropriate spatial units; they have fairly natural boundaries, are of sufficient size to support populations of large, wide-ranging mammals, and are compatible with existing maps and databases. Time scales should be sufficiently long to include recovery of wetland ecosystems from human perturbations. In practice, available data sets limit analysis to no longer than 50 yr. Eight indicators of landscape integrity are identified, based on generally available long-term data sets.

Linking technical information concerning cumulative effects on landscapes to the evaluation of cumulative impacts in regulatory programs (i.e., goal-setting) is a serious issue that can benefit from precedents found in the field of epidemiology, and in the establishment of clean air and clean water standards. We suggest that reference data sets must be developed, relating BLH function to structure (forest area). These can be used to set goals for individual watersheds, based on their present conditions and the magnitude and type of perceived development pressures. Thus the crucial steps in establishing a successful program appear to be (1) establish study unit boundaries, (2) assess the condition of study unit landscape integrity (3) set goals, and (4) consider the impacts of permit proposals with both goals and the existing condition of the study unit landscape in mind.

TOPIC: 1.3.2

AUTHOR(S): Linker, Lewis C.

DATE: 1989

TITLE: Creation of Wetlands for the Improvement of Water Quality: A Proposal for the Joint Use of Highway Right-of-Way

ORGANIZATION:

SOURCE: From Proceedings from the First International Conference on Constructed Wetlands for Wastewater Treatment held in Chattanooga, Tennessee June 13-17, 1988.

ABSTRACT: This chapter describes a proposal to incorporate public lands through joint use of highway right-of-way, identifying a site in Maryland for joint use as an engineered wetland; providing preliminary analysis of the site's control effectiveness and design life costs.

TOPIC: 1.3.2

AUTHOR(S): Livingston, E.H.

DATE: 1988

TITLE: The Use of Wetlands for Urban Stormwater Management.

ORGANIZATION:

SOURCE: Presented at International Conference on Wetlands for Wastewater Treatment, June 13-17, 1988, Chattanooga, TN. Paper also in pp. 467-490: Roesner, L.A., B. Urbonas, and M.B. Sonnen (eds) 1989. Design of Urban Runoff Quality Controls.

ABSTRACT: The natural capabilities of wetlands imply that they could be incorporated into a stormwater management system to enhance the removal of pollutants commonly found in urban stormwater. However, the design of such systems must consider many factors to assure that the wetland filter is not damaged nor is the wetland ecologically harmed. Design variables for natural and constructed wetland stormwater treatment systems will be discussed. Criteria used in Florida for natural wetland treatment systems and criteria used in Maryland for constructed wetland systems will be reviewed. The review of this "art" will include a discussion of the many unknowns that must still be determined concerning the long-term ability of using wetlands for stormwater management.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Livingston, G.H.

DATE: 1988

TITLE: The Case for Wetlands for Urban Stormwater Management.

ORGANIZATION:

SOURCE: Proceedings of the Engineering Foundation Conference on Design of Urban Runoff Quality Control. Potosi, MO.

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Lloyd-Evanns, T.L.

DATE: 1989

TITLE: Use of Wetlands for Stormwater Detention Effects on Wildlife Habitat.

ORGANIZATION:

SOURCE: Manomet Bird Observatory. Cited In Azous, 1991

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Loucks, O.L.

DATE: 1989

TITLE: Restoration of the Pulse Control Function of Wetlands and Its Relationship to Water Quality Objectives.

ORGANIZATION:

SOURCE: p 55-65 In: J.A. Kusler and M.E. Kentula (eds), Wetland Creation and Restoration: The Status of the Science. Vol II: Perspectives. US EPA Environmental Research Laboratory, Corvallis, OR. EPA/600/3-89/038.

ABSTRACT: Many wetlands and wetland restoration opportunities occur in the poorly drained headwaters of streams, along the stream floodplains, and at discharge points to larger water bodies. All of these are greatly changed by upland development that accelerates flows and increases the runoff pulse from headwater areas. In turn, the runoff increases scouring and transport of sediments, and subsequent deposition in or erosion of downstream wetland types. Successful restoration must consider how the hydrologic pulse may have been changed and whether pulse control measures can bring stream flows within a range consistent with historical development of downstream wetlands.

Comparison of spring versus summer loadings pulses indicates major differences in the seasonality of transport of excess nutrients into wetlands and downstream water bodies. The annual average loading is misleading, indicating that statements on wetland functions which ignore their role during pulsed events probably understate their significance in the landscape. Modelling studies of runoff and sediment transport suggest the combination of reduced soil exposures and restoration of wetland cover in temporary detention areas can produce major benefits in stream water quality. With additional parameters, quantitative estimates could be made of the cumulative impact of wetland restoration toward mitigation of flood peaks and the transport of sediment and toxic substances into adjacent aquatic systems.

At present, the general physical relationships between land use and hydrology provide only a guide to the prospective benefits we associate with investment in wetland restoration. They suggest how to evaluate tradeoffs in benefits and costs between a lower cost investment higher in the watershed (carried out over large areas), versus investment in a higher risk but potentially higher quality wetland restoration along the main stem or outlet of a drainage system. Although limited predictive capabilities exist for assessing the efficacy of restored wetlands, they have not been subjected to quantitative testing within the environment of wetland restoration technology. There is a need for more complete treatment response modeling and model testing if the predictive capability needed to improve wetland restoration is to become available.

TOPIC: 1.3.2

AUTHOR(S): Loucks, O.L.

DATE: 1981

TITLE: The Littoral Zone as a Wetland: Its Contribution to Water Quality.

ORGANIZATION:

SOURCE: Proceedings of the Midwest Conf. on Wetland Values and Management.

ABSTRACT:

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Lowrance, R., R. Leonard, and J. Sheridan.

DATE: 1985

TITLE: Managing Riparian Ecosystems to Control Nonpoint Pollution.

ORGANIZATION:

SOURCE: Journal of Soil and Water Conservation, Jan-Feb 1985. 40: 87-91.

ABSTRACT: Although riparian wetlands in different environments feature some differing characteristics, they all share common functional traits. Riparian ecosystems in Coastal Plain environments may have more potential for controlling water quality because of land use and hydrologic characteristics, but all streamside ecosystems exert significant effects on nonpoint-source pollution. Management or preservation of riparian ecosystems must occur on a watershed-by-watershed basis, and either management or preservation should take into account the potential use of the ecosystems to enhance water quality. Many areas of riparian habitat, especially on perennial streams in the West, are lost to impoundments or overwhelmed by invasion of exotic species.

Future management policies for riparian ecosystems should recognize inherent and man-made regional differences. In the West and Midwest, restoration of riparian ecosystems may be a cost-effective means of controlling nonpoint source pollution. In the East, especially in the Piedmont and Coastal Plain, management of existing riparian ecosystems to improve both their productivity and their pollution control capacity is in order. Projects that link riparian ecosystem management with upland conservation practices should be considered in watershed management programs.

TOPIC: 1.3.2

AUTHOR(S): Lukens, J.E., and J.M. Everett.

DATE: 1978

TITLE: Artificial Wetlands: Values, Regulatory, and Developmental Issues.

ORGANIZATION:

SOURCE: Office of Water Research and Technology, Washington, DC. NTIS PB80-115934.

ABSTRACT: This study has proven valuable on several counts. First, in raising the question of comparability between natural and artificial wetlands it has been possible to show that: a) many apparent natural wetlands are in effect man-made and b) that within a very few years after its creation and without manipulation and maintenance a man-made wetland will resemble a natural wetland. Second, that wetland identity and interest depends on its type and its form as a wetland diminished through the successive stages of filling. Three, it is possible to program the replacement of natural wetlands with artificial wetlands of equal or even higher value so as to allow more rational development. However, the corollary to this observation is that in most cases such manipulation will be costly and of marginally beneficial value. Economics more than persuasion dictate retention of natural situations in most cases. Fourth, the study points out that a rating of wetland value is essential so that targeted, significant wetlands can be protected with enforcement. Conversely, less valuable wetlands can then be more straightforwardly dealt with in cases of modification or even filling. Fifth, it has been shown that urbanization has been, in part, shaped by proximity to wetlands and that, by and large, this limitation has constricted sprawl and concentrated development in a beneficial way. In some cases, however, settlement configuration has been extended by the meandering of wetlands. Where this has been detrimental to town cohesion, modifications (filling) of wetlands has occurred historically, and should be permitted and encouraged in the future.

Therefore, the major recommendation is for a more reasonable evaluation system which would permit easy identification of key important wetlands followed by stringently enforced protection. Several public and private agencies are currently working on various aspects of this problem. Such a system would ideally help to improve each state's legal situation in that it would reduce required surveillance and identify the most critical areas before situations arise.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Lyon, J.G., R.D. Drobney, and C.E. Olson, Jr.

DATE: 1986

TITLE: Effects of Lake Michigan Water Levels on Wetland Soil Chemistry and Distribution of Plants in the Straits of MacKinac.

ORGANIZATION:

SOURCE: J. Great Lakes Res. 12(3): 175-183.

ABSTRACT: The effects of short-term or summer season water level fluctuations on wetlands were determined from measurements of flooding, relative soil chemistry, and the presence of plants. Analyses demonstrated higher relative concentrations of plant-available soil nutrients and higher density of plants on flooded emergent wetlands as compared to infrequently flooded, unconsolidated shore sites. Flooding resulted in anaerobic soil conditions and increased concentrations of nutrients for wetland plants. The density of emergent wetland plants was highest where the topographic conditions and water level led to duration of flooding between 50 and 85% of the growing season. The effects of long-term water level fluctuations on wetlands were measured from historical aerial photographs of low, average, and high lake level conditions (1938 to 1980). An increase in water levels of 0.3 m reduced the extent of coastal wetlands by 18%. Historical aerial photos demonstrated and a model predicted that 13% of the total wetlands measured at low lake levels remained in the study area at the highest lake level sampled. This result was verified during the high lake levels of May 1985.

TOPIC: 1.3.2

AUTHOR(S): Marble, A.D.

DATE: 1992

TITLE: A Guide To Wetland Functional Design

ORGANIZATION:

SOURCE: Lewis Publishers, Boca Raton, FL

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Maryland Dept. of the Environment

DATE: 1978

TITLE: Wetland Basins for Stormwater Treatment: Discussion and Background.

ORGANIZATION:

SOURCE: MD. Dept of Env.

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): McArthur, B.H.

DATE: 1989

TITLE: The Use of Isolated Wetlands in Florida for Stormwater Treatment

ORGANIZATION:

SOURCE: p. 185-193 In: D.N. Fisk (ed), Wetlands: Concerns and Successes. Proceedings, American Water Resources Association Symposium, Tampa, FL, Sept. 17-22, 1989.

ABSTRACT: The Florida Department of Regulation (FDER) under Chapter 84-79, Laws of Florida, the Warren S. Henderson Wetland Protection Act of 1984 and Chapters 40D-4 and 17-25 of the Florida Administration code (FAC) provide for the use of isolated wetlands for the treatment of stormwater runoff. Wetlands in the past have been used for disposal of treated effluent but prior to October 1, 1984 wetlands have not been permitted through the state agencies to receive direct discharge of untreated stormwater runoff from developments. This concept allows for the incorporation of isolated wetlands into stormwater management plans and has provided incentive for the preservation of wetlands within a development. It is the intent of this concept to show that with proper design, a wetland can be used to treat stormwater runoff by natural means without damaging or significantly altering the existing ecosystems. In fact, research has shown that the addition of stormwater can help ensure the maintenance of existing hydroperiods and provide additional nutrients which could increase the productivity of the wetland. Stabilizing the ecosystem can improve wildlife habitat and provide an enhancement of the aesthetic value of the wetland and the development. The purpose of this paper is to discuss stormwater treatment in isolated wetlands with emphasis on the continuing research in Florida. The review will include 1) the rules and regulations set forth by the State of Florida; 2) detention times and the benefits to water quality; 3) sampling procedures to insure water quality standards, and 4) the design of a pilot project to be used by the state to set and check compliance with standards.

24-Apr-98

TOPIC: 1.3.2
AUTHOR(S): Meiorin, Emy
DATE: 1986
TITLE: Urban Storm Water Treatment at Coyote Hills Marsh
ORGANIZATION: ABAG
SOURCE: Oakland, CA
ABSTRACT: Effectiveness data for a wetland used to improve water quality of urban runoff.

TOPIC: 1.3.2
AUTHOR(S): Merrow, R.L.
DATE: 1978
TITLE: The Effects of Temperature on Denitrification of Wetland Soils.
ORGANIZATION:
SOURCE: M.S. Thesis, Tufts University, Medford, Massachusetts.
ABSTRACT:

TOPIC: 1.3.2
AUTHOR(S): Milligan, D.A.
DATE: 1985
TITLE: The Ecology of Avian Use of Urban Freshwater Wetlands in King County, Washington.
ORGANIZATION:
SOURCE: Master's Thesis, University of Washington College of Forest Resources. 145 pp.

ABSTRACT: The ecology of avian use of urban freshwater wetlands in King County, Washington was examined in order to determine what factors affected bird species use of these systems. Bird species use was found to be correlated with wetland habitat complexity. Combination wetlands (those with three or more wetland classes) that had the highest number of plant communities present had the highest bird use as measured by bird species richness, plant species richness, and more bird species breeding than in Open Water or Scrub-Shrub wetlands.

Different buffer widths were tested to determine their effects on bird community composition. The amount of buffer was positively correlated with bird community response variables such as bird species diversity. The amount of buffered wetland edge proved to have the strongest correlation. Furthermore, results showed there was only a minor increase in predicted bird species response with the increased buffer widths of 50 feet, 100 feet, and 200 feet.

Comparisons made between the created and natural Combination and Open Water wetlands indicated that it is possible to simulate natural wetlands and create wetlands for wildlife habitat. Results served not only as baseline biological information regarding the ecology of urban wetlands but also as the basis for design decisions when enhancing natural urban wetlands or when creating urban wetlands. Design implication and recommendations are discussed.

TOPIC: 1.3.2
AUTHOR(S): Mitsch, W.J.
DATE: 1992
TITLE: Landscape Design and the Role of Created, Restored, and Natural Riparian Wetlands in Controlling NonPoint Source Pollution.
ORGANIZATION:
SOURCE: Ecol. Enginn. 1; 27-47
ABSTRACT:

TOPIC: 1.3.2
AUTHOR(S): Mitsch, W.J., and J.G. Gosselink.
DATE: 1986
TITLE: Wetlands.
ORGANIZATION:
SOURCE: Van Nostrand Reinhold Company, NY., NY.
ABSTRACT: An excellent textbook dealing with scientific and management aspects of U.S. wetlands, aimed at scientists, engineers, and planners in wetland management, as well as upper-level undergraduates and graduate students.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Mitsch, W.J.; Reeder, B.C. and Klarer, D.M.

DATE: 1989

TITLE: The Role of Wetlands in the Control of Nutrients with a Case Study of Western Lake Erie.

ORGANIZATION:

SOURCE: Ecological Engineering: An Introduction to Ecotechnology., Mitsch, W.j. and Jorgensen, S.E. (eds.). Wiley Publishing.

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Morris, F.A., M.K. Morris, T.S. Michaud, and L.R. Williams.

DATE: 1981

TITLE: Meadowland Natural Treatment Processes in the Lake Tahoe Basin: A Field Investigation. (Final Report.)

ORGANIZATION:

SOURCE: Environmental Protection Agency report EPA-600/54-81-026, NTIS PB81-185639.

ABSTRACT: The report investigates the effectiveness of using natural meadowlands and wetlands to trap nutrients and sediments on land from surface and storm water runoff before they reach Lake Tahoe. Seven systems consisting of four streams and three drainage areas were studied. The study systems can be divided into those which remained channelized and those which spread as sheet flow across meadowlands. In the channelized systems, P, N, suspended sediments, and organic carbon concentrations usually remained unchanged or increased from the inlet to the outlet of the meadow. The sheet flow systems exhibited reductions up to 93% of total p, 71% of NH₃(-N), 96% of NO₂(-NO₃(-)N, 82% of Kjeldahl-N, 94% of turbidity, 75% of TOC, 91% of POC, 91% of total residue, and 97% of non-filtrable residue. The effectiveness of nutrient removal in the functional systems approached that of conventional tertiary treatment.

TOPIC: 1.3.2

AUTHOR(S): Mudrock, A., and J.A. Capobianco.

DATE: 1979

TITLE: Effects of Treated Effluent on a Natural Marsh.

ORGANIZATION:

SOURCE: Journal WPCF 51(9): 2243-2256.

ABSTRACT: Selected water quality parameters were monitored during an 8-month period in 1975 to 1976 in streams draining into Cootes Paradise. During the study period, the discharge from the Dundas wastewater treatment plant, which passed through West Pond marsh area, was the major contributor of nutrients to the main body of water in Cootes Paradise.

The geochemical analyses of bottom sediments obtained from five localities in Cootes Paradise showed increased amounts of Pb, Cr, Hg, Cu, and Zn in the sediment vertical profile at West Pond.

N, P, and organic C contents in the bottom sediments obtained from the main body at Cootes Paradise were found to be comparable to the unpolluted bottom sediments from lakes and marshes. A high concentration of N, P, and organic C was found at the surface (0 to 5 cm) of the bottom sediment sample from West Pond.

The major plant species growing in the West Pond, Desjardins Canal, and Long Valley Creek area is *Glyceria grandis*. According to the vegetation maps from 1949, these areas formerly were occupied by a mixed stand of *Typha* sp. and *Glyceria grandis*. Today, only *Glyceria grandis* remains.

The shoot standing crop of *Glyceria grandis* at three localities, mainly West Pond, Desjardins Canal area, and Long Valley marsh area, was associated with the amounts of P, N, and organic C in the sediments in which the plants were growing and with the amounts of P and N in the surrounding water. Tissue nutrient levels in April were highest in *Glyceria grandis* at the West Pond area. However, in July, the plants collected at the Long Valley area had the highest nutrient content. The shoot standing crop yield affected the total uptake (weight per unit area) of nutrients by *Glyceria grandis* at each sampling station. The highest yield was obtained from the West Pond area in April and in July.

Lemna minor and *Myriophyllum verticillatum*, collected at the West Pond area, accumulated larger quantities of Pb, Zn, Cr, and Cd than the same species collected along the north shore of Cootes Paradise main body of water. Because the concentration of the examined metals in the West Pond outlet water, in the streams, and in the main body of water were generally low, it was assumed that the source of these metals for the plants was the bottom sediment and/or the suspended matter.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Mulica, W.S.

DATE: 1977

TITLE: Wetlands and Municipal Ground Water Resource Protection.

ORGANIZATION:

SOURCE: p. 297-316 in: R.B. Pojasek (ed), Drinking Water Quality Enhancement Through Service Protection.

ABSTRACT: The groundwater value of wetlands has gone generally unnoticed. Wetlands have a proven capability of attenuating a variety of point and nonpoint pollutants generated by land uses near water supplies. Wetland plants remove nitrates, phosphates, and heavy metals from wastewater. Two case histories dealing with wetlands and municipal water supply protection are presented to illustrate the proven municipal value of wetlands. The first, from southeastern Wisconsin, illustrates how a major wetland is critical to water supplies in several communities. The second, from Burlington, Mass., documents how a major municipal groundwater supply adjacent to a wetland has been impaired by recent urban encroachment. In Massachusetts, the Wetlands Protection Act states that wetlands have protectable, water related values, including water supply, groundwater, flood control, storm damage prevention, prevention of pollution, fisheries, and shellfish. A wetland evaluation system used to gather data necessary to rate wetland significance within a municipality is described.

TOPIC: 1.3.2

AUTHOR(S): Newton, Richard

DATE: 1989

TITLE: The Effects of Stormwater Surface Runoff on Freshwater Wetlands

ORGANIZATION: Un. of MA

SOURCE: Publication 90-2, The Environmental Institute, University of Massachusetts, Amherst, MA 77 pp.

ABSTRACT: Use of natural wetlands discouraged. Created wetlands could be used if a regular maintenance schedule is in place. A bibliography for the effects of stormwater on wetlands was included. No cost information.

TOPIC: 1.3.2

AUTHOR(S): Nichols, D.S.

DATE: 1983

TITLE: Capacity of Natural Wetlands to Remove Nutrients from Wastewater.

ORGANIZATION:

SOURCE: Journal WPCF 55(5): 495-505.

ABSTRACT: Application of treated wastewater to wetlands is gaining attention as a simple and energy-efficient method of nutrient removal. Wetlands retain wastewater P by adsorption and precipitation reactions with Al, Fe, and Ca in the soil. Adsorption/precipitation is not a limitless sink. With continued application, the capacity of wetland soils to retain P declines as the soils become saturated. Adsorption is at least partially reversible. Some P that is adsorbed from the water at high concentrations can be released to the water when P levels are lower. Wastewater N is removed by denitrification in the wetland soil. Denitrification is dependent on a supply of available organic carbon. In typical wetlands with large amounts of organic matter in the soil, N removal does not seem to decline with time, in contrast to P removal. Wetland vegetation can absorb large quantities of N and P during the growing season, but much of it is released to the water when the plants die. The removal of wastewater N and P by wetlands is most efficient at low N and P loading rates. Removal efficiency of both N and P falls off rapidly as loadings are increased. On the average, perhaps 1 ha of wetland is required to remove 50% of the N and P from wastewater produced by 60 people. Much larger wetland areas are required for higher removal efficiency. Application to natural wetlands can be an effective method of wastewater nutrient removal if wetland is abundant and populations are low.

TOPIC: 1.3.2

AUTHOR(S): Nickerson, N.H.

DATE: 1978

TITLE: Freshwater Wetlands: Their Nature and Importance to Man.

ORGANIZATION:

SOURCE: Tufts University, Medford, MA.: The Lincoln Filene Center for Citizenship and Public Affairs.

ABSTRACT:

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Niering, W.A.

DATE: 1989

TITLE: Effects of Stormwater Runoff on Wetland Vegetation.

ORGANIZATION:

SOURCE: Draft. Connecticut College, New London, CT.

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Nixon, S.W. and Lee, V.

DATE: 1985

TITLE: Wetlands and Water Quality.

ORGANIZATION:

SOURCE: Report to the Waterways Experiment Station, U.S. Army Corps of Engineers, Vicksburg, Miss.

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Nixon, S.W. and Lee, V.

DATE: 1989

TITLE: Wetlands and Water Quality

ORGANIZATION:

SOURCE: U.S. Army Corps of Engineers Rep. T-86-2, pp.-229

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Nixon, S.W., and V. Lee.

DATE: 1986

TITLE: Wetlands and Water Quality: A Regional Review of Recent Research in the United States on the Role of Freshwater and Saltwater Wetlands as Sources, Sinks, and Transformers of Nitrogen, Phosphorus, and Heavy Metals.

ORGANIZATION:

SOURCE: Prepared by Univ. of Rhode Island, for US Army Engineer Waterways Experiment Station, Vicksburg, Miss. Technical Report Y-86-2.

ABSTRACT: This report is the first in a series of four literature reviews on wetland functions and values. Each review covers one of the following four broad wetland functions and values: (1) water quality, (2) fish and wildlife habitat, (3) socioeconomics, and (4) hydraulics. The four reports, along with other information, were used to develop a multiyear wetlands functions and values research study plan implemented by the US Army Engineer Waterways Experiment Station. This report examined the literature on water quality functions of wetlands.

The coterminous United States and Alaska were divided into seven geographic regions representing groups of Corps of Engineers Districts. Within each geographic region, the quality and quantity of literature were examined by wetland type and function within wetland types. The specific water quality functions examined included wetlands as sources, sinks, and transformers of nutrients and heavy metals. A review of literature on mass balance studies of nutrients, and heavy metals was also provided for each region. Recommendations are provided to address data gaps identified during the literature review.

Study results indicated considerable diversity in the quantity and quality of wetlands water quality literature between and within each geographic region of the coterminous United States and Alaska. In general, wetlands water quality has been studied most intensely in the estuarine marshes of the Gulf and North Atlantic coasts. Water quality in freshwater has not received attention commensurate with the wide distribution of these wetland types. Most previous wetlands water quality research has been fragmented into site-specific or function-specific studies. Very few mass balance studies have been conducted.

Two complementary approaches to addressing wetlands water quality research data gaps are recommended. The first approach is to develop mass balances or budgets of carbon, nutrients, heavy metals, and other possible pollutants. The mass balance studies should be determined at carefully selected field sites over several annual cycles. The second approach would focus on the design, construction, and use of experimental wetland microcosms. The microcosms would permit assessment of the fates and effects of various materials under highly controlled conditions.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Novitzki, R.P.

DATE: 1979

TITLE: The Hydrologic Characteristics of Wisconsin Wetlands and Their Influence on Floods, Streamflow and Sedimentation.

ORGANIZATION:

SOURCE: Wetlands Function and Values: The State of Our Understanding. The American Water Resources Association, Minneapolis, MI.

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Oberts, G., and R. Osgood

DATE: 1988

TITLE: Lake McCarrons Wetland Treatment Systems: Final Report on the Function of Wetland Treatments

ORGANIZATION:

SOURCE: Metropolitan Council of the Twin Cities Area

ABSTRACT: Wetlands are very eff. in removal of solids associated pollutants and moderately eff in removing soluble nutrients. Treatment efficiencies are lower for the wetland than for the detention ponds. Wetland did good job on solid settling, less eff for sol. nutrients. Performance of detention pond and wetlands are evaluated and some additional design criteria are provided.

TOPIC: 1.3.2

AUTHOR(S): Oberts, G.L.

DATE: 1981

TITLE: The Impacts of Wetlands on Water Quality.

ORGANIZATION:

SOURCE: Presented at the Minnesota Water Planning Board Wetlands Values and Management Conf., St. Paul, MN. June 1981

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Oberts, G.L.

DATE: 1981

TITLE: Impact of Wetlands on Watershed Water Quality.

ORGANIZATION:

SOURCE: Presented at Minnesota Water Planning Board Wetland Values and Management Conference, St. Paul, MN, June 1981.

ABSTRACT: A nonpoint source water quality sampling study was conducted on six rural and 11 urban watersheds in the Minneapolis-St. Paul Metropolitan Area (2,968 square miles). Wetland occurrence was one principal watershed selection criterion because wetlands were expected to play a major role in determination of watershed water quality. Regionally, wetlands comprise approximately 7.4 percent of the total seven-county area; wetlands percentages in the sampled watersheds vary from 4.8 to 16.3 in the rural basins and from 0 to 14.5 in the urban basins. Results of the water quality monitoring show that wetlands occurrence relates to the annual watershed loads for several sampled constituents. Multiple regression statistical modeling of the sampled watersheds yields significant relationships when various combinations of wetland-related watershed factors are evaluated.

Dependence upon wetlands for treatment of soluble or fines-associated pollutants in rural areas does not appear feasible because wetlands are frozen and/or biologically dormant during the period when most of the annual load occurs. From a management standpoint, retention of urban wetlands as treatment systems appears to be a very beneficial practice, as does retention of rural wetlands for particulate controls and related natural resource benefits. Additional study is needed concerning the impact on wetlands from continuous nonpoint loading.

24-Apr-98

TOPIC: 1.3.2
AUTHOR(S): Oberts, Gary
DATE: 1982
TITLE: Impact of Wetlands on Nonpoint Source Pollution
ORGANIZATION: Un. of KY
SOURCE: International Symposium on Urban Hydrology,Hydraulics and Sediment Control. Lexington, KY
ABSTRACT: TSS, TN, and TP removal are increased in wetland areas. No cost data available.

TOPIC: 1.3.2
AUTHOR(S): Occoquan Watershed Monitoring Lab
DATE: 1990
TITLE: Final Project Report, The Evaluation of a Created Wetland as an Urban BMP
ORGANIZATION: NVSWCD
SOURCE:
ABSTRACT: Effectiveness data for a wetland used to treat urban runoff. No cost data.

TOPIC: 1.3.2
AUTHOR(S): Odum, E.P.
DATE: 1978
TITLE: The Value of Wetlands: A Hierarchial Approach
ORGANIZATION:
SOURCE: Pp. 16-25, In: P.E. Greeson et al (eds.), Wetland Functions and Values: The State of Our Understanding. American Water Resources Assoc, Minneapolis,MN.
ABSTRACT: The value of wetlands is being recognized in political and economic circles; however, the means for quantifying values for decision purposes are yet to be developed. The hierarchial approach to determining the values involves a consideration of component levels (for example, population), ecosystem levels, and global levels. In ecosystems, values are implied for hydrologic considerations and productivity. Waste assimilation and the role of wetlands in global cycling and atmospheric stability form the highest level. Several approaches for summarizing the values that accrue to the various hierarchical levels are possible, including the common denominator approach, the scaling and weighting approach, and the replacement value approach. The latter seems to be more acceptable to economists because one can make an accurate estimate of the monetary costs associated with the loss of a "free" service performed by a wetland ecosystem.

TOPIC: 1.3.2
AUTHOR(S): Olson, R.K.
DATE: 1992
TITLE: Created and Natural Wetlands for Controlling Nonpoint Source Pollution.
ORGANIZATION:
SOURCE: Lewis Publ., Boca Raton, FL.
ABSTRACT:

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Palmer, C.N. and J.D. Hunt

DATE: 1989

TITLE: Greenwood Urban Wetland: A man-made Stormwater Treatment Facility.

ORGANIZATION:

SOURCE: p. 205-214 In: D.W. Fisk (ed) Wetlands: Concerns and Successes. Proceedings, American Water Resources Association Symposium in Tampa, Florida, Sept. 17-22, 1989.

ABSTRACT: The Greenwood Urban Wetland was built to alleviate flooding in a 522-acre drainage basin in Orlando, Florida, pretreat stormwater runoff prior to disposal down drainage wells and use water collected in the storage basins for irrigation of an adjacent cemetery and park. Formerly vacant city-owned land was excavated to form a series of ponds and a bypass stream leading to five drainage wells. A 25 to 30 foot wide littoral zone was established for each pond and planted with 10 species of native macrophytes. A riverine flood plain was established in the bypass canal consisting of 7 species of hardwood swamp trees. A 26-acre park with walkways and bridges built over hydraulic control structures was landscaped with 7 species of native upland trees. Hydraulic control structures were built to maximize stormwater detention time. Aeration devices were installed in each pond to improve the system's capacity to assimilate incoming organic contaminants in the stormwater runoff. A sediment control device was built upstream of the project to reduce both nutrient and solids loading. Skimmers and floatable debris collectors were installed upstream of the drainage well intake structures to control oils and grease and floating trash. A 4-foot diameter wet well, intake flume and pump station were installed to provide irrigation water for adjacent lands. this paper describes the need for and construction of the urban wetland project and discusses preliminary findings of the effectiveness of the treatment system.

TOPIC: 1.3.2

AUTHOR(S): Peinelt, L.E. and R.R. Horner

DATE: 1995

TITLE: Pollutant Removal from Stormwater Runoff by Palustrine Wetlands Based On A Comprehensive Budget

ORGANIZATION:

SOURCE: Ecological Engineering 4:77-97

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Pelletier, G.J. and J.W. Joy

DATE: 1989

TITLE: Lake Sawyer - Black Diamond Waste Load Allocation Evaluation.

ORGANIZATION:

SOURCE: Washington State Dept. of Ecology, Surface Water Investigations Section, Olympia, WA. Segment No. 04-09-06.

ABSTRACT: The Black Diamond Wastewater Treatment Facility (WWTF) discharges treated sewage to a wetland, which drains to Rock Creek and then Lake Sawyer. Total phosphorus concentrations in Lake Sawyer increased following start-up of the WWTF. The observed increase in whole-lake total P content corresponds closely to the estimated loading currently discharged from the WWTF. The condition of Lake Sawyer is predicted to reach a eutrophic state in the future (2010) if discharges from the Black Diamond WWTF continue at existing or currently permitted levels of treatment. Diversion of WWTF discharge from the Rock Creek/ Lake Sawyer system would probably return the condition of the lake to the mesotrophic (threshold eutrophic) condition that existed prior to WWTF start-up. An in-lake total P criterion of 25 ug P/L is recommended for protection of lake water quality.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Perry, J.J., D.E. Armstrong, and D.D. Huff.

DATE: 1981

TITLE: Phosphorus Fluxes in an Urban Marsh During Runoff.

ORGANIZATION:

SOURCE: pp. 199-212 in: B. Richardson (ed.), Selected proceedings of the midwest conference on wetlands values and management. Minnesota Water Planning Board, St. Paul, MN. 660 pp.

ABSTRACT: Marshes have frequently been regarded as filters that remove nutrients from water passing through them. A field-oriented study was done to show the effects of an urban marsh on the transport of dissolved and particulate P during runoff events. The marsh was particularly amenable to evaluation because a water budget had been developed for the area and 90 percent of the water enters the marsh as residential runoff from a gaged storm sewer.

The basic approach involved direct measurement of P input from runoff, precipitation, and groundwater recharge. P output was obtained from P concentrations in surface and groundwater discharge. Laboratory and field investigations were used to calculate the extent of P flux in the marsh by the mechanisms of particulate sedimentation, soil sorption and leaching from vegetation.

The annual dissolved P input was 224 kg. Approximately 14% of the dissolved P was retained in the marsh, primarily by the mechanisms of sorption during filtration. Seasonal variability in dissolved P retention (8-50%) reflects the capacity of the runoff water to infiltrate the marsh soils. Annual particulate P input was 282 kg. of which 82% was retained by particulate sedimentation. These values do not include release of particulate P originating from the erosion of marsh soils. Reservation should be used in extrapolating the data to other wetlands owing to the unique hydrology in Wingra Marsh.

TOPIC: 1.3.2

AUTHOR(S): Peverly, J. H.

DATE: 1982

TITLE: Stream Transport of Nutrients Through a Wetland.

ORGANIZATION:

SOURCE: J. Environmental Quality

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Phipps, RG; Crumpton, WG

DATE: 1994

TITLE: Factors affecting nitrogen loss in experimental wetlands with different hydrologic loads

ORGANIZATION: Dep. Bot., Iowa State Univ., Ames, IA 50011, USA

SOURCE: ECOL. ENG., vol. 3, no. 4, pp. 399-408, 1994

ABSTRACT: Constructed or restored wetlands have great potential for reducing nonpoint source contamination of surface and ground waters by agricultural chemical contaminants. The work reported here combines field and experimental studies of factors affecting nitrogen loss in the Des Plaines River Experimental Wetlands, northeastern Illinois, USA. These wetlands receive approximately 5-36 cm/week of pumped river water with significant but seasonally variable loads of nitrate and organic nitrogen. On an annual basis, the wetlands removed 78-95% of the nitrate and 54-75% of the total nitrogen received. At the low hydrologic loading rate, organic nitrogen exports approximately equalled imports. However at the higher hydrologic loading rate, the wetlands exported 22-31% more organic nitrogen than received. Seasonal variation in nitrate and organic nitrogen loads had significant effects on the effectiveness of the wetlands as sinks for total nitrogen. The wetlands were nitrogen sinks during periods of high nitrate loading and nitrogen sources during periods of low nitrate loading. Experimental studies demonstrated the effects of nitrate concentration, temperature, and location on rates of nitrate loss. Results suggest that nitrate loading rates might influence not only nitrate loss rates but also loss rate coefficients.

TOPIC: 1.3.2

AUTHOR(S): Pressley, H.E.

DATE: 1989

TITLE: The Use of Artificial Wetlands for the Management of Stormwater Runoff Water Quality.

ORGANIZATION:

SOURCE: Draft Technical Working Paper #3, Stormwater Unit, Water Quality Program, Washington State Department of Ecology, Olympia, WA.

ABSTRACT:

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Preston, E.M., and B.L. Bedford.

DATE: 1988

TITLE: Evaluating Cumulative Effects on Wetland Functions: A Conceptual Overview and Generic Framework

ORGANIZATION:

SOURCE: Environmental Management 12 (5): 565-583.

ABSTRACT: This article outlines conceptual and methodological issues that must be confronted in developing a sound scientific basis for investigating cumulative effects on freshwater wetlands. We are particularly concerned with: (1) effects expressed at temporal and spatial scales beyond those of the individual disturbance, specific project, or single wetland; that is, effects occurring at the watershed or regional landscape level; and (2) the scientific (technical) component of the overall assessment process. Our aim is to lay the foundation for a research program to develop methods to quantify cumulative effects of wetland loss or degradation on the functioning of interacting systems of wetlands. Toward that goal we: (1) define the concept of cumulative effects in terms that permit scientific investigation of effects: (2) distinguish the scientific component of cumulative impact analysis from other aspects of the assessment process: (3) define critical scientific issues in assessing cumulative effects on wetlands: and (4) set up a hypothetical and generic structure for measuring cumulative effects on the functioning of wetlands as landscape systems.

We provide a generic framework for evaluating cumulative effects on three basic wetland landscape functions: flood storage, water quality, and life support. Critical scientific issues include appropriate delineations of scales, identification of threshold responses, and the influence on different functions of wetland size, shape, and position in the landscape.

The contribution of a particular wetland to landscape function within watersheds or regions will be determined by its intrinsic characteristics, e.g., size, morphometry, type, percent organic matter in the sediments, and hydrologic regime, and by extrinsic factors, i.e., the wetland's context in the landscape mosaic. Any cumulative effects evaluation must take into account the relationship between these intrinsic and extrinsic attributes and overall landscape function. We use the magnitude of exchanges among component wetlands in a watershed or larger landscape as the basis for defining the geographic boundaries of the assessment. The time scales of recovery for processes controlling particular wetland functions determine temporal boundaries. Landscape-level measures are proposed for each function.

TOPIC: 1.3.2

AUTHOR(S): Reed, S.C.

DATE: 1991

TITLE: Subsurface Flow Constructed Wetlands Systems.

ORGANIZATION:

SOURCE: Presented at the Natural/Constructed Wetlands Treatment Systems Workshop. Sponsored by the EPA Region VIII and Colorado Dept. of Health, Denver, CO., Sept 1991.

ABSTRACT:

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Reinelt, L.E., and R.R. Horner.

DATE: 1990

TITLE: Characterization of the Hydrology and Water Quality of Palustrine Wetlands Affected by Urban Stormwater.

ORGANIZATION:

SOURCE: Report prepared for the Puget Sound Wetlands and Stormwater Management Research Program, coordinated by King County Resource Planning, Seattle, WA.

ABSTRACT: The quantity and quality of stormwater entering many palustrine wetlands in the Puget Sound region has changed as a result of rapid development in urbanizing areas. These changes may affect the functions and values of wetlands by impacting soils, plants and animal communities. This report summarizes the results from the hydrology and water quality components of the long-term effects study from April 1988 (start of study) to December 1989. This study is organized on the basis of a control/treatment, before/after (urbanization) experimental design. It is part of the Puget Sound Wetlands and Stormwater Management Research Program.

The hydrology of the wetlands included in this study was highly variable. The range of maximum water level fluctuations for the 19 wetlands was large (0.62 to 4.28 feet), but there was no apparent association with the type of hydrologic system (open water versus flow-through) or outlet conditions. Water level fluctuations on the high end of this range are likely to affect wetland plant and animal communities.

For purposes of the water quality data analysis, the 19 wetlands in the program were classified based on their control/treatment status, degree of existing urbanization and hydrologic system. The control/highly urbanized (CH) and treatment/moderately urbanized (TM) wetlands exhibited the most degraded water quality conditions. On average, these wetland types exhibited the highest values for conductivity, total suspended solids, fecal coliforms and enterococci. A number of differences in wetland water quality were identified based on hydrologic system, but few differences were evident based on treatment status. However, the period for which data are available covers only the baseline condition and the early portion of the development condition for the treatment sites.

Overall, the water quality of the wetlands was characteristic of freshwater systems with similar discharges. The values observed were similar to those found in freshwater lakes and streams in the region. Since water is transient, its greatest effect probable results from accumulation of pollutants in the sediments due to physical settling and chemical reactions. High water level fluctuations likely pose more significant problems to wetland functions because of potential effects on plant succession, habitat and breeding conditions.

TOPIC: 1.3.2

AUTHOR(S): Reppert, R.T., et al.

DATE: 1979

TITLE: Wetland Values Concepts and Methods for Wetlands Evaluation.

ORGANIZATION:

SOURCE: Research Report 79-R1, Institute for Water Resources, US Army Corps of Engineers, Fort Belvoir, VA 22060.

ABSTRACT: Report presents concepts and methods for the evaluation of wetlands pursuant to Section 404, PL 92-500 (as amended), President Carter's May 24, 1977 Executive Order on wetlands protection, and other statutory and Administrative authorities. The evaluation of wetlands is based on the analysis of their physical, biological and human use characteristics. The report discusses these functional characteristics and identifies specific criteria for determining the efficiency with which respective functions are performed.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Reuter, J.E.; Djohan, T.; Goldman, C.R.

DATE: 1992

TITLE: The use of wetlands for nutrient removal from surface runoff in a cold climate region of California: Results from a newly constructed wetland at Lake Tahoe.

ORGANIZATION: Div. Environmental Studies, University Calif., Davis, Calif. 95616

SOURCE: Journal of Environmental Management. 1992. 36(1): 35-53

ABSTRACT: Pollutant removal by wetlands represents potential mitigation technique for treating urban runoff in the cold climates of the Sierra Nevada. This is especially encouraging in the Lake Tahoe Basin (USA), where research has demonstrated the link between nitrate and phosphorus, and a precipitous increase of algal growth in the lake. In September 1987 a plastic-lined, gravel-filled wetland was constructed for experimental purposes and is the first demonstration of its kind in a subalpine region of the western United States. The primary objective of our research was to evaluate the effectiveness of this system in removing nitrogen, phosphorus, iron, suspended sediments and other constituents from runoff. Data collected between August 1987 and March 1989 show that the average per cent removal of total Kjeldahl-N as it passed through the wetland was low at -3%. In contrast, nitrate concentrations declined by greater than + 85-90%. Changes in particulate phosphorus concentrations between inflow and outflow decreased by +47%, however, the soluble-P component showed a -28% reduction due to a contamination of the gravel during construction. The reduction of iron was very high at +84% for total reactive iron and +78% for soluble reactive iron. Finally, both turbidity and suspended solids was removed by the wetlands at an efficiency of approximately +85%.

TOPIC: 1.3.2

AUTHOR(S): Richardson, C.J.

DATE: 1985

TITLE: Mechanisms Controlling Phosphorus Retention Capacity in Freshwater Wetlands.

ORGANIZATION:

SOURCE: Science 228: 1424-1427.

ABSTRACT: Freshwater wetland ecosystems do not effectively conserve phosphorus in the way that terrestrial ecosystems do. The phosphorus retention capacity varies greatly among bogs, fens, and swamps and is concomitant with the amorphous acid oxalate-extractable aluminum and iron content in the soil. However, the phosphorus adsorption potential in wetland ecosystems may be predicted solely from the extractable aluminum content of the soil. Wetlands tested as wastewater filtration systems became phosphorus-saturated in a few years, with the export of excessive quantities of phosphate.

TOPIC: 1.3.2

AUTHOR(S): Richardson, C.J.

DATE: 1989

TITLE: Wetlands As Transformers, Filters and Sinks For Nutrients

ORGANIZATION:

SOURCE: In Freshwater Wetlands: Perspectives On Natural, Managed And Degraded Ecosystems. University of Georgia, Savannah River Ecology Laboratory, Ninth Symposium, Charleston, SC

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Richardson, C.J., and D.S. Nichols.

DATE: 1985

TITLE: Ecological Analysis of Wastewater Management Criteria in Wetland Ecosystems.

ORGANIZATION:

SOURCE: p. 351-389 in: P.J. Godfrey et al. (eds), Ecological Considerations in Wetlands Treatment of Municipal Wastewaters. Van Nostrand Reinhold Co., New York.

ABSTRACT: Considerable interest has been focused on the use of wetlands to treat secondary municipal sewage effluent further. Reports on the effectiveness of wetlands in removing nitrogen and phosphorus from effluent have been encouraging, but questions persist about sorption capacity, uptake rates, and long-term capacities of wetland ecosystems to remove nutrients. In this paper, we present a series of ecological management criteria that should be addressed prior to the decision to use any wetland ecosystem for treatment of secondary municipal effluent. These criteria include the value of the effluent as a resource, the capacities and limitations of wetlands to accomplish wastewater treatment, wastewater management objectives, wastewater suitability for wetland discharge, and wetland values. Also presented are discussions of wetland hydrology, productivity, cycling of nutrients and heavy metals, and estimates of efficiencies of wastewater nutrient removal by wetlands and the wetland area needed for specific levels of nutrient removal.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Richardson, C.J., and J.A. Davis.

DATE: 1987

TITLE: Natural and Artificial Wetland Ecosystems: Ecological Opportunities and Limitations.

ORGANIZATION:

SOURCE: Pp. 819-854, In: K.R. Reddy and W.H. Smith (eds.) 1987, Aquatic Plants for Water Treatment and Resource Recovery. Magnolia Publishing, Inc.

ABSTRACT: Available data suggest that natural and artificial wetlands offer some opportunity for removal or processing of certain nutrients, suspended solids, and BOD. Phosphorus removal efficiency, however, can quickly decrease from more than 90% to as low as 30% in a few years, depending on wetland type, loading rate, and season of application. The capabilities and weaknesses of both natural and artificial wetlands to filter, transform, and store nutrients are discussed, along with an analysis of the mechanisms controlling nutrient cycling and retention of N and P. A series of management guidelines based on ecological principles are presented for the selection and potential utilization of natural wetlands for effluent treatment as well as the impacts of using wetland systems for wastewater.

TOPIC: 1.3.2

AUTHOR(S): Richardson, C.J., D.L. Tilton, J.A. Kadlec, J.P.M. Chamie, and W.A. Wentz.

DATE: 1978

TITLE: Nutrient Dynamics of Northern Wetland Ecosystems.

ORGANIZATION:

SOURCE: In: R.E. Good, et al. (eds.), Freshwater Wetlands, Ecological Processes and Management Potential. Academic Press, New York, NY.

ABSTRACT: Nutrient information was reviewed by compartment (i.e. soils, plants, water) and at the ecosystem level among 4 northern wetland types: fens, bogs, swamps, and marshes. Total soil N, P, and Ca were lowest in bog peats but the Mg content did not vary appreciably among wetland types. Cation exchange capacity was >100 meq/100g for all wetlands. Concentrations of N, P, Ca and Mg were significantly lower in bog plants than fen plants. Seasonal patterns of nutrient concentrations (N and P) in leaves and stems decreased through the growing season in fen plants. Translocation of nutrients from plant parts prior to abscission did not occur in the plants studied. Minerotrophic fen water chemistry differed from that of ombrotrophic bogs in that fen waters were dominated by Ca⁺⁺ and HCO₃⁻ ions and bog waters were dominated by H⁺ and SO₄⁺⁺ ions. Seasonal variations in NH₄H, NO₃N and PO₄P were closely related to peatland hydrology, organism uptake and peat exchange characteristics. A cycling study for a central Michigan fen revealed that 97% of the N, P and Ca was in the peat compartment. The turnover time for N in aboveground biomass was 2 years. An examination of plant uptake rates of N and P in the Michigan fen revealed that low plant productivity may be related to low N and P availability. Nutrient outputs for wetland ecosystems, when compared to yields from terrestrial forest systems, indicate that natural outputs for some wetland types are well within the range, or in some cases exceed, outputs from upland terrestrial ecosystems. The capacity of acid peatlands to store or assimilate additional P or K on a long-term basis appears limited. Nutrient dynamics in wetlands at the organism, community and ecosystem level are all poorly understood and are deserving of further study.

TOPIC: 1.3.2

AUTHOR(S): Richardson, C.J.

DATE: 1989

TITLE: Freshwater Wetlands: Transformers, Filters, or Sinks?

ORGANIZATION:

SOURCE: Freshwater Wetlands and Wildlife., Shaitz, R.R. and Gibbons, J.W. (eds.). Oak Ridge: U.S. Dept. Energy.

ABSTRACT:

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Risser, P.G.

DATE: 1988

TITLE: General Concepts for Measuring Cumulative Impacts on Wetland Ecosystems.

ORGANIZATION:

SOURCE: Environmental Management 12 (5): 585-589.

ABSTRACT: Because environmental impacts accumulate over space and time, analysis is difficult, and we must incorporate the most recent scientifically defensible information and methods into the process. Methods designed to deal specifically with cumulative impacts include checklists of characteristics or processes, matrices of interactions (rated according to their level of importance) between disturbance activities and environmental conditions, nodal networks or pathways that depict probable effects of disturbances, and dynamic system models. These methods have been tested over the past decade and have proven generally successful.

Landscape perspectives have emerged as especially helpful in analyzing cumulative effects, and have focused specific attention on questions of spatial and temporal scale, while leading to recognition of the complexity of ecosystem processes in general. An evaluation of several cases studies by the Commission on Life Sciences of the U.S. National Academy of Sciences emphasizes the importance of interactions and cumulative effects, but recognizes that current knowledge of the processes involved is insufficient to make specific recommendations for conceptual frameworks.

The conceptual approach suggested by Preston and Bedford (1988) addresses many critical issues, such as the need to define dimensions of scale, and the importance of wetland size, shape, and location in the landscape. This approach and similar ones must be tested and evaluated so that a consensus may eventually emerge.

A cumulative impact matrix is proposed that sets additive, synergistic, and indirect categories, each capable of variation in space and time. Every interaction would be carefully examined to determine the likelihood of cumulative impact in any of the six categories. Because of its "magnifying glass" approach, such a matrix could be a very useful analytical tool, using existing methods to uncover all the information presently available about the behavior of the ecosystem of concern.

TOPIC: 1.3.2

AUTHOR(S): Robb, DM

DATE: 1992

TITLE: The role of wetland water quality standards in nonpoint source pollution control strategies.

ORGANIZATION: US EPA, Off. Wetlands, Oceans, Watersheds, 401 M St., SW (A-104F), Washington, DC 20460, USA

SOURCE: ECOL. ENG., vol. 1, no. 1-2, pp. 143-148, 1992.

ABSTRACT: States in the United States are required to develop water quality standards for their wetlands by the end of Fiscal Year 1993. Standards are vital to the protection of wetlands from a broad array of perturbations including nonpoint source (NPS) pollution. The natural water quality functions of wetlands make them potential components of NPS control strategies, but protection of wetland structure and functions takes precedence over their use in NPS control. Narrative biological criteria are one part of standards and can serve as a mechanism to address NPS pollution impacts. Criteria can also be used as a baseline to determine the effectiveness of best management practices. Numeric biocriteria are under development and will require additional research.

TOPIC: 1.3.2

AUTHOR(S): Roesner, et al

DATE: 1988

TITLE: Long Term Effect of Urban Stormwater on Wetlands

ORGANIZATION: ASCE

SOURCE: In "Design of Urban Runoff Quality Controls: ASCE Conference Proceedings" Roesner, L., B. Urbonas, M. Sonnen (editors), 1988

ABSTRACT: Effectiveness data for pathogen removal. No cost data.

TOPIC: 1.3.2

AUTHOR(S): Rogers, K.H.

DATE: 1983

TITLE: Wetlands as Accreting Systems: Organic Carbon.

ORGANIZATION:

SOURCE: Journal Limnological Society S. Afr.9:96

ABSTRACT:

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Rushton, B.; Carr, D.

DATE: 1993

TITLE: Isolated wetland used for stormwater treatment.

ORGANIZATION:

SOURCE: Water Resour Plann Manage Urban Water Resour. ISBN 0872629120 -- [S.I.]ASCE, NEW YORK, NY, 1993 p. 105-108. (MdBeCS)0056182

ABSTRACT: A marsh used for stormwater management showed gradually increasing levels of pH, dissolved oxygen and conductivity in the flow path. The system was especially effective in removing suspended solids through somewhat less so for selected metals. Relationships are discussed to explain significant differences in water quality.

TOPIC: 1.3.2

AUTHOR(S): Sather, J.H.; R.D. Smith.

DATE: 1984

TITLE: An overview of major wetland functions and values.

ORGANIZATION:

SOURCE: Fish and Wildlife Service publication FWS/OBS-84/18.

ABSTRACT: This report was prepared to provide background information for participants at the National Wetlands Values Assessment Workshop held at Alexandria, Virginia, in May 1983.

The Wetlands Values Bibliographic Database proved to be of inestimable value in the initial stages of the literature search. Annotations of each referenced document can be found in the Database. This report is divided into the following major headings: hydrology, water quality, food chain, habitat, and socioeconomic.

TOPIC: 1.3.2

AUTHOR(S): Schueler, T.R.

DATE: 1992

TITLE: Design of Stormwater Wetland Systems

ORGANIZATION:

SOURCE: Metropolitan Washington Council of Governments, Washington, D.C. pp. 148

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): SCS Engineers, Inc.

DATE: 1981

TITLE: Analysis of Selected Functional Characteristics of Wetlands.

ORGANIZATION:

SOURCE: Report for the US Army Corps of Engineers, Institute for Water Resources, Ft. Belvoir, VA.

ABSTRACT: This study investigated 4 functions attributed to wetlands: Water quality improvement, groundwater recharge, storm and flood water storage, and shoreline protection. For water quality improvement, the existing data base indicated that in some instances water quality was improved by wetlands, although no consistent trend indicated that one type of wetland contributed to water quality improvement more effectively than another type. Under some specific circumstances wetlands would recharge groundwater, marine and estuarine wetlands were identified as discharge areas, whereas riverine, palustrine and lacustrine wetlands have some potential for recharge. Little substantive information was found in the literature to define storm and flood water storage functions of wetlands.

TOPIC: 1.3.2

AUTHOR(S): Segelquist, C.A., W.L. Slauson, M.L. Scott, and G.T. Auble

DATE: 1990

TITLE: Synthesis Of Soil Plant Correspondence Data From Twelve Wetland Studies Throughout The United States

ORGANIZATION:

SOURCE: FWS Biological Report 90(19). U.S. Fish and Wildlife Service, National Ecology Research Center, Fort Collins, CO.

ABSTRACT:

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Seidel, K.

DATE: 1976

TITLE: Macrophytes and Water Purification.

ORGANIZATION:

SOURCE: p. 109-121 in: J. Tourbier, R.W. Pierson (eds.), Biological Control of Water Pollution. Univ. Pennsylvania Press, Philadelphia, PA.

ABSTRACT: Seidel's work at the Max Planck Institute in West Germany in 1953 began the research efforts on the ability of aquatic macrophytes to remove pollutants from water. Her work formed the basis for design techniques for using wetlands for urban runoff water quality control.

TOPIC: 1.3.2

AUTHOR(S): Shapiro and Associates, Inc.

DATE: 1979

TITLE: An Assessment of Wetlands Research and Regulations in King County.

ORGANIZATION:

SOURCE: Unpublished report for Municipality of Metropolitan Seattle (Metro). (Metro library #3037).

ABSTRACT: This report compares agency definitions and policies on wetlands, and discusses regulations for cities in King County. A literature review of the functional characteristics of wetlands (hydrology, productivity, habitat value, and water quality) was completed.

TOPIC: 1.3.2

AUTHOR(S): Shedden, R.D.

DATE: 1975

TITLE: Biological Denitrification of Nitrates in Ground Waters by the Anaerobic Sediments of Freshwater Wetlands.

ORGANIZATION:

SOURCE: M.S. thesis, Tufts University, Medford, MA. 95 pp.

ABSTRACT: This study looked at the denitrification potential of a freshwater wetlands that serves as a groundwater recharge area. It had been reported in the literature that nitrates contained in polluted groundwater, upon passing through an anaerobic zone, are converted to inert molecular nitrogen, and ultimately released to the atmosphere. This study tested this hypothesis in the great meadows, a large tract of wetland in east Lexington, MA. The great meadows are covered with grasses and cattail with small patches of deciduous trees. Peat under the vegetation is usually waterlogged, but there is seldom standing water. There is sufficient diversity in the wildlife species to warrant its preservation as an ecological habitat. In addition, the area serves as a flood control and stream augmentation. The meadows also serve as a reservoir and recharge area for groundwater which contributes to the stream flow in dry weather.

Results showed that: 1. Denitrification of nitrate-polluted groundwaters occurs in freshwater wetlands sediments., 2. The nitrate uptake in wetlands sediments is primarily a biological phenomenon which occurs under anaerobic conditions., 3. Greater rates of denitrification occur at higher temperatures. This suggests that the changing seasonal temperatures affect the rates of nitrogen removal in wetlands., and 4. The apparent increase in denitrification rate with depth observed in this system is perhaps more rationally attributed to the increased contact time of the nitrate-rich water with the sediment.

TOPIC: 1.3.2

AUTHOR(S): Shih, F.F., A.C. Federico, J.F. Milleson, and M. Rosen.

DATE: 1979

TITLE: Sampling Programs for Evaluating Upland Marsh to Improve Water Quality.

ORGANIZATION:

SOURCE: Transactions of the American Society of Agricultural Engineers 22(4): 828-833.

ABSTRACT: Performance of upland marsh to improve water quality was evaluated using an indirect sampling program which included the water chemistry, marsh vegetation, nutrient uptake, soil profile nutrient content, and flow velocity measurement. The results indicated that the retention rates for phosphorus were about 2.0-9.8 mg/day/m², the release rate for nitrogen was about 0.7-5.9 mg/day/m², the nutrient uptake rates by vascular marsh vegetation were 0.031 and 0.007 g/day/m² for nitrogen and phosphorus, respectively; the highest concentrations for nitrogen, phosphorus, and calcium were in the top 15 cm layer of the soil; and the flow velocity in the marsh ranged from 1.2 to 2.8 cm/s during the middle of wet season.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Shih, S.E.

DATE: 1981

TITLE: Upland Marsh for Water Quality Control.

ORGANIZATION:

SOURCE: Proceedings, ASCE, Vol. 107, No. EE4, August, 1981.

ABSTRACT: Vascular plants in wetland habitats have been investigated as a method to improve the water quality in fresh water marshes through the natural filtering of the marsh vegetation. Studies done near Martinez, California, indicated that marsh plots flooded with waste effluent not only remove nutrients from water but also provide favorable conditions for small crustaceans and other animals to further cleanse algae and suspended matter from the water. Water quality characteristics such as biological oxygen demand (BOD), suspended solids, and nitrate and ammonium nitrogen all showed overall reduction. Even chlorine residuals between 2 mg/L and 2.5 mg/L were effectively removed by marsh. Research studies by National Space and Technological Laboratories of NASA indicate that the water hyacinth, present in abundance in marshes of the Southeast United States, is an efficient natural pollution control for lead, Sr (90), nitrates, phosphates, potassium, and possible carcinogens found in agricultural runoff, sewage, and industrial effluent.

The main objectives of this study were: (1) To analyze plant nutrient uptake by using time series analysis; (2) to use the F-test as the statistical criterion to determine the possibility of any component existing in series; and (3) to demonstrate the application of time series analysis to interpolate the missing data.

TOPIC: 1.3.2

AUTHOR(S): Siegel, D.I.

DATE: 1988

TITLE: The Recharge-Discharge Function of Wetlands Near Juneau, Alaska: Part II: Geochemical Investigations.

ORGANIZATION:

SOURCE: Groundwater 26(5): 580-586.

ABSTRACT: The recharge-discharge function of bogs, fens, and forested wetlands near Juneau, Alaska, was investigated by comparing concentrations of solutes and measurements of specific conductance in wetland ground water and surface water. Average concentrations of major metals define major wetland types. Bogs and fens are in recharge areas and have the most dilute ground water. Forested wetlands are in discharge areas and have ground-water chemistry similar to that found in domestic wells completed in mineral soils.

Concentration profiles of total dissolved metals in blanket bogs were compared to theoretical concentration profiles based on the diffusion of solutes from mineral soil into the overlying peat. All observed concentration profiles are less than predicted by diffusion, and show that the blanket bogs are long-term recharge zones.

TOPIC: 1.3.2

AUTHOR(S): Siegel, D.I.

DATE: 1988

TITLE: The Recharge-Discharge Function of Wetlands Near Juneau, Alaska: Part I. Hydrogeological Investigations.

ORGANIZATION:

SOURCE: Groundwater 26(4): 427-433.

ABSTRACT: Water levels in piezometers and the hydraulic conductivity of organic and mineral soils were measured during spring and summer 1986 to evaluate the recharge-discharge function of wetlands in the vicinity of the Mendenhall Valley near Juneau, Alaska. Computer modeling experiments were also done to evaluate the function of a large patterned fen.

The blanket bogs are probably recharge zones, whereas forested wetlands are discharge zones. Approximately the upper third of the patterned fen is a ground-water recharge zone, whereas its northern margin receives ground-water discharge from flow systems recharged on moraines.

The amounts of wetland recharge and discharge are very small. Recharge from wetlands to viable aquifers is probably less than 1% of the total annual recharge to the aquifer system. The amount of ground-water discharge to streams from wetlands is too small to measure.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Silverman, G.S.

DATE: 1983

TITLE: Seasonal Fresh Water Wetlands Development and Potential for Urban Runoff Treatment in the San Francisco Bay Area.

ORGANIZATION:

SOURCE: Ph.D. dissertation, U.C. Los Angeles. Available from University Microfilms, International, Ann Arbor, MI.

ABSTRACT: Wetlands development offers an attractive means of reducing the pollutant load from urban runoff into the San Francisco Bay while creating valuable ecosystems. Design principles for pollutant removal have not been the focus of substantial study for wetlands systems receiving stormwater runoff. Furthermore, no comprehensive system exists to coordinate the activities of the many levels of government, agencies and groups that regulate or are interested in wetlands. An analysis is presented in this paper of the potential for development of urban runoff treatment wetlands, including a case study of the design and subsequent creation of a prototype wetlands system.

TOPIC: 1.3.2

AUTHOR(S): Silverman, GS; Meiorin, EC; Berger, JJ. (ed)

DATE: 1990

TITLE: Seasonal freshwater wetland development in South San Francisco Bay.

ORGANIZATION:

SOURCE: ENVIRONMENTAL RESTORATION. SCIENCE AND STRATEGIES FOR

ABSTRACT: A 20-ha fallow agricultural field in Fremont, California, was converted into a seasonal freshwater wetland, creating habitat historically characteristic of south San Francisco Bay but largely missing today. This project was unusual in using urban stormwater runoff for its water supply. Primary design considerations were water quality enhancement and long term fate of pollutants. The success of this system would indicate a potential for developing similar systems around the bay. Local agencies may find wetlands to be effective tools to meet nonpoint source water quality control requirements now being developed at the federal level.

TOPIC: 1.3.2

AUTHOR(S): Simpson, R.L.; D.F. Whigham, R. Walker.

DATE: 1978

TITLE: Seasonal Patterns of Nutrient Movement in the Freshwater Tidal Marsh.

ORGANIZATION:

SOURCE: In: R.E. Good, D.F. Whigham and R.L. Simpson (eds), Freshwater Wetlands, Ecological processes and Management Potential, Academic Press, NY, p. 243-257.

ABSTRACT: surface waters of a freshwater tidal marsh near Trenton, New Jersey. The nutrients studies were O₂, CO₂, N₀₃-N, NH₃-N and PO₄-P. The different patterns in nutrient distribution were attributed to the periodic tidal cycle. Emergent vegetation plays an important role in the uptake and retention of inorganic N and PO₄-P. Inorganic N and PO₄-P levels remain depressed through the winter and spring in pond-like areas where filamentous algae blooms. The authors state that it appears that "almost all habitats of freshwater tidal marshes may be sinks for inorganic N and PO₄-P during the vascular plant growing season and that certain habitats may continually function as sinks".

TOPIC: 1.3.2

AUTHOR(S): Simpson, R.L.; R.E. Good, R. Walker, B.R. Frasco.

DATE: 1983

TITLE: The Role of Delaware River Freshwater Tidal Wetlands in the Retention of Nutrients and Heavy Metals.

ORGANIZATION:

SOURCE: J. Environ. Quality 12(1): 41-48.

ABSTRACT:

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TOPIC: 1.3.2

AUTHOR(S): Sloey, W.E.; F.L. Spangler, and C.W. Fetter, Jr.

DATE: 1978

TITLE: Management of Freshwater Wetlands for Nutrient Assimilation.

ORGANIZATION:

SOURCE: p. 321-340 in: R.E. Good, et al (eds.), Freshwater Wetlands: Ecological Processes and Management Potential. Academic Press, NY.

ABSTRACT: Nutrient transformation processes such as sorption, coprecipitation, active uptake, nitrification and denitrification remove P and N from the free-flowing water of a wetland and transfer them to the substrate and biota for storage. Advantage is being taken of these processes by using wetlands to treat sewage in Germany, Holland, Finland, and other European countries. In the U.S., experimental application of cultural water (wastewater) to peatlands in Michigan, tidal marshes in Louisiana and New Jersey, cattail marshes in Wisconsin, cypress domes and sawgrass in Florida and many more have shown promising results. Denitrification may remove up to 3.5 kg N/ha/day and as much as 20 g P/m² may be detained in a growing season. Natural release of nutrients between growing seasons, however, either restricts application periods, or demands management of the wetland systems to regulate such releases. The most obvious management tool, plant harvesting, removes only a few grams of P per square meter per year which is usually 20% of that detained. Most of the remainder is in the substrate-microbial compartment and is subject to between-season washout. Chemical treatment to reduce the surplus of P has also been considered. Management options for a specific wetland will depend to a large extent upon that particular hydraulic regime. Riverine systems have different hydraulic patterns than lacustrine or palustrine systems. Flow-through systems cannot be managed like influent or seepage systems. Already, changes in the biota of some experimentally treated wetlands indicate undesirable natural disturbances of these valuable resources. Caution in widespread use of natural wetlands to treat waste at this time is advised and careful monitoring of all biotic communities in experimental programs is essential. Artificial marshes and peat filters offer feasible alternatives to other treatment methods for small systems and do not endanger natural wetlands.

TOPIC: 1.3.2

AUTHOR(S): Small, M.M.

DATE: 1978

TITLE: Artificial Wetlands as Nonpoint Source Wastewater Treatment Systems.

ORGANIZATION:

SOURCE: In: Environmental quality through wetlands utilization, proceedings from a symposium sponsored by the Coordinating Council on the Restoration of the Kissimmee River, Feb 28, Tallahassee, FL.

ABSTRACT: The use of a meadow/marsh/pond natural system for the treatment of agricultural runoff from individual farms was assessed. The primary concern was the ability of these small systems to remove nitrogen and phosphorus to the extent necessary to make them cost-effective and energy-conservative eutrophication abatement devices for the Kissimmee agricultural region in Central Florida. Design parameters were defined for meadow/marsh/pond systems that would be capable of meeting the nitrogen and phosphorus effluent requirements for discharge.

TOPIC: 1.3.2

AUTHOR(S): Spangler, F.L., C.W. Fetter, Jr., and W.E. Sloey.

DATE: 1977

TITLE: Phosphorus Accumulation-Discharge Cycles in Marshes.

ORGANIZATION:

SOURCE: Water Resources Bulletin 13(6): 1191-1201.

ABSTRACT: Changes in the quality of polluted waters flowing through artificial and natural marshes were monitored. Although P was removed by the sediments and plant parts, it was discharged following the growing season. Recommended methods to prevent the seasonal discharge of P into surface waters included using the discharge water for irrigation on land, lagooning the water to recycle later, or using conventional treatment methods.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Spangler, F.L., W.W. Sloey, and C.W. Fetter, Jr.

DATE: 1976

TITLE: Wastewater Treatment by Natural and Artificial Marshes.

ORGANIZATION:

SOURCE: Report to the U.S. EPA, Office of Research and Development, Robert S. Kerr Environmental Research Laboratory, Ada, OK. 74820. EPA document EPA600/2-76-207.

ABSTRACT: This report covers investigations of the use of artificial and natural marshes as purifiers of effluents from municipal treatment plants. Marshes remove phosphorus during the growing season, but release it at other times of the year. It was concluded that emergent vegetation can be used to treat wastewater biologically and thereby attain an acceptable level of water quality in certain circumstances. It is suggested that further research could lead to widespread application of the process.

TOPIC: 1.3.2

AUTHOR(S): Stark, J.R. and R.G. Brown.

DATE: 1988

TITLE: Hydrology and Water Quality of a Wetland Used to Receive Wastewater Effluent, St. Joseph, Minnesota.

ORGANIZATION:

SOURCE: In Kusler, J.A. and Brooks, G., Proceedings of a National Symposium; Wetland Hydrology. Association of State Wetland Managers, Berne, New York.

ABSTRACT: The hydrologic and chemical balances of the bog and marsh in the St. Joseph wetland are greatly affected by the discharge of wastewater. Wastewater inflow represents 38 percent of the total inflow to the bog. If wastewater was not discharged to the bog, groundwater would be a more dominant inflow component to both the bog and marsh, and the total inflow and outflow of both the bog and marsh would be approximately 38 percent smaller. The wastewater input of total suspended solids, total phosphorus, and total ammonia plus organic nitrogen represented 74, 96, and 82 percent of the total chemical-constituent input of total suspended solids and total phosphorus that exceeded the input from sources other than the wastewater. Therefore, if wastewater was not present, the export of these two constituents to the marsh would be nearly zero. The retention of total ammonia plus organic nitrogen would be primarily in the bog if wastewater input was not present.

The vegetational composition of the bog and marsh has changed greatly since discharge of wastewater began in 1962. The vegetational composition in the bog was a spruce/tamarack/wetland/grass bog in 1958 and a tamarack/cattail/wetland/grass bog in 1986. The marsh was a wetland-grass/tamarack marsh in 1958 and is a cattail/tamarack marsh in 1986. The invasion of cattails and loss of original vegetation may be an indication of the effects of wastewater input to the bog and marsh.

TOPIC: 1.3.2

AUTHOR(S): Stephenson, M., G. Turner, P. Pope, and A. Knight.

DATE: 1981

TITLE: Wetlands for Wastewater Treatment: Just Another Threat - or an Opportunity?

ORGANIZATION:

SOURCE: Wetlands 1: 204-207.

ABSTRACT: The use of wetlands to dispose of wastewater is not a new phenomenon. There are a number of sites where wastewater discharges have been made to wetlands since the 1920's. But the purposeful use of wetlands in the treatment process began in the early 1960's and it has been given impetus by the need to develop low energy-consuming, low-cost treatment facilities. Although they are commonly called wetland systems, these alternative wastewater treatment systems are varied in character. Some of the natural wetlands used for wastewater treatment and disposal are cypress domes (in Florida), peat bogs and cattail marshes (in the upper Midwest), and both riverine and lacustrine marshes (in Canada). Artificial wetland systems are as varied as man's ingenuity; typically troughs or ponds are planted with reeds, rushes, cattails, water hyacinths, or a combination of emergent and floating plants. What is the likelihood of this particular interest in wetlands continuing?

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Stockdale, E.C.

DATE: 1986

TITLE: The Use of Wetlands for Stormwater Management and Nonpoint Source Pollution Control.

ORGANIZATION:

SOURCE: Washington Dept. of Ecology. Doc. No.87-7a

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Stockdale, E.C. and R.R. Horner.

DATE: 1988

TITLE: Using Freshwater Wetlands for Stormwater Management: A Progress Report.

ORGANIZATION:

SOURCE: Presented at the Wetlands '88: Urban Wetlands and Riparian Habitat Symposium. Association of State Wetland Managers, June 26-29, Oakland, California.

ABSTRACT: At the Coastal Zone '87 symposium in Seattle, Washington, we reported on the first stage of a wetlands research program. The study, begun in 1986, set forth to determine the feasibility of using freshwater wetlands to manage urban runoff and control nonpoint source pollution. This paper is a progress report on the on-going research program and findings to date.

This research program is an example of how scientific research can interface with the needs of policy makers and resource managers to improve the stewardship of natural systems. Findings from this effort may be transferrable to other regions of the country facing similar problems. The process developed to answer these needs may also serve as a model approach on how to resolve future, similar management needs.

TOPIC: 1.3.2

AUTHOR(S): Strecker, E.W., J.M. Kersnar, E.D. Driscoll, and R.R. Horner

DATE: 1992

TITLE: The Use of Wetlands for Controlling Stormwater Pollution

ORGANIZATION: Terrene Institute

SOURCE:

ABSTRACT: A literature review of 140 papers and reports provided data for this analysis of stormwater pollutant removal provided by natural and constructed wetlands. An effort to obtain a uniform set of data and parameters for analysis required that some authors be personally contacted. Median pollutant load removals by wetlands are reported for TSS, metals, and nutrients. Coefficients of variation were calculated showing the range of performance around the median value. It was found that constructed wetlands reduced loads generally greater than natural wetlands. The variations in removal effectiveness are attributed to a number of differences including design features, maintenance, climate, vegetation, seasonal effects, monitoring, and performance computation method.

TOPIC: 1.3.2

AUTHOR(S): Strickland, R. J. (ed.)

DATE: 1987

TITLE: Wetland Functions, Rehabilitation and Creation in the Pacific Northwest: The State of Our Understanding.

ORGANIZATION:

SOURCE: Publication 86-14, Washington Department of Ecology, Olympia, WA. Proceedings of a conference held April, 1986, Fort Worden State Park, Port Townsend, WA.

ABSTRACT: This volume presents the proceedings of a conference held on April 30-May 2, 1986, at Fort Worden State Park Conference Center in Port Townsend, Washington, organized by the Shorelands Program of the Washington State Department of Ecology. The subject of the conference was the state of wetlands science in the Pacific Northwest, including the states of Washington, Oregon, and Idaho, and the Canadian province of British Columbia. The conference included several activities (Appendix A): a keynote address, seven plenary talks, five working group discussions, a slide show, a panel discussion, and a closing address. The goals of the conference were to document our present state of knowledge about how Northwest wetlands function, and to assess our ability to create or restore them. A primary objective was to produce a document that would provide wetland scientists, managers, planners, and policymakers with sound scientific data on which to base decisions.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Surowiec, M.S.

DATE: 1989

TITLE: An Hydrogeologic and Chemical Characterization of an Urban and Nonurban Wetland.

ORGANIZATION:

SOURCE: M.S. thesis, University of Washington.

ABSTRACT: This thesis developed from the activities of the Puget Sound Wetlands Stormwater Management Research Project in King County, Washington. It compares the hydrologic and water quality conditions of an urban wetland, Bellevue number 3I and a rural one, Patterson Creek number 12. The research reported in this thesis addresses two specific aspects of the research program: the importance of the groundwater component to wetland water quality and quantity, and the assimilative capacity of the urban wetland for loaded lead and zinc with respect to downstream sediment and water quality improvement.

The hydrogeological findings of this study indicated that the groundwater component of flow can be of considerable significance to wetland water budgets. The view that wetlands function primarily as groundwater recharge areas may not apply to the majority of the wetlands in King County, particularly those bordered by steep forested slopes. In contrast, their function is more probably related to the temporary storage of discharged groundwater. The groundwater quality data indicate that the Bellevue and Patterson Creek wetlands differ in composition for a number of parameters. Most of these differences can be attributed to geochemical or biologic conditions specific to each wetland.

The ammonia-nitrogen concentrations at the Bellevue 3I strongly suggest a negative impact to groundwater quality, probably related to urbanization. It appears from the groundwater quality data, that the majority of pollution impact to the Bellevue 3I wetland is occurring from direct roadway runoff. The analysis of metals loading and distribution in Bellevue 3I indicate that the wetland is inefficient at retention of metal pollutants, in part related to short retention time, and may not be a good candidate for diversion of stormwater high in such pollutants.

TOPIC: 1.3.2

AUTHOR(S): Taylor, H.N.; Choate, K.D. and Brodie, G.A.

DATE: 1993

TITLE: Storm Events Effects on Constructed Wetlands Discharge.

ORGANIZATION:

SOURCE: In Constructed Wetlands for Water Quality Improvement. Moshiri, G. (ed.) Lewis Publishers.

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): Tchobanoglous, G., and G.L. Culp.

DATE: 1979

TITLE: Wetland Systems for Wastewater Treatment: An Engineering Assessment.

ORGANIZATION:

SOURCE: pp. 13-42, In: S.C. Reed and R.K. Bastian (eds.), Aquaculture systems for wastewater treatment: An engineering assessment. US Environmental Protection Agency Publication EPA-430/8-80-007.

ABSTRACT: The use of artificial and natural wetlands for the treatment of wastewater is examined in this engineering assessment. The primary objective of the assessment was to answer the question of whether the technology of using wetlands for the treatment of wastewater is ready for routine use and, if not, what must be done to make it a reality. On the basis of 1) treatment efficiency and reliability, 2) availability of design criteria and procedures, 3) availability of proven management techniques, 4) energy and resources consumption, 5) costs, and 6) health risks, it is concluded that the current status of wetlands technology is not yet developed to the point where the use of wetland systems can be considered routine. Data and information that must be developed before the design of wetland systems can become a rational undertaking are identified and discussed.

TOPIC: 1.3.2

AUTHOR(S): The Center For Watershed Protection

DATE: 1994

TITLE: Adequate Treatment Volume Critical In Virginia Stormwater Wetland

ORGANIZATION:

SOURCE: Watershed Protection Techniques 1(1): 24-25

ABSTRACT:

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Thompson, D., and J. Minor.

DATE: 1985

TITLE: Wetlands/Marsh Treatment System Improves Lagoon Effluent Quality.

ORGANIZATION:

SOURCE: Presented at the 52nd Annual Pacific Northwest Pollution Control Association, October 28-30, 1985, Seattle, WA.

ABSTRACT: The City of Cannon Beach's upgraded wastewater treatment facility was dedicated June 1, 1984. The wetlands/marsh cells, a "natural" effluent polishing system following a four-celled aerated/facultative lagoon complex, was placed into operation as part of the ceremony marking the first marsh treatment system in the Pacific Northwest, and only the second Environmental Protection Agency (EPA)-designated "Innovative/Alternative" treatment system in Oregon, conceived and constructed under the provisions of the federal Clean Water Act. The lagoon and marsh treatment complex opened in 1984, and is used only during the summer, when its natural flow drops and the population of the resort community increases. The final effluent has met TSS and BOD standards during the first two years of operation.

TOPIC: 1.3.2

AUTHOR(S): Tilton, D.L.

DATE: 1981

TITLE: The Environmental Impacts Associated with Developments in Wetlands.

ORGANIZATION:

SOURCE: p. 357-362 in: B. Richardson (ed.) Selected Proc. Midwest Conference on Wetland Values and Management, June 17-19, 1981. Freshwater Society, 2500 Shadywood Rd, Box 90, Navarre, MN 55372.

ABSTRACT: The environmental impacts associated with the utilization of wetland ecosystems for stormwater management, waste water treatment, or other purposes is not widely understood. This paper suggests a conceptual framework which is useful for the preparation of wetland environmental impact assessments and presents several examples of impacts associated with altering the energy budget, nutrient budget, or hydrologic budget of various wetland ecosystems.

TOPIC: 1.3.2

AUTHOR(S): Tilton, D.L., and R.H. Kadlec.

DATE: 1979

TITLE: The Utilization of Freshwater Wetland for Nutrient Removal from Secondarily Treated Wastewater Effluent.

ORGANIZATION:

SOURCE: Journal Environmental Quality 8: 328-334.

ABSTRACT: In order to test the feasibility of utilizing a fresh-water wetland for tertiary waste water treatment, secondarily treated waste water was applied to a wetland in the northern lower peninsula of Michigan. During the discharge of 38,840 cubic meters (10,260,000 gal) and 23,520 cubic meters (6,213,000 gal) of secondarily treated waste water in 1976 and 1977, respectively, surface water quality, plant productivity, and nutrient status of plants and soils were measured.

In 1976 the concentration of (nitrate + nitrite) N averaged 0.36 mg/liter in the effluent and 0.01 mg/liter at stations 25 m from the discharge pipeline. Total dissolved phosphorus (TDP) averaged 0.41 mg/liter in the effluent and 0.11 mg/liter at sampling stations 25 m from the discharge. The efficiency of phosphorus removal from the effluent was greater when surface water depths were 6 cm compared to 30 cm. Ammonium N concentrations were rarely higher in the effluent compared to background concentrations in the wetland surface waters.

In 1977 a point source distribution system was used. The effluent averaged 1.50 mg/liter nitrate N and 1.57 mg/liter TDP. Within 30 m, nitrate N was 0.10 mg/liter in the surface water and within 80 m TDP was 0.07 mg/liter.

Biomass of live plants in 1976 was somewhat greater near the pipeline compared to control areas. Leaves of cattail (*Typha latifolia*) were longer near the pipeline in 1976 compared to control areas. Chemical analysis of sedge (*Carex* spp.) leaves and roots, standing dead, and litter sampled in 1976 showed no significant differences in N concentrations among sampling locations, but P concentrations were higher in leaves and roots 6 m from the pipeline compared to control areas.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Tourbier, J., and R.W. Pierson (eds.).

DATE: 1976

TITLE: Biological Control of Water Pollution.

ORGANIZATION:

SOURCE: University of Pennsylvania Press, Philadelphia, PA.

ABSTRACT: This publication contains a number of articles that are related to the topic of wastewater renovation by natural and artificial wetlands, including research performed in foreign countries. The section entitled "Biological Treatment of Wastewater" contains a number of papers that deal with specific vegetation types and their relationship to water purification.

TOPIC: 1.3.2

AUTHOR(S): Tsihrintzis, VA; Vasarhelyi, GM; Lipa, J

DATE: 1995

TITLE: Multiobjective approaches in freshwater wetland restoration and design

ORGANIZATION: Dep. Civ. and Environ. Eng. and Drinking Water Res. Cent., Florida Intl. Univ., Univ. Park, VH169, Miami, FL 33199, USA

SOURCE: WATER INT., vol. 20, no. 2, pp. 98-105, 1995

ABSTRACT: Water quality problems in receiving waters in the Los Angeles area, and recent federal, state, and local environmental ordinances oblige large developments in California to cleanse urban stormwater runoff on-site before releasing it into storm drains, natural streams, or into the ocean. As a requirement for a land development permit, a channel/pond system was engineered to provide three independent functions: flood control for existing and proposed developments, urban stormwater runoff treatment, and freshwater habitat for fish and wildlife. These functions are achieved by designing the channel as a riparian corridor with a freshwater wetland pond at the downstream end. This article presents an overview of the current regulations, a description of Best Management Practices (BMPs), and the example design of the riparian corridor/freshwater wetland system emphasizing hydraulic analysis and design, biotic design, environmental function and effectiveness, management, operation, monitoring and maintenance, and project permit requirements.

TOPIC: 1.3.2

AUTHOR(S): U.S EPA.

DATE: 1987

TITLE: Report on the Use of Wetlands for Municipal Wastewater Treatment and Disposal.

ORGANIZATION:

SOURCE: U.S. EPA Office of Water, Washington, D.C. EPA 430/9-88-005.

ABSTRACT: This report reviews current knowledge of the use of both natural and constructed wetlands for municipal wastewater treatment and disposal. The extent and circumstances of this practice are reviewed and summaries of the regulatory issues involved as well as EPA policies are presented.

TOPIC: 1.3.2

AUTHOR(S): U.S. Dept. of the Interior

DATE: 1962

TITLE: The Value of Wetlands to Modern Man.

ORGANIZATION:

SOURCE: In Proj. MAR: Proc. Conf. IUCN, Morges, Switzerland.

ABSTRACT:

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): U.S. EPA

DATE: 1983

TITLE: Freshwater Wetlands for Wastewater Management: Environmental Impact Statement - Phase I Report.

ORGANIZATION:

SOURCE: U. S. EPA Region IV -Atlanta, GA. EPA 904/9-83-107. 380 p.

ABSTRACT: The understanding of wetland functions and values has increased significantly during the past decade. During that period more attention has also been given to the use of wetlands for wastewater management. With increased pressure placed on wetland systems in recent years, regulatory and ecological issues have been raised. This EIS is designed to develop tools that can assist local, state and federal agencies in making wastewater management decisions affecting wetlands.

TOPIC: 1.3.2

AUTHOR(S): U.S. EPA

DATE: 1985

TITLE: Freshwater Wetlands for Wastewater Management: Environmental Assessment Handbook.

ORGANIZATION:

SOURCE: Region IV -Atlanta, GA. EPA 904/9-85-135. 493 p.

ABSTRACT: The purpose of this handbook is to respond to difficulties encountered by EPA-Region IV's regulatory personnel when evaluating and permitting domestic wastewater discharges to natural, freshwater wetlands in the Southeast. This handbook addresses the institutional, scientific and engineering issues important to the use of wetlands in wastewater management, and it is designed to provide guidance in evaluating wetlands for this purpose. It is not a statement of policy supporting the use of wetlands for wastewater management under any or all conditions; but it is an acknowledgement that wetlands are currently being used as such by over 400 communities in the Southeast, and for many other communities such use may be a cost-effective wastewater management alternative.

TOPIC: 1.3.2

AUTHOR(S): U.S. EPA

DATE: 1979

TITLE: Aquatic Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment

ORGANIZATION:

SOURCE: EPA Office of Water Program Operations, Washington, D.C. EPA 430/9-80-006

ABSTRACT:

TOPIC: 1.3.2

AUTHOR(S): U.S. EPA

DATE: 1984

TITLE: Literature Review of Wetland Evaluation Methodologies: Technical Report.

ORGANIZATION:

SOURCE: Chicago: U.S. EPA Region 5. Microfiche PB85-186922. NTIS code PB 85 186 922. \$30.95 paper, \$6.50 fiche.

ABSTRACT: Reviews and summarizes direct and cumulative impacts that may result from a wastewater treatment plant and the available literature of methodologies of wetlands evaluation and human impacts.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): U.S. EPA

DATE: 1981

TITLE: Annotated Bibliography of Wetland Functions and Values.

ORGANIZATION:

SOURCE: Office of Federal Activities. Prepared by JRB Associates, 8400 Westpark Drive, McLean, Virginia 22102. EPA Contract No. 68-01-6087.

ABSTRACT: This compilation of references on wetland functions and values is intended to aid the 404 Program in its focus on evaluation of dredge and fill activities by providing information on key reports and studies selected from a large list prepared for EPA's Office of Federal Activities entitled, "Preliminary Bibliography on Wetland Functions and Values." The annotation presented informs the user of the general content, and in some cases, the results, conclusions or recommendations of the source.

The bibliography is organized into eight sections reflecting the various designated wetland functions and values: general, hydrologic, water quality, harvest, habitat, food chain, heritage, and valuation techniques. Within each category, references are numbered and arranged in alphabetical order. An index is provided for ease of retrieval of information.

TOPIC: 1.3.2

AUTHOR(S): Ulrich, H.E.

DATE: 1984

TITLE: The Role of Emergent Aquatic Vegetation in the Nutrient Budgets of Managed Marshes.

ORGANIZATION:

SOURCE: Ph.D. dissertation, Michigan State University, Lansing, Mi. 125 pp.

ABSTRACT: Wetlands are often used as disposal areas for nutrient-enriched waters; the emergent vegetation is needed in the system's hydrology and nutrient budgets. This study was concerned with the response of emergent plant spp. to quantities and proportions of substrate macronutrients, and vegetation establishment and harvest. Five species were used in nutrient uptake experiments; *Typha angustifolia*, *T. latifolia*, *Zizania aquatica*, *Phragmites australis* and *Sparganium eurycarpum*. Plants grown in sand substrate were fertilized with nitrate, potassium and phosphate using a factorial treatment arrangement. Treatments of phosphate and nitrate and their combination affected plant growth significantly while treatment by K had very little effect. Dry weight distribution was regulated by nitrate and the belowground:aboveground ratio of dry weight varied, within species, by a factor of 3; low nitrate was associated with the highest ratios. N and P tissue content was enlarged 2-3 times over that required to reach maximum production of biomass. Severely P and N limited growth occurred when N:P ratios were greater than 12 and less than 4, respectively. Very high levels of nitrate were tolerated the least by *S. eurycarpum*. The 5 species and *Spartina pectinata* were then planted in a man-made clay-lined marsh; *S. pectinata* and *Z. aquatica* did not become established, while the other 4 established with varying success. *Typha* spp. multiple harvests resulted in removal of N and P and biomass phosphate of about 150% of the controls and 130% of single harvest controls, respectively. For 3 man-made marsh-ponds, developed nutrient budgets indicated a net fixed N extraction from flow-through waters but a variable total P status.

TOPIC: 1.3.2

AUTHOR(S): Ulrich, K.E., and T.M. Burton.

DATE: 1984

TITLE: The Establishment and Management of Emergent Vegetation in Sewage-Fed Artificial Marshes and the Effects of These Marshes on Water Quality.

ORGANIZATION:

SOURCE: Wetlands 4: 205-220.

ABSTRACT: Experiments on the establishment and harvest of *Phragmites australis*, *Zizania aquatica*, *Typha latifolia*, *Typha angustifolia*, *Sparganium eurycarpum* and *Spartina pectinata* were conducted in three 0.4 ha clay-bottomed man-made marshes in the central portion of the lower peninsula of Michigan. Propagules consisted of seeds for the annual *Z. aquatica* and root and rhizome clumps for the other species. *S. eurycarpum* showed rapid establishment but was subject to invasion by other species. *Typha* spp. established stands more slowly but maintained better stand density and purity. *P. australis* sent out mainly tillers from propagule clumps rather than rhizomes and vertical shoots. *S. pectinata* and *Z. aquatica* failed to establish. Multiple harvests of *Typha* spp. at intervals of 3 or 6 weeks resulted in biomass removal of 130% and N and P removal of 150% of the controls. Nutrient budgets developed for the three marsh-ponds after six years of intermittent operation showed a net removal of fixed N from flow-through waters but a variable situation with total P.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Van der Valk, A.G., et al.

DATE: 1978

TITLE: Natural Freshwater Wetlands as Nitrogen and Phosphorus Traps for Land Runoff.

ORGANIZATION:

SOURCE: p. 457-467 in: P.E. Greeson, et al. (eds.), 1978, Wetland Functions and Values: The State of Our Understanding.

ABSTRACT: All types of natural wetlands behave as nitrogen (N) and/or phosphorus (P) traps at least seasonally and, as a consequence, improve the quality of polluted water passing through them. Annual efficiency of N and P removal by a wetland is primarily a function of the wetlands hydrologic regime, litter pattern, and rate of litter decay. Improving the efficiency of N and P removal by proper management of a wetland is at least theoretically possible in some cases.

TOPIC: 1.3.2

AUTHOR(S): Vincent, G

DATE: 1992

TITLE: Artificial marshes to maintain water quality: The beach of Ile Notre-Dame, Montreal.

ORGANIZATION: Jardin Bot. Montreal, Inst. Rech. Biol. Vegetale, 4101, rue Sherbrooke est, Montreal, PQ H1X 2B2, Canada

SOURCE: WATER POLLUT. RES. J. CANADA., vol. 27, no. 2, pp. 327-339, 1992.

ABSTRACT: In June 1990, the City of Montreal opened a beach on an artificial lake in the southern sector of Ile Notre-Dame in the Saint Lawrence River, a man-made island built for Expo '67. This lake is fed from the Saint Lawrence River and the beach stretches some 600m with a swimming area of approximately 15,000 m². Since the desired environmental character was that of a natural lake, it was decided to avoid the use of conventional methods of water purification such as treatment with chlorine. Instead, a series of techniques more compatible with natural systems were chosen in order to maintain water quality. The major component of these techniques is a "filter-lake" complex. During the last two seasons, several parameters were monitored in order to evaluate the efficiency of the system. Preliminary results indicate that the system of artificial wetlands used at the beach of Ile Notre-Dame is efficient in water purification. The ponds are very good traps for soluble reactive phosphorus and nitrates. A good interception is also observed in the second pond for total phosphorus and suspended solids. Faecal coliforms removal however seems uncertain and long-term effectiveness is questionable.

TOPIC: 1.3.2

AUTHOR(S): WAPORA, Inc.

DATE: 1983

TITLE: The Effects of Wastewater Treatment Facilities on Wetlands in The Midwest.

ORGANIZATION:

SOURCE: U.S. Environmental Protection Agency publication EPA-905/3-83-002.

ABSTRACT: The report describes issues of wastewater and wetlands in Midwest States, summarizes the existing knowledge (including a bibliography), inventories the 98 existing wetland discharges in EPA region V and identifies potential sites and topics for additional study. Both natural and constructed (artificial) wetlands are considered for alternative wastewater treatment technology. Key areas for future study to contribute to a Generic Environmental Impact Statement include: constructed wetlands, hydrologic impacts, long-term ecological effects, legal and administrative constraints, mitigation of impacts, management of receiving wetlands and disease and health considerations.

TOPIC: 1.3.2

AUTHOR(S): Wass, RD; Fox, P

DATE: 1995

TITLE: Constructed wetlands enhances stormwater quality in Arizona

ORGANIZATION: Plann. Project Div., Maricopa County Flood Control District, Phoenix, AZ, USA

SOURCE: IND. WASTEWATER, vol. 3, no. 2, pp. 43-47, 1995 IS: ISSN

ABSTRACT: Prompted by Sec. 402(p) of the 1987 Clean Water Act Amendments, the Flood Control District of Maricopa County, Ariz., began exploring best management practices (BMPs) for enhancing stormwater quality in arid regions. The most attractive BMPs are effective at attenuating targeted pollutants, economical to construct and have modest maintenance requirements. Under this premise, the county obtained partial funding from an EPA 319(h) Nonpoint Source Demonstration Grant and began working with researchers at Arizona State University and the Arizona Department of Environmental Quality to design and construct a submerged-flow vegetated treatment system (SVTS). Such a system, it was hoped, would improve the quality of stormwater runoff by promoting the microbial degradation of petroleum hydrocarbons

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Weller, M.W.

DATE: 1981

TITLE: Freshwater Marshes: Ecology and Wildlife Management.

ORGANIZATION:

SOURCE: Minneapolis: Univ. of Minnesota Press.

ABSTRACT: This book on marshes and marsh wildlife is intended mainly to provide a general introduction for individuals who are not wetland experts. It covers wetland basin formation, hydrology, substrate, depth, plant forms, wetland structure, food chains and webs, and nutrients. Biological features of wetlands are discussed, including animal adaptations, ecological relationships, animal groups, and habitat dynamics. The book includes management issues such as water level regulation, vegetation and herbivore management, and marsh restoration and creation. Use of marshes for water purification and energy is also discussed.

TOPIC: 1.3.2

AUTHOR(S): Weller, M.W.

DATE: 1987

TITLE: Freshwater Marshes (second edition).

ORGANIZATION:

SOURCE: University of Minnesota Press, Minneapolis, MN. 55414. 150 pp.

ABSTRACT: Aimed at instilling an appreciation of freshwater marshes in the general public, Freshwater Marshes offers a basic understanding of freshwater wetland science and management with an emphasis on wildlife. Topics covered include: hydrology, flora and fauna, habitat dynamics, management, and restoration. The material is frequently depicted in graphs, diagrams, and photographs, and further organized with an index, glossary, species list, and references. The author makes a creative effort to give readers first-hand knowledge and encourages citizen participation in wetland protection. This is accomplished by outlining techniques for field studies and explaining that knowledge from such studies can be used by citizens in interpreting environmental impact statements and other public documents available for public review and comment.

TOPIC: 1.3.2

AUTHOR(S): Wenk, N.C.

DATE: 1981

TITLE: Wetlands and Organic Soils for the Control of Urban Stormwater.

ORGANIZATION:

SOURCE: p. 227-240 in: B. Richardson (ed), Selected Proc. Midwest Conference on Wetland Values and Management. St. Paul, MN. 660 pp.

ABSTRACT: This paper consists of two major areas of interest. The first area is a review of a research project performed for the EPA to evaluate and assess urban runoff treatment methods using non-structural wetland treatment techniques. The second area will be to show examples of the application of the technology gained from the research. Five projects which are either constructed or in the design stage will be addressed.

TOPIC: 1.3.2

AUTHOR(S): Wentz, W.A.

DATE: 1987

TITLE: Ecological/Environmental Perspectives on the Use of Wetlands in Water Treatment.

ORGANIZATION:

SOURCE: p. 17-25, In: K.R. Reddy and W.H. Smith (Eds.) Aquatic Plants for Water Treatment and Resource Recovery

ABSTRACT: As natural values and potential uses of wetland systems are better understood, ecologists and engineers will face significant new opportunities and problems. A high potential for the use of natural and artificial wetlands for treating wastewater and enhancing wildlife production exists. Such uses are in early design stages and we must better define the assimilative capacities of wetland types and the impact of their utilization. Recent experiences have shown that wetlands and their biological components can be seriously damaged by uncontrolled delivery of wastewater. These experiences should cause us to exercise caution in the utilization of wetlands. The experience of wildlife managers in creating and manipulating wetlands, combined with appropriate engineering design holds promise for the construction of wetlands to provide multiple public benefits. Great strides have been made in educating the public and decision makers to the values of wetlands. As a result, many people question the use of wetland systems for such purposes as cleansing wastewaters. Continuing to educate the public on the values of wetlands, protecting these natural values, and developing a better understanding of the range of possible uses for both natural and artificial wetlands, while maintaining public credibility, are crucial challenges to ecologists and engineers.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Wetlands Research, Inc.

DATE: 1991

TITLE: The Des Plaines River Wetlands Demonstration Project: Bibliography

ORGANIZATION:

SOURCE:

ABSTRACT: Bibliography for Des Plaines River Wetlands Demonstration Project. No cost or effectiveness data.

TOPIC: 1.3.2

AUTHOR(S): Whigham, D.F., and R.L. Simpson.

DATE: 1976

TITLE: The Potential Use of Freshwater Tidal Marshes on the Purification of Water Quality in the Delaware River.

ORGANIZATION:

SOURCE: p. 173-186 in: J. Tourbier and R.W. Pierson (eds.), Biological Control of Water Pollution. Univ. Pennsylvania Press, Philadelphia, PA.

ABSTRACT: Some researchers have suggested that brackish-water tidal marshes may act as nutrient sinks, while others have suggested a similar role for freshwater marshes. Our data suggest that the high marsh areas may be acting as a nutrient sink during the summer months and that perhaps the pond-like areas of the marsh may be playing a similar role in the winter. Salt marsh plots fertilized with sewage sludge have been shown to retain substantial amounts of the applied nutrients and thus may be potentially valuable as tertiary treatment systems. It was estimated that each acre of salt marsh was worth as high as \$83,000 as a tertiary treatment facility. Based on our data, and that of others, it would appear that freshwater tidal marshes may also be capable of performing tertiary treatment. We believe that, these tidal marshes can process greater amounts of effluent each treatment period than many biological treatment systems, perhaps as much as 2-5 inches of wastewater per day. In April 1975 we began experiments to assess the tertiary treatment capabilities of the Hamilton Township Sewage Treatment Plant. The effluent was sprayed on 10 by 20m study plots located in a high marsh area at site SA dominated by mixed vegetation according to the treatment regime given in Table 20-3. The results of this experiment will determine when and how much effluent can be applied during each treatment period. If the marsh can assimilate secondarily treated effluent at out low treatment level (2 inches per day), then the high marsh areas dominated by mixed vegetation should be able to process over 18 million gallons of effluent per day, about two and a half times the current daily flow from the Hamilton plant into Crosswicks Creek.

TOPIC: 1.3.2

AUTHOR(S): Whigham, D.F., and S.E. Bayley.

DATE: 1978

TITLE: Nutrient Dynamics in Freshwater Wetlands.

ORGANIZATION:

SOURCE: p. 468-478 in: P.E. Greeson et al. (eds), 1978, Wetlands Functions and Values: The State of Our Understanding.

ABSTRACT: The purpose was to determine if definable trends appear when comparisons are made between the nutrient absorption capacities of various types of fresh water wetlands. The review showed that there are few data available for comparison, with the exception of N and P in above ground vegetation. Data from mass balance studies are almost nonexistent, which makes it impossible to determine the conditions necessary for specific types of wetlands to annually lose, gain, or be in balance with regard to nutrient fluxes. The only discernable trend was that wetlands with predominantly organic substrates seem to be capable of long-term storage of N and P. Recommendations for future research on nutrient dynamics in fresh water wetlands are discussed.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Whigham, D.F., C. Chitterling, and B. Palmer.

DATE: 1988

TITLE: Impacts of Freshwater Wetlands on Water Quality: A Landscape Perspective.

ORGANIZATION:

SOURCE: Environmental Management 12 (5): 663-671.

ABSTRACT: In this article, we suggest that a landscape approach might be useful in evaluating the effects of cumulative impacts on freshwater wetlands. The reason for using this approach is that most watersheds contain more than one wetland, and effects on water quality depend on the types of wetlands and their position in the landscape. Riparian areas that border uplands appear to be important sites for nitrogen processing and retention of large sediment particles. Fine particles associated with high concentrations of phosphorus are retained in downstream wetlands, where flow rates are slowed and where the surface water passes through plant litter. Riverine systems also may play an important role in processing nutrients, primarily during flooding events. Lacustrine wetlands appear to have the least impact on water quality, due to the small ratio of vegetated surface to open water. Examples are given of changes that occurred when the hydrology of a Maryland floodplain was altered.

TOPIC: 1.3.2

AUTHOR(S): Whigham, D.F., R.L. Simpson, and K. Lee.

DATE: 1980

TITLE: The Effect of Sewage Effluent on the Structure and Function of a Freshwater Tidal Marsh Ecosystem.

ORGANIZATION:

SOURCE: Water Resources Research Institute, Rutgers University, New Brunswick, NJ.

ABSTRACT: The effects of spraying chlorinated secondarily treated sewage on a Delaware River freshwater tidal wetland for three years was studied. Macrophyte net primary production was significantly lower in the experimental sites receiving sewage than in the no treatment controls in 1975 but not in 1976 or 1977. Diversity of annuals was reduced in the experimental sites largely due to the elimination of annuals. Although percent N and P were generally high in the vegetation of experimental sites, there was little difference in total N and P between treatments and controls. Macrophyte decomposition rates were little affected by sewage application. Substrate N and P were not significantly different between sites, but surface litter of the experimental sites accumulated N and P. Epibenthic algae may contribute to this accumulation. Water quality studies showed the high marsh to be metabolically active. Tide cycle flux studies indicated that up to 40% of the N added to the wetland was assimilated during the late spring-early summer period. Conversely, there was a net loss of P from the wetland. These results are compared with those of similar pulsed tidal regimes of the wetland, the low organic content substrate, and the eutrophic nature of the Delaware River waters contribute to the inability of the wetland to efficiently assimilate nutrients from sewage.

TOPIC: 1.3.2

AUTHOR(S): Williams, J.B., B.J. Copeland, and R.J. Monroe.

DATE: 1988

TITLE: Denitrification in a Natural Wetland Receiving Secondary Treated Effluent.

ORGANIZATION:

SOURCE: Water Research 22(4): 431-439.

ABSTRACT:

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Winter, T.C..

DATE: 1988

TITLE: A Conceptual Framework for Assessing Cumulative Impacts on the Hydrology of Nontidal Wetlands.

ORGANIZATION:

SOURCE: Environmental Management 12 (5): 605-620.

ABSTRACT: Wetlands occur in geologic and hydrologic settings that enhance the accumulation or retention of water. Regional slope, local relief, and permeability of the land surface are major controls on the formation of wetlands by surface-water sources. However, these landscape features also have significant control over groundwater flow systems, which commonly play a role in the formation of wetlands. Because the hydrologic system is a continuum, any modification of one component will have an effect on contiguous components. Disturbances commonly affecting the hydrologic system as it relates to wetlands include weather modification, alteration of plant communities, storage of surface water, road construction, drainage of surface water and soil water, alteration of groundwater recharge and discharge areas, and pumping of groundwater. Assessments of the cumulative effects of one or more of these disturbances on the hydrologic system as related to wetlands must take into account uncertainty in the measurements and in the assumptions that are made in hydrologic studies. For example, it may be appropriate to assume that regional groundwater flow systems are recharged in uplands and discharged in lowlands. However, a similar assumption commonly does not apply on a local scale, because of the spatial and temporal dynamics of groundwater recharge. Lack of appreciation of such hydrologic factors can lead to misunderstanding of the hydrologic function of wetlands within various parts of the landscape and mismanagement of wetland ecosystems.

TOPIC: 1.3.2

AUTHOR(S): Witmer, G.W.

DATE: 1985

TITLE: Assessing Cumulative Impacts to Wetlands.

ORGANIZATION:

SOURCE: p. 204-208 in: J.A. Kusler (ed), Proceedings of the National Wetland Assessment Symposium, Portland, Maine, June 17-20, 1985. ASWM Technical Report I.

ABSTRACT: The quantity and quality of North American wetlands have been greatly reduced in this century. Growing concern over the social and ecological effects of this situation has led to increased efforts to study the ecology of wetlands and to classify, monitor, and predict the impacts to wetlands from various human activities. Assessing and predicting land use and developmental activity -- particularly cumulative impacts -- to wetlands is difficult because of the diverse, complex, and dynamic nature of wetlands. Methods of assessing and predicting cumulative impacts must involve features beyond those associated with traditional impact assessment methods. For example, the assessment methodology for cumulative impacts must allow for consideration of multiple projects or multiple land uses, extended time frames, the aggregation of impacts, flexibility in geographic boundaries, and adaptability to new techniques and sources of information.

24-Apr-98

TOPIC: 1.3.2

AUTHOR(S): Wolf, R.B., L.C. Lee, and R.R. Shartz.

DATE: 1986

TITLE: Wetland Creation and Restoration in the U.S from 1970 to 1985: An annotated bibliography.

ORGANIZATION:

SOURCE: Wetlands 6 (1): 1-88. (Journal Society of Wetland Scientists).

ABSTRACT: This bibliography deals with the creation of new and restoration of disturbed salt and freshwater wetlands in the United States since 1970. Our aim was to provide wetland scientists and regulatory agencies with an index for identifying and locating publications useful in planning new projects or reviewing old. In selecting publications we emphasized site engineering and plant propagation. Thus numerous articles that discuss preparing the site for natural or artificial revegetation, and transplanting and seeding of vegetation are included in the 304 reports cited. However, articles concerning more minor habitat adjustments and, for example, lake or reservoir management for wildlife or waterfowl are not included.

Documents are arranged alphabetically by senior author. A full citation and brief description of the problem or topic discussed is included for each one. National Technical Information service (NTIS, Springfield, VA 22161) order numbers are provided for publications available through that office. Following the citations are plant species, subject and state indices.

Reports of wetland restoration and creation projects from more than 30 states are cited. In these articles all major aspects of wetland construction are described in detail. Such topics as site selection; planning; engineering and design; seeding; plant material selection, harvest, storage and transplanting; fertilization requirements; cost and labor estimates; and maintenance requirements are included for marsh and riparian and littoral zone development. Detailed directions for propagating about 150 plant species can be found. Additionally, more basic questions are addressed, such as the value of wetlands, whether artificial or restored wetlands approximate natural, and how wetlands should be and are regulated. Several bibliographies, project surveys and literature reviews are also included.

Most artificial wetlands have been developed either by the Federal government, especially under the U.S. Army Corps of Engineers program for marsh development on dredged material deposits, or by private contractors in response to federal mitigation regulations. Thus the majority of the documents cited here are not from the referred scientific literature.

Because wetland restoration and creation is a very young science, many basic and applied research questions remain unanswered. For example, a question of major importance to both regulatory agencies and wetland scientists is if and when restored or artificially created wetlands function as do natural wetlands. Comparisons of some aspects of wetlands and their functions can be found in several articles listed in this bibliography, but the definitive answer to this question is still unknown, and is the subject of much debate.

Our knowledge of and experience in freshwater wetland creation is limited. Many more wetland restoration and creation projects have been undertaken in saltwater than in freshwater areas, and those in freshwater have often been in tidal regions. This is another area needing more research.

A final example is the difference between creating the physical environment of a wetland and planting wetland vegetation. These two distinct problems involve very different approaches in wetland creation and restoration projects, and should be thoroughly addressed. We hope that additional attention will be given these and many other topics of research in the future, and that soon we will know a great deal more about all aspects of wetland creation and restoration.

TOPIC: 1.3.3

AUTHOR(S): Carleton, MG; Nielsen, JS

DATE: 1990

TITLE: A study of trash and trash interception devices.

ORGANIZATION: Sch. Civ. Eng., Univ. Technol., Sydney, P.O. Box 123 Broadway, N.S.W. 2007, Australia

SOURCE: URBAN STORM WATER QUALITY AND ECOLOGICAL EFFECTS UPON RECEIVING WATERS., 1990., pp. 287-290, WATER SCI. TECHNOL., vol. 22, no. 10-11

ABSTRACT: The composition of trash found in urban stormwater runoff was analyzed following its collection by a trash rack and two floating booms in Sydney, Australia. Basically garden refuse, plastic and paper products were the main components of the trash collected. The effectiveness of trash interception devices was examined using results of field trials. For various flow velocities, widths of channels or river, storm-related loads and cleansing frequency, the choice of trash racks or booms can be made. Testing of a range of trash rack designs was performed in the laboratory with the principal aim of preventing rack blockages. Whilst both spacing between bars and the angle of inclination of the rack were related to self cleaning, ultimate blockage could not be prevented for the configuration tested. Either the racks should be designed to allow for overtopping when blocked or booms be used, despite their lesser efficiency.

24-Apr-98

TOPIC: 1.3.3

AUTHOR(S): Duran, A. (editor)

DATE: 1990

TITLE: Oil/Water Separators: Asset or Liability

ORGANIZATION:

SOURCE:

ABSTRACT: (1) 1990 March 15th, R.I. D.O. Environment Management issued a memo that oil/water separator structures should be limited to (i) large parking area for commercial and concentrated resident developments (ii) direct discharge (no appreciative overland separator) to rivers, streams, or aquatic ecosystems. (iii) loading facilities in industrial areas where large amounts of petroleum products are handled (Handout #6).

(2) Introduce Massachusetts DPW precast concrete catchbasin with plate separator and twin manhole oil/water separator by Rhode Island (Handout #10).

(3) Different types of oil/water separators are also introduced by (Handout #11) newest oil/water separator - "Coalescing Plate Oil Trap" - disadvantage high cost, possible clogging. How about water quality inlets with sorbent pads.

TOPIC: 1.3.3

AUTHOR(S): Pitt, R.

DATE: 1996

TITLE: New Critical Source Area Controls In The SLAMM Stormwater Quality Model

ORGANIZATION: Alabama Uni. at Birmingham

SOURCE: Presented at the Assessing the Cumulative Impacts of Watershed Development on Aquatic Ecosystems and Water Quality conference, March 18-21, 1996. USEPA and the Northeast Planning Commission, Chicago, IL

ABSTRACT:

TOPIC: 1.3.3

AUTHOR(S): Pitt, R.

DATE: 1996

TITLE: The Control Of Toxicants At Critical Source Areas

ORGANIZATION: Alabama Uni. at Birmingham

SOURCE: Presented at the ASCE/Engineering Foundation conference: Effects of Watershed Development and Management on Aquatic Ecosystems, Snowbird, Utah. August 4-9, 1996

ABSTRACT:

TOPIC: 1.3.3

AUTHOR(S): Pitt, R.; B. Robertson, A. Ayyoubi, and R. Field

DATE: 1994

TITLE: Treatment Of Stormwater From Critical Source Areas Using A Multi-Chambered Treatment Train (MCTT)

ORGANIZATION:

SOURCE: Water Environment Federation, 67th Annual Conference & Exposition. Chicago, IL. October 15-19, 1994

ABSTRACT:

TOPIC: 1.3.3

AUTHOR(S): Pitt, R.; B. Robertson; and R. Field

DATE: 1995

TITLE: A Multi-Chambered Stormwater Treatment Train For The Treatment Of Stormwater

ORGANIZATION: Alabama Uni. at Birmingham and USEPA

SOURCE: 21st Annual RREL Research Symposium

ABSTRACT:

24-Apr-98

TOPIC: 1.3.3

AUTHOR(S): Robertson, B., R. Pitt, A. Ayyoubi, and R. Field

DATE: 1994

TITLE: A Multi-Chambered Stormwater Treatment Train

ORGANIZATION:

SOURCE: Proceedings Of An Engineering Foundation Conference. August 7- 12, 1994. Grande Butte Hotel and Conference Center, Mount Crested Butte, CO

ABSTRACT:

TOPIC: 2.0

AUTHOR(S): Beck, P.C.

DATE: 1995

TITLE: Stormwater Permit Program: An Industrial Experience

ORGANIZATION: Environmental Engineering, Coors Brewing Company, CE200, Golden, Colorado 80401

SOURCE: Torno, H.C. (ed). 1995. Stormwater NPDES-related monitoring needs. Conference proceedings. American Society of Civil Engineers. Mt. Crested Butte, CO. Aug. 7-12, 1994.

ABSTRACT: The impact of the NPDES stormwater permit program on a Fortune 500 company located in the semi-arid west is discussed. The results of a stormwater outfall sampling program are presented. Modifications to the facility were made as a result of the sampling and site inspection program. The problems and successes of the stormwater permit program from an industrial environmental manager's perspective are presented. Concerns about the future direction of the program and economic impact on industry are raised. A balanced cost-versus-benefit analysis of the program before the enactment of additional regulatory requirements within the stormwater program is needed. An understanding of the basin-wide impacts of non-point discharges is needed. Industry must be an active participant in the development of future stormwater regulations.

TOPIC: 2.0

AUTHOR(S): Birosik, SA

DATE: 1989

TITLE: Water quality issues in Los Angeles/Long Beach Harbor.

ORGANIZATION: California Reg. Water Qual. Control Bd., Los Angeles Reg., 107 S. Broadway, Rm. 4027, Los Angeles, CA 90012, USA

SOURCE: OCEANS '89: THE GLOBAL OCEAN. VOLUME 2: OCEAN POLLUTION., 1989., p. 695, OCEANS '89.

ABSTRACT: Los Angeles/Long Beach (LA/LB) Harbor is a large man-made complex located south of the city of Los Angeles. Data from water quality monitoring over 20 years shows an initial improvement, after regulation of waste discharges went into effect, followed by a leveling off to their current acceptable levels. This trend is also reflected in SMW results which have revealed a steady decline in DDT levels and, for the most part, a comparable decline in PCB levels. High concentrations of either metals or organics in SMW results are now largely limited to problem sites, or "hot spots", generally a result of poor housekeeping on-site, and areas which have high historical levels of contaminants in the sediment.

TOPIC: 2.0

AUTHOR(S): Burby, RJ

DATE: 1995

TITLE: Coercive versus cooperative pollution control: Comparative study of state programs to reduce erosion and sedimentation pollution in urban areas

ORGANIZATION: Coll. Urban and Public Aff., Univ. New Orleans, New Orleans, LA 70148, USA

SOURCE: ENVIRON. MANAGE., vol. 19, no. 3, pp. 359-370, 1995

ABSTRACT: This article examines coercive and cooperative approaches to implementing state urban erosion and sedimentation pollution control programs. State administrators report serious shortfalls in their ability to control sources of pollution, but comparison of more and less successful programs provides evidence of what states can do to make programs more effective. Key ingredients for a successful state effort include the use of coercion with both the private sector and local government, adequate staffing, application of severe sanctions when violations of state standards are detected, and provision of technical assistance. Many state programs lack one or more of those elements, which explains their inability to adequately control urban erosion and sedimentation pollution.