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Engineer Manual
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ENGINEERING AND DESIGN
Environmental Quality in Design of Civil Works Projects

1. Purpose. This manual furnishes guidance on the environmental quality aspects of engineering design for Civil Works projects. This guidance pertains to the design of those project features which previously have been selected as the best alternative for project development in the project formulation process.
2. Applicability. It is applicable to all divisions and districts having Civil Works responsibilities.
3. Policy. Maintenance and improvement of the environment--including avoidance of destruction or degradation, preservation, and enhancement (including restoration)--in a manner calculated to foster and promote the general welfare, allow man and nature to exist in productive harmony, and fulfill social, economic, and other requirements of present and future generations of Americans, is established by PL 91-190 as a valid objective of Federal programs. Therefore, it shall be treated equally with other established objectives in the design of Civil Works projects.
4. Environmental Quality Objective. The environmental quality objective is to preserve or enhance certain water and related resources and amenities that have ecological, cultural, aesthetic or other values which make them significant in terms of environmental quality. Ecological values pertain to the structure and function of ecosystems - in essence man's habitat. Cultural values are characterized by that which is man's heritage. Aesthetic values are attributed to man's sensory perception of the environment.
5. Nature of Environmental Quality. Environmental quality is the aggregate of subjective and objective expressions of the capability of the environment to serve the full range of man's needs. On the one hand, its dimensions include things as specific as physical measures of the condition of land, water, and air, generally expressed as standards; on the other hand, things as illusive as the spiritual and therapeutic value of beautiful natural scenery, or the knowledge that such areas exist.

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6. Environmental Quality in Design. Incorporating environmental quality in project design involves considerably more than a superficial treatment of aesthetics. It involves designing with nature in all of its dimensions--ecological, visual and human-cultural--rather than against or onto it. The environmental quality objective imposes a number of broad new requirements on the overall post-authorization planning and design process--the need for an ecological point of view, the need to use new types of information and employ new types of talents and skills, and the need to innovate.

a. Visual and Human-cultural Values. All project features will be designed so that the visual and human-cultural values associated with the project will be protected, preserved, maintained or enhanced to the maximum extent possible. Structures should be designed to blend with their physical surroundings, or where contrast is necessary and appropriate, to achieve that contrast in a manner which, insofar as possible, will improve the environment.

b. Reevaluation of Designs. Standardized approaches and designs will be continuously reevaluated on the basis of evolving environmental design principles and concepts, and will be modified as applicable and feasible.

c. Innovation in Design. Innovative design approaches which minimize environmental disruptions and/or enhance or restore environmental values will be encouraged among Corps employees, AE's and consultants.

d. Restorations, Enhancements and Unavoidable Environmental Disruptions. These considerations when associated with the proposed project design, together with a comprehensive description of actions required to mitigate disruptions, will be fully discussed in the appropriate design memorandum.

7. Specific Considerations of Ecological and Cultural Values.

a. While more definitive guidance concerning attainment of ecological and cultural values through the engineering design process will be presented in later manuals, early consideration should be given to their nature, scope and relationships with the aesthetic treatments that follow. The underlying ecological concern is for maintenance of the integrity of affected ecosystems, such that necessary actions do not impair their basic structure and function and thus reduce the health, productivity and diversity of man's environment. Opportunities for enhancement through design will be vigorously sought. Specific ecological considerations include actions to preserve or enhance

critical habitats of fish and wildlife, accomplish sedimentation and erosion control, maintain or enhance water quality, or regulate streamflow, runoff and groundwater supplies; as well as avoidance and/or mitigation of actions whose effect would be to reduce scarce biota, ecosystems or basic resources.

b. Actions of cultural value that should be considered include the following: incorporation of regional ethnic values related to art forms, folklore and skills; providing for social opportunities both in spacial and temporal relationships; reducing social stress factors attributed to noise and crowding situations; and other actions related to values important to mans' heritage, both past and present.

8. Specific Considerations of Aesthetic Values. Following are considerations that should be applied as general guidance in designing Civil Works projects to improve the quality of the environment.

a. Site Plan.

(1) An over-all site development plan with emphasis on function and aesthetics in siting of structures and features, in grading, and in landscape preservation and enhancement should be made for each project.

(2) Site plans should include the arrangement of construction facilities and facilities required for operation and maintenance. To avoid additional landscape scars, construction facilities should be planned for later utilization in permanent administration, operation and maintenance, i.e. roads, parking areas and outside storage areas whenever possible.

b. Structures.

(1) In initial planning, mass relationships and architectural concepts should be visualized and then integrated into the design and related to surroundings insofar as feasible.

(2) Facilities should be designed with neat, clean lines and with uncluttered appearance. Clean-cut design is an important objective. Particular attention should be given to design and location of safety railings, fencing, machinery and equipment layouts, and power and communication lines, poles and appurtenances. Harsh appearances in structural forms should be subdued by use of architectural techniques, landscape planting or a combination of the two. Specialized architectural treatment of specific project features can frequently enhance the overall appearance of the project at

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minor added cost, particularly if provisions for such treatment are considered early in the planning process.

(3) Final structure fenestration should be the most pleasing possible at nominal cost. Artistic use of color, materials selection, texture, and combinations and variation of forming are possible means of enhancing appearance. Concrete finishes should be appropriate for the structure and its viewability by the public. New ideas in treatment of geometry and surfaces for structures are encouraged.

(4) Machinery and other equipment often requires overhead protection covers, safety railings, and protection against vandalism. In some cases, appearance could be improved by housing the facilities in architecturally-pleasing structures or shrouds.

(5) There is a marked tendency to protect all exposed metals with galvanizing or aluminum paint. The combination of such metal finish with the appearance of concrete is not unpleasant, but consideration could be given to using colored preservative coatings or self-coating metals where enhanced appearance would result.

(6) Use of chain link fencing on structures, such as to protect gate hoists and as fences on stilling basin walls, for example, often creates an appearance that is less than desirable. Consideration should be given to providing concrete walls, parapets topped with railings, or metal railings instead of fencing. In dangerous locations, such barriers should be specifically designed to prevent entry of small children into the area.

(7) Particular attention should be given to screening unsightly areas. If siting cannot provide the appropriate screen, then landscape plantings are usually the most effective method. The most important broad objectives for effective landscape planting are (a) to tie the structure to the ground; (b) to break the monotonous expanses of large buildings; (c) to provide accent for the buildings and their surroundings and reduce the apparent scale; (d) to reduce air conditioning loads; (e) to provide shade and wind-breaks; and (f) to reduce noise, dust and erosion. The above should be considered in landscape planting for all building sites of Civil Works projects. Where practicable, indigenous plantings should be used to reduce project maintenance costs.

c. Embankment and Dike Slopes. Erosion control is all that is needed in most cases. Hurricane barrier dikes in urban areas may be screened by landscape plantings, where practicable.

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d. Contractor Work Areas. These areas should be confined to the minimum necessary, planned for minimum despoilment, controlled during construction, and restored at completion of the project.

e. Quarries, Borrow Pits, and Waste Disposal Areas. These areas should be graded and landscaped as practicable to restore a natural appearance and for erosion control. Waste disposal areas should be chosen to minimize problems of restoration and screening and should be designed to avoid air and water pollution. Seeding, sodding, and landscape planting should be considered where appropriate because of the location.

f. Road, Railroads and Utility Lines. At reservoir projects, the appearance of the shores should be considered in locating and designing relocations, access roads, and utilities. This applies to both Government-constructed works and works by others under license or permit on Government lands. Alignments will be compatible with the natural terrain and will avoid or minimize scars on the environment. Clearing of vegetation for construction should be selective rather than to rigid limits. In many relocations there is more damage done to the natural landscape than is necessary. Roads or railroads to be relocated can sometimes utilize common rights-of-way with other utilities to minimize damage to the environment. Landscape planting of roads should be in general accordance with the AASHO publication, "Landscape Design Guide" (1965).

g. Reservoir Areas. Marked progress is needed in reforestation and in planting shade trees and ornamentals in reservoir areas at many existing projects. At some reservoir projects with considerable difference between top of power or conservation pool and flood control pool, most of the existing timber near normal shoreline has been killed and left standing with no attempt made to replace species intolerant to water with more tolerant species. Killing of intolerant species by a rising flood control pool is an eventual certainty. As time and funds permit, unsightly dead timber should be removed and tolerant species should be planted. At new projects, planting of tolerant species should begin early in project life and not wait until a large pool rise has occurred.

h. Floodways and Channels.

(1) Alignment. Care should be exercised to preserve major trees or vegetation, scenic points or historical buildings that may be adjacent to channels and floodways. From the aesthetic standpoint, gentle curves in alignment are preferable to long, straight reaches of channel.

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(2) Levee Treatment. In urban areas, slopes should be turfed where feasible. When riprap is required on slopes of channels used extensively for recreational boating, consideration should be given to provision of turfed or paved areas on convex bends to provide landings for boats, particularly at areas otherwise suitable for recreational development. In urban areas, consideration should be given to providing walkways along channel berms, with access to street level at bridges. Suitable sodding and plantings can be used to further enhance the appearance of urban channels.

(3) Spoil. Spoil should be molded into the topography or contoured and landscaped, where feasible, in order to prevent unsightliness.

(4) Channel Walls. Where rectangular or trapezoidal channels are necessary for hydraulic or other reasons, special attention should be given to channel appearance. Measures that may be used to improve appearance include formed patterns in channel walls, textured concrete, colored concrete, gabions, use of wood or colored, vinyl-clad fences, and suitable landscape plantings.

i. Continuing Maintenance. Frequent cleanup should be required as an item of local cooperation for future channel and floodway projects. Channels should not be used as public dumping grounds, as is so often the case on existing urban projects maintained by local interests. Regular removal of debris by local interests would help prevent small harbors from becoming unsightly from floating drift.

j. Reservoir Backwater Areas. In connection with many reservoir projects, problems are encountered in backwater reaches where denudation of vegetation and deposition of sediment create unsightly conditions and possible health hazards as a result of poor drainage and related mosquito problems. Under present practices, easements are usually acquired in an effort to offset adverse economic effects caused to the property owners. Some of the adverse aesthetic effects of these backwater areas could be eliminated by the construction of sub-impoundment reservoirs. It is possible that, in some cases, an arrangement could be developed whereby local interests would provide lands, rights-of-way, and possibly contribute toward construction of sub-impoundments in order to obtain the recreational and scenic advantages. Projects of this nature have been proposed by field offices in a few cases, and have been adopted as being cheaper than acquiring the flowage rights. Proposals for sub-impoundment reservoirs, where costs lower than land or easement acquisition is not the deciding factor on feasibility, should be referred to the Chief of Engineers, Attention: ENGCW-EZ for advice

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9. Implementation. Design memoranda should be specific with regard to measures proposed, using terms descriptive of the work, such as aesthetics of architectural features, erosion control, reforestation, landscape planting, and treatment of necessary construction scars, rather than in general terms. Consideration should be given to the various aspects of the environment all through the Corps' period of concern in a project, beginning with survey report project formulation and continuing through design, construction, project operation, and project management. Design alone cannot produce the desired results. It must be followed by high quality construction surveillance and inspection. Close control over construction operations must be maintained. Construction must be followed by expert management of the project and lands. Design concepts and objectives should be understood by those who carry out and preserve the design. This policy should be carried out with careful consideration of progressive resource conservation practices, economics, and coordination of professional practice of the various related disciplines such as engineering, architecture, site planning, agronomy, geology, and others. There is no intent to "gold-plate". Simple, harmonious treatments which will provide attractive appearance and surroundings for the enjoyment of the public, and projects in which the public may take pride of ownership are desired. This objective is not always easy to attain, but should be included as an integral part of the design of a project in the degree appropriate for each type of project or feature and commensurate with its location and exposure to the public. The costs of such measures are a regular project cost. The extent of these costs will depend on what is necessary to accomplish the objectives outlined above. Each case should be judged on its merits.

a. General Design Memoranda. The general design memorandum should be particularly responsive to the environmental aspects of project planning and design. Specifically, it should (1) include a narrative description of environmental impacts of items of work proposed, (2) discuss and illustrate proposed architectural treatment, (3) provide a site layout plan for the entire dam site or other project construction areas showing the over-all interrelation of various project features, roads, utilities, work areas, borrow and spoil areas, quarries, project headquarters, overlook, access, clearing, public use areas and all other proposed development for the construction phase as well as for operation of the project. This plan should be presented so as to show adequately the proposed development in relation to site and surrounding topography. Several methods and combinations may be employed, depending on magnitude and complexity of the project and cost of presentation. Examples are superimposition of the layout on aerial mosaics, perspective drawings, artists' renditions, color photography, and photography of scale models. The presentation should show clearly

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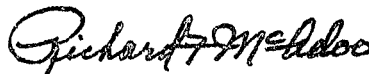
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that the project has been planned to provide for overall environmental enhancement and minimum despoilment of the landscape. Costs for environmental considerations will not be shown separately, but will be included in the costs for the project features to which the environmental treatment pertains.

b. Feature Design Memoranda. Planning for development of the individual project features should be responsive to the needs for architectural design, land treatment or other resource conservation measures. Particular emphasis should be given to development of measures proposed for realizing the full scenic potential of the project feature as it affects the overall project, by providing for cover reforestation, erosion control, landscape planting, management of vegetation, healing of construction scars, prevention of despoilment, and other related activities for all project lands. The presentation must be detailed in design memoranda and chapters of the Master Plan for construction of project features and of public use areas.

c. Plans and Specifications. Project plans and specifications will carry through the degree of protection to the environment as presented in approved design memoranda. Guide Specification CE-1300 should be adapted as necessary in preparing the contract specifications to protect the project environment during the construction phase.

FOR THE CHIEF OF ENGINEERS:



RICHARD F. McADOO
Colonel, Corps of Engineers
Executive