



# Wetlands Engineering: Design Sequence for Wetlands Restoration and Establishment

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**PURPOSE:** This technical note describes a sequence of activities for design and selection of construction techniques for wetlands restoration and establishment. The design sequence includes consideration of wetlands needs, site characteristics, and design criteria; fill or excavation equipment and techniques for wetlands soils; water and erosion control structures for wetlands hydrology; and techniques and materials for establishing wetlands vegetation. Duplicative and unnecessary design evaluations can be avoided by following the guidance in this technical note (TN).

**BACKGROUND:** Guidelines pertaining to various aspects of wetlands design are available [Environmental Laboratory (1978), Federal Highway Administration (1990), Soil Conservation Service (in preparation)], and additional guidance is being developed as a part of the WRP Restoration and Establishment Task Area. This TN supplements the currently available guidance by describing a design sequence for wetlands establishment and restoration projects.

**DESIGN SEQUENCE:** The flowchart shown in Figure 1 illustrates the design activities for a wetlands restoration and establishment project and the sequence in which the activities should be considered. The overall sequence is based on the concept that design activities associated with establishing wetland substrate soils and hydrology should precede those associated with establishing wetland vegetation.

The numbered blocks in the flowchart in Figure 1 are referenced to the following brief descriptions of the activities:

- (1) Conduct an initial evaluation of wetlands needs for the area under consideration for the restoration/establishment project.
- (2) Select a desired set of wetlands functions and values for the project.
- (3) Perform a baseline site survey in the project area to determine initial topographic, hydrologic, soils, and vegetative conditions.
- (4) Prioritize and select specific sites for restoration and establishment within the project area.
- (5) Determine design criteria for soils, hydrology, and vegetation based on desired functions and values and site characteristics as determined in Step 2.
- (6) Determine if existing substrate soils and hydrology meet the design criteria. If substrate soils and criteria are adequate, proceed to Step 22 to evaluate wetlands vegetation requirements.
- (7) Determine if substrate fill or excavation will be required. If existing substrate elevation and grading are adequate, proceed to Step 17 to evaluate water and erosion control measures.
- (8) If fill or excavation will be required, determine substrate elevation and grading requirements to meet the design criteria (i.e. design the new substrate topography).
- (9) Select borrow material sources for fill requirements and placement sites for any excavated material (preferably within the restoration/establishment site).

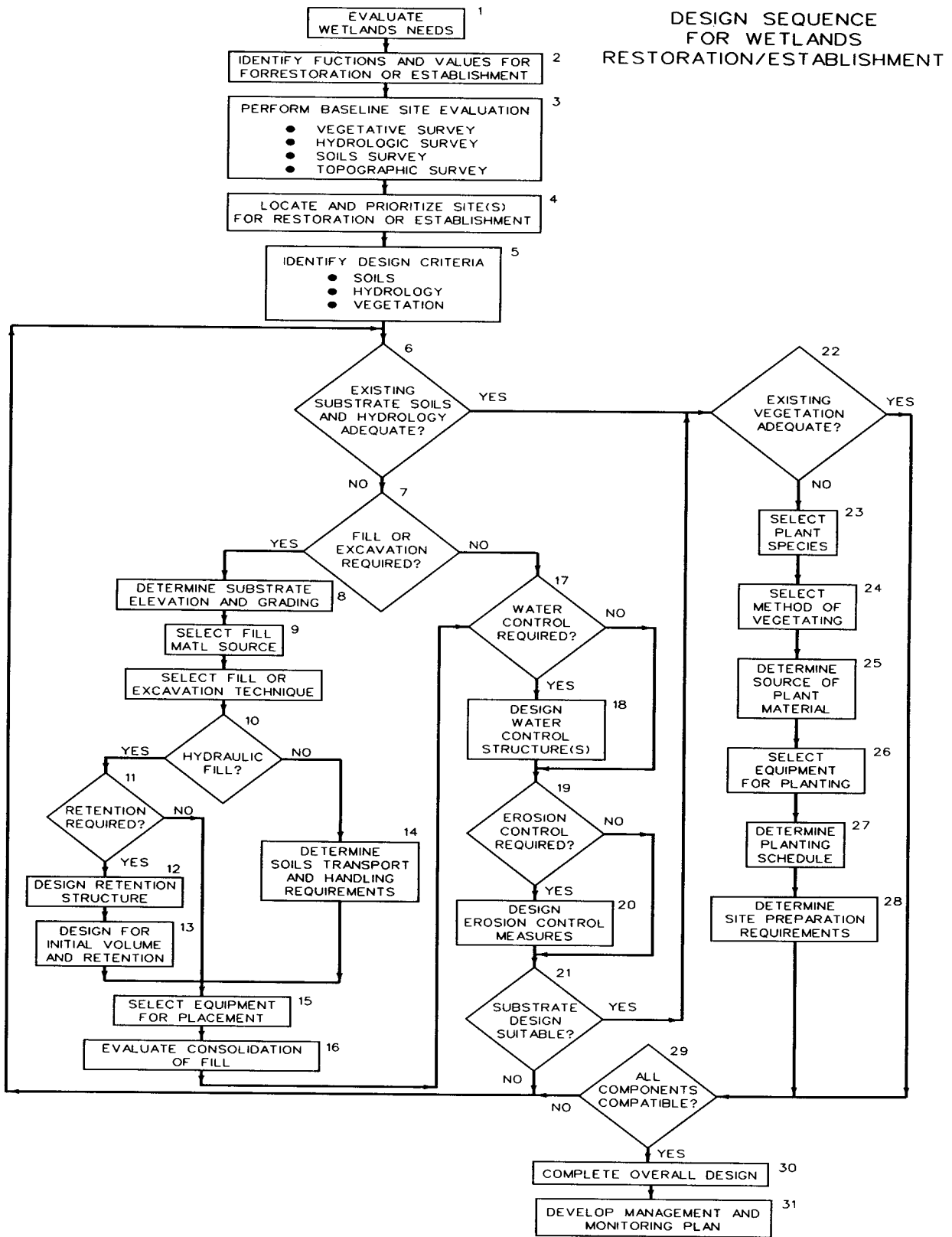


Figure 1. Flowchart illustrating design sequence for wetlands restoration and establishment projects

- (10) Determine the most desirable fill or excavation process (i.e. hydraulic fill or conventional soils handling). If a conventional soils handling process is chosen, proceed to Step 14 to select soils handling requirements.
- (11) If hydraulic fill is the desirable approach, determine if retention of the material will be required. If not, proceed to Step 15 to select the appropriate hydraulic dredging equipment.
- (12) If retention of hydraulic fill is required, design the retention dike or structure.
- (13) Design the retention area for initial volume of material to be placed hydraulically and for retention of suspended solids during placement.
- (14) If conventional soils handling is the desirable approach, determine soils handling requirements.
- (15) Select equipment for hydraulic placement or placement using conventional soils handling techniques.
- (16) Predict consolidation of fill and account for consolidation in fill elevation and grading.
- (17) Evaluate requirements for water control. If water control structures are not required, proceed to Step 19 to evaluate erosion control requirements.
- (18) Design any required water control structure(s).
- (19) Evaluate requirements for erosion control. If erosion control measures are not required, proceed to Step 21 to evaluate overall suitability of the substrate design.
- (20) Design necessary measures for erosion control.
- (21) Evaluate compatibility of all design components pertaining to substrate soils and hydrology. If compatible, proceed to Step 22 to evaluate vegetation requirements. If not, return to Step 6 to reevaluate requirements or designs associated with substrate soils and hydrology.
- (22) Determine if adjacent vegetation is adequate and will colonize the restoration/establishment site in an appropriate time frame without active planting. If adequate, proceed to Step 29 to evaluate overall compatibility of design components.
- (23) If active planting is required, select species for planting.
- (24) Select method of vegetating (e.g. seeds, propagules, etc.)
- (25) Determine source(s) of plant materials.
- (26) Select equipment for planting.
- (27) Determine planting schedule.
- (28) Determine site preparation requirements.
- (29) Evaluate overall compatibility of all components of design (soils, hydrology, vegetation). If not compatible, return to Step 6 to reevaluate requirements or designs.
- (30) Complete overall design.
- (31) Develop management and monitoring plan to include appropriate remedial actions.

Future TN's in the WRP series will provide more detailed information on the various activities included in this design sequence.

**CONCLUSION:** By following an efficient sequence of activities for design, unnecessary evaluations can be avoided and a fully integrated design will result.

May 1992

**REFERENCES:**

Environmental Laboratory. 1978. Wetland habitat development with dredged material: Engineering and plant propagation. Technical Report DS-78-16. Vicksburg, MS: U.S. Army Engineer Waterways Experiment Station.

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Soil Conservation Service. In preparation. Wetland restoration, enhancement, or creation. Chapter 13, Engineering Field Handbook. Washington, D.C. Soil Conservation Service.

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