SELF-TAUGHT EDUCATION UNIT

Human Activities, Impacts and Alternatives

By Walter I. Priest, III

QH76 .V8 P74 1995

Introduction

Regardless of the nature of human activities, they all impact the environment. These impacts are rarely all good or bad. Most often some aspects are beneficial and some are deleterious. The question of whether the benefits exceed the detriments associated with some activity is always a matter of perspective. In the environmental management arena, however, the critical concern is an accurate assessment of both sides of the equation, the impacts as well as the benefits. In this way, and only this way, can rational and equitable decisions be made affecting both humans and their environment.

The assessment of any proposal can be divided into five basic parts:

1. Description and purpose of project
2. Description of resources
3. Impacts on resources
4. Analysis of alternatives
5. Conclusions and recommendations.

Description and Purpose of Project

The assessment process must begin with a detailed description of the proposed activities. The project description should accurately characterize the nature and extent of the proposed project so that its impacts can be accurately assessed. The following are a number of routinely encountered activities which can have profound environmental impacts. Included with each activity are a number of concerns which can influence the degree of impact and need to be considered in evaluating the proposal.

Dredging is one of the more frequently proposed environmental modifications. There are basically two types of dredging, new work and maintenance dredging. New work is usually the most environmentally consequential because it involves areas that have not been previously impacted and retain most of their inherent natural values. On the other hand, maintenance dredging is usually less damaging because the area has already been dredged and the value of the area compromised to some degree. The method of dredging, whether mechanical or hydraulic, can also influence the degree of impact. Mechanical dredging using a crane and a bucket of some type is usually less damaging. Hydraulic dredging has the potential for more widespread impacts because of the large quantities of water used to move the dredged material. A bermed upland placement area that effectively contains the dredged material helps minimize the impacts of the dredging. Unconfined overboard placement can have much more significant impacts because much larger areas are being affected. The impacts of dredging sand are usually less than those of dredging silt and clay because sand settles quicker.

Filling to convert an aquatic habitat to upland also results in serious environmental consequences. The factor of primary importance in assessing impacts is the size of the area to be filled. Other important considerations are the quantity and nature of the fill material and its method of containment to prevent its discharge into the waterway.

Shoreline defense structures such as bulkheads and riprap can also be responsible for significant alterations

of aquatic habitats. The length of the structure and its encroachment into a waterway, particularly channelward of mean high water are the most significant parameters in determining the extent of the structure's impact. Also important are the size and type of material to be used, lumber for bulkheads and stone for riprap, and its suitability to the conditions at the project location. Filter cloth should be used behind either type of structure to prevent the leaching of the backfill material through the structure and into the waterway. Properly designed return walls are also necessary to prevent the structure from being outflanked by the erosion of adjacent areas.

Whenever possible, shoreline defense structures such as bulkheads should be placed landward of wetlands.

Groins and jetties almost always precipitate rapid responses along adjacent shorelines. The characteristics which have the most influence on these responses are the length of structures, their height and the distance between the structures. Some design considerations such as being low profile, spurs and T-heads can measurably reduce impacts and increase the effectiveness of the structures. The proximity of similar structures along adjacent shorelines is also a very important factor in assessing impacts.

This is but a small sampling of the types of projects that could potentially be encountered. It is critically important that clear and accurate drawings be provided to describe any proposed projects. Without these drawings the assessment of the impacts on the local environment is extremely difficult, if not impossible.

A statement on the purpose of the proposed project is also vitally important, particularly when considering alternatives to the proposal. The extent of public and/or private use of the proposed facility as well as the perceived public and private need can become pivotal factors when framing alternatives to a proposal with significant environmental ramifications. The question of water dependency (Is the project inherently dependent on its proximity to the waterway or not?) can also become a critical factor in the decision-making process.

Description of Resources

The next step in the assessment process requires an appraisal of the habitat types, directly and indirectly involved in or impacted by the proposal. This information can be derived from a site visit, resource inventories or other sources. The description of the proposed project derived above must then be applied to the project locale and the nature and extent of the impacts to the natural system. The following are representative types of habitats that are important components of

Wetlands Program
College of William and Mary
School of Marine Science
Virginia Institute of Marine Science
Gloucester Point, Virginia 23062

December 1993

Dr. Carl Hershner, Program Director
Editors: Maryann Wohlgemuth
Pam Mason
Published by: VIMS Publication Center

"A publication of the Virginia Department of Environmental Quality's Coastal Resources Management Program pursuant to National Oceanic and Atmospheric Administration Award No. NA27OZ0312-01."

"This paper is funded in part by a grant/cooperative agreement from the National Oceanic and Atmospheric Administration. The views expressed herein are those of the author and do not necessarily reflect the views of NOAA or any sub-agencies."

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aquatic systems and are typically afforded special protection.

Wetlands are critical links between upland and aquatic systems which are critical to maintaining productivity. Wetlands can either be tidal or non-tidal and can either be vegetated or non-vegetated depending on the hydrologic regime and the sediment type.

Subtidal bottoms are those areas that are permanently inundated and occur channelward of mean low water in tidal situations.

Seagrass beds are basically subtidal areas which support the growth of submerged aquatic vegetation. These areas are immensely productive areas which provide important habitat for numerous fishes and shellfish. They are also important indicators of the good water quality necessary to maintain the seagrass beds.

Sand dunes are located adjacent to relatively high energy shorelines that have a sufficient supply of sand. The dunes act as a reservoir of sand that is available to modulate shoreline changes during storm events. They also provide protection against tidal flooding and wildlife habitat.

Shellfish beds are productive areas of primarily oysters and clams both natural and cultivated which merit consideration by virtue of their economic and/or ecological value.

Riprap Revetment Construction

Right

Wrong

Spawning areas are those areas of concentrated finfish spawning, primarily for anadromous fishes in the freshwater reaches of the estuary. Also included are important shellfish beds that produce above average recruitment.

Threatened and endangered species habitats are those areas of critical habitat considered necessary for the survival of the species of concern.

Impacts on Resources

The third step in the assessment process involves the detailed evaluation of the potential for the proposed project to impact any number of ecological and socio-economic values. The following is not intended to be a comprehensive list of potential impacts. It is designed to cover the most frequently encountered situations and to hopefully stimulate the imagination to consider less routine circumstances.

Navigation Concerns

Often overlooked, the impacts of a project on navigation as well as the ecological impacts of a navigation project should be considered.

The location and position of piers, groins and breakwaters can have an impact on navigation. This may be of particular concern in areas of high volumes of boat traffic or at the upper ends of tidal creeks where turning space is limited.

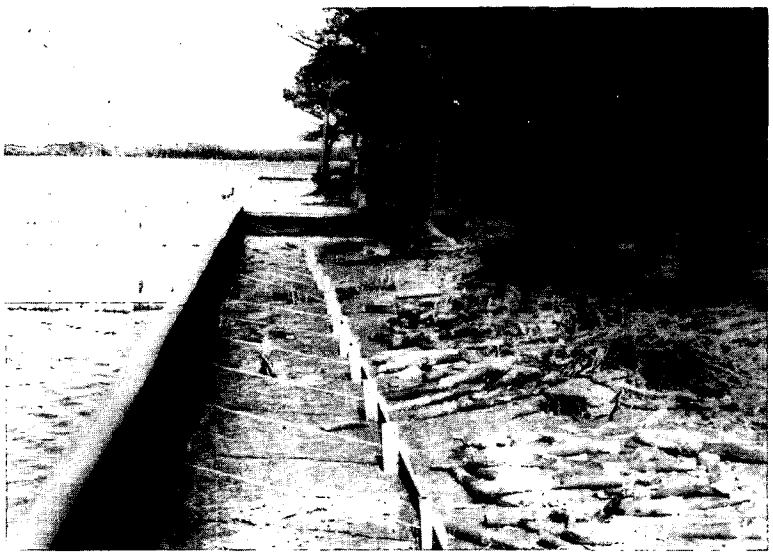
Dredging for the purpose of providing navigation can cause a variety of environmental impacts. More frequent boat traffic by larger vessels may lead to increased shoreline erosion from boat wakes. Impacts to water quality from boat discharges, accidental spills and overboard garbage are also a concern. Maintenance dredging can cause continuing disruptions to biological communities and loss of productivity.

Flooding

Many types of projects can alter the flow modulating characteristics of wetlands and waterways. Changes in channel cross-section increase or decrease tidal amplitudes by improving or restricting the flow of water. Filling of wetlands can eliminate the flood buffering capacity of these areas increasing both the height and duration of floods. Stream channelization and diversion projects can also produce similar problems by circumventing wetlands and increasing flow velocities. All of these situations can lead to increased flooding potential downstream of the project.

Shoreline Erosion and Accretion

Shoreline defense structures and dredging can have pronounced effects on shoreline erosion and accretion. Jetties, groins and similar structures alter littoral currents and drift causing changes in scour and deposition patterns. A reach of shoreline currently enjoying protection due to sediment accretion may be negatively affected by an updrift structure. Vertical walls reflect incident wave energy to adjacent shorelines increasing erosion rates. Changes in inlet configuration can cause increased scour in some places and increased shoaling in others that requires more frequent maintenance dredging. The removal of erosion buffering marshes by dredging and filling can also accelerate local erosion rates.



The proper design and construction of a bulkhead include the use of tiebacks and filter cloth.

Fish and Wildlife

Fish and wildlife resources generally receive the most severe impacts from construction activities because the two are seldom compatible. The loss of wetlands and subaqueous habitats are usually of the greatest concern. These areas provide much of the primary production which supports aquatic food webs. They are also the pri-

mary habitats for forage fishes and invertebrates that contribute significantly to food webs. They also provide critical nursery areas for juveniles of commercially important finfish and shellfish. All of the above make these areas important feeding, nesting and resting areas for waterfowl, shorebirds and wading birds.

Dredging can impact fish and wildlife resources in a number of ways. Increased turbidity decreases light penetration reducing the photosynthetic ability of plankton and SAV. It can also stress filter feeders by clogging gills and interfering with feeding. Spawning areas for anadromous fishes can be adversely impacted by increased turbidity which reduces egg hatching success and larval survival. Benthic communities destroyed in dredged areas can be expected to repopulate the areas within one or two years depending on new water depths, substrate and food availability.

Rare or endangered species have very specific habitat requirements with little tolerance for modification or disturbance that may result from proposed construction activity or increased human usage of an area after the project has been completed.

Water Quality

Water quality is very easily affected by a wide range of construction related impacts. Dredging, for example, can cause significant increases in the turbidity of a waterway, particularly a small creek. This increase in suspended material can reduce the level of dissolved oxygen in the water column due to increased biochemical oxygen demand from the resuspension of organic sediments. This resuspension of bottom sediments can also increase the availability of any contaminants present to filter feeding organisms.

Marina construction and ancillary upland development can impact water quality as a result of increased coliform bacteria levels due to ineffective sewage disposal including failing septic systems, boats and sewage treatment plants. Also, non-point source inputs of nutrients, sediment and other pollutants from upland runoff can be very deleterious to water quality.

Wetland losses can also affect water quality by reducing the capacity for nutrient cycling within the water body. They are important sites of nutrient remineralization which involves the conversion of nutrients from organic particulate to more available dissolved forms. Wetlands can also act as a sink which can absorb pulses of nutrients and release them slowly over time.

Canals, particularly long convoluted residential canals, which are dredged into uplands are very prone to developing water quality problems. Their extreme length makes it difficult for material introduced at the head to be flushed out of the canal. This leads to an accumulation of both organic materials and nutrients which are washed into the canal from the adjacent uplands. As the organic material decays it requires oxygen for decomposition. This increases the biochemical oxygen demand (BOD) in the water and reduces the amount of dissolved oxygen available, particularly during the summer when water temperatures are high. Added to this problem is the abundance of nutrients also present in the canal. These nutrients stimulate the growth and reproduction of phytoplankton until bloom conditions are eventually reached. This is not a problem during the day when there is so much photosynthesis that the dissolved oxygen levels become saturated. The phytoplankton population continues to expand until one night there are so many phytoplankters in the water column that there is not enough oxygen dissolved in the

Access to navigable water should be achieved by piering across wetlands rather than dredging and filling.

water to support their respiration. By very early in the morning, before sunrise, the phytoplankton has respired all of the oxygen out of the water and there is none left for the fishes and other animals in the canal. If these animals are unable to leave the canal in time, the result is a massive fish kill caused by suffocation from the lack of dissolved oxygen in the water.

Water quality can also be markedly affected by point source discharges that might result from a proposed construction activity. These discharges are controlled by the Virginia Pollutant Discharge Elimination System. When assessing the impacts of a particular project, these secondary impacts must also be included as a part of the overall impact of the project. Also included in this category of impacts is the potential for spills of petroleum products or other hazardous materials.

Non-point sources of nutrients, pesticides, organic material and sediments from urban and agricultural runoff can also have significant impacts on water quality.

Aesthetics

By far the most difficult factor to assess is aesthetics because everyone's aesthetic perceptions are different. Generally, the replacement or removal of dilapidated or derelict structures and removing or covering existing solid fill or rubbish fills can be considered to improve the aesthetics of an area. However, many more construction projects will be viewed as detracting from the natural beauty of an area. When the pristine attributes of an area are radically changed, the aesthetic impacts are usually considered negative.

Archaeological and Cultural

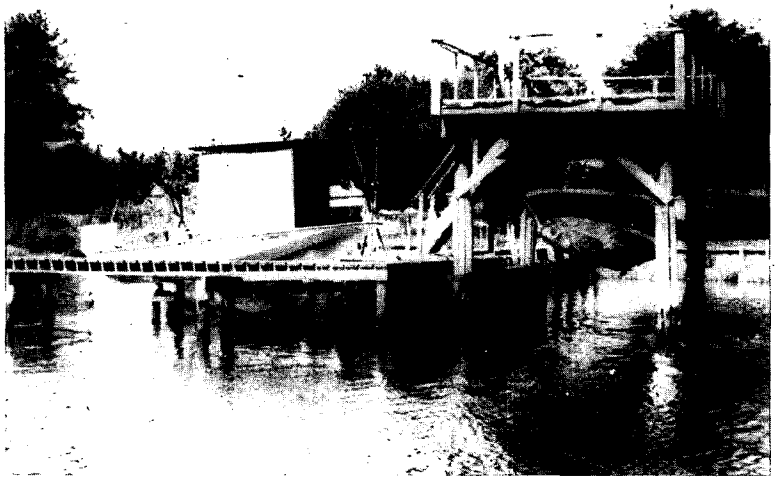
The archaeological and cultural resources of a site can also be significantly impacted by proposed construction activity. Since these resources are, for the most part, irreplaceable, a considerable amount of coordination with knowledgeable persons is usually required. This can include several phases of field surveys depending on discoveries on the site. Coordination with the State Historic Preservation Office, the Virginia Historic Landmarks Commission and the National Register of Historical Properties is generally required as a minimum.

Recreation

The recreational aspects of a particular project can play an important role in how a particular project is perceived, particularly with regard to whether the public benefits might surpass the public detriments. The positive aspects can be developed, for example, by enhancing existing recreational facilities that might improve access to a waterway or create new recreational opportunities. This increases the number of people able to use a project and thereby increases its public benefit. The negative aspects can be minimized by avoiding the degradation of existing recreational facilities and ensuring public access to new recreational facilities.

Socioeconomics

The socioeconomics of a project, by and large, receives more attention and is afforded more weight in the decision-making process than it generally deserves. The most often cited public benefit to be derived from a particular project is that it will increase the local tax base. This means that the improvements made as a result of the proposal will increase the value of the property and allow the locality to charge the owner more in taxes thereby increasing revenues. The issue that is usually ignored is that these improvements almost always require an increased level of local services such as roads, utilities, schools, and police and firefighting services. An objective analysis in many circumstances



Dredging can often be avoided by the use of boat lifts in shallow areas.

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Exam Questions

1. List the five major parts of the assessment outline presented in the education module.
    1.
    2.
    3.
    4.
    5.

2. Describe the difference between maintenance and new work dredging.

3. Define the major resource areas susceptible to impact by human activities.

4. What kind of environmental impacts can occur as a result of increased navigational use of a waterway?

5. Describe the flood buffering capabilities of wetlands.

6. How do groins and jetties effect the littoral transport of sand along a shoreline?

7. Describe some of the ways dredging can adversely effect fish and wildlife habitat.

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School of Marine Science
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Gloucester Point, Virginia 230623

8. Describe the water quality degradation process which is often the result of the construction of long convoluted dead-end canals.

9. What role does aesthetics play in the evaluation process?

10. How are the potential impacts of a project on archaeological or cultural resources identified?

11. What role do enhanced recreational opportunities play in the assessment process?

12. What is the most often cited public benefit to be derived from a development proposal?

13. What are the hidden costs of development which must be shouldered by community resources?

14. What are the four major parts of the analysis of alternatives?
    1.
    2.
    3.
    4.

15. What are the three types of recommendations that a staff can make regarding the disposition of a permit applications?
    1.
    2.
    3.

would probably show that the increased cost of services usually offsets the increased revenues.

Many times it will be argued that a proposed project will stimulate the local economy by creating jobs and increasing payrolls. When new industries, fisheries or commerce are developed, they can stimulate the economy of an area. These economic gains also have their costs such as increased demands for potable water and wastewater treatment which must be factored into the overall equation along with their environmental costs, for example, lower ground water levels, saltwater intrusion, ecological impacts of additional impoundments and the potential for water quality degradation from wastewater discharges.

Local zoning and land use plans are also a factor in determining the level and direction of economic growth. These can and do become important factors in siting facilities and designing developments that must comply with the requirements of local ordinances.

Analysis of Alternatives

This portion of the process involves making the determination of which impacts appear to be avoidable and which appear unavoidable. It also includes the development of reasonable means to reduce the impacts of the proposal and re-establish the values lost when possible.

The first alternative which must be considered is whether the impacts to important resources can be avoided by using an alternative location. If the impacts cannot be totally avoided, can they be significantly reduced by using different methods of construction, changing the access to the site, avoiding critical times of the year or employing best management practices. Alternative means of achieving the stated purpose should also be considered.

If a significant reduction in impacts could not be achieved through avoidance, consideration should be given to reducing the scope of the project to a level the site can support at an acceptable level of impact. This can be accomplished in some circumstances by the use of previously disturbed areas to reduce the scope of project impacts on undisturbed habitats. The use of areas of lesser ecological significance should also be considered where justified to avoid impacting the more ecologically important habitats.

When all of the impacts possible have been avoided and the scope of the project cannot be reduced any further and there is still a significant level of impact, consideration should be given to the restoration of adjacent areas which have been damaged by previous activities.

Only after all of the above have been considered and implemented to the maximum extent possible should compensation for the unavoidable losses be considered as a viable alternative to reduce the level of impact. This alternative should only be considered when it has been determined unequivocally that the unavoidable impacts are in the public interest and the public and private benefits clearly outweigh the public and private detriments.

The proper design and construction of dredged material placement areas can avoid many environmental impacts.

Conclusions and Recommendations

This is where the weighing of the public and private benefits versus detriments occurs as well as the formulation of recommendations to ensure that the benefits outweigh the detriments.

In making these decisions, extenuating circumstances or any other relevant information either pro or con not mentioned in the above

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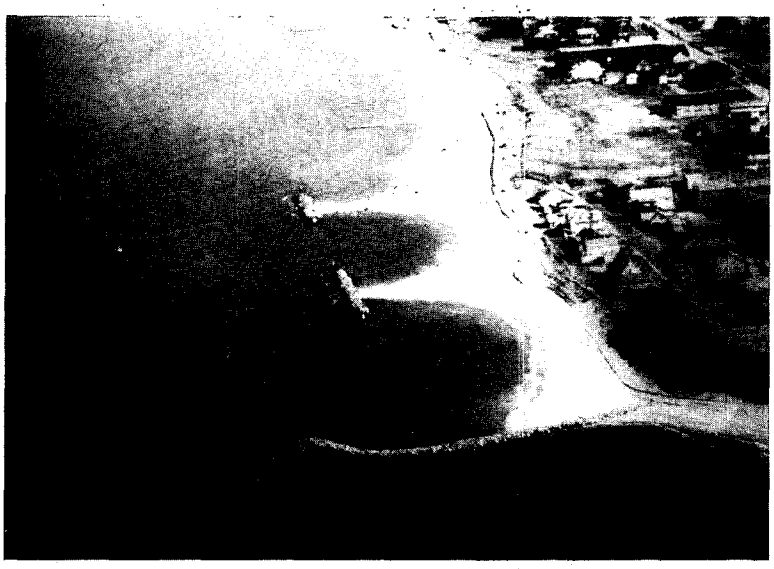
paragraphs that might affect recommendations need to be addressed.

Recommendations should also be made for additions, deletions or modifications to the proposal, including any reasonable alternatives, necessary to make the project environmentally acceptable.

Upon completion of this process, a recommendation should be developed which either recommends approval as proposed or puts well defined and readily determinable conditions or limits on the project so that the benefits outweigh the detriments and approval can be recommended. If a project cannot be sufficiently conditioned then the recommendation should be for denial.



Whenever possible, shoreline defense strategies should be designed to include the whole reach of a shoreline to help avoid the impacts of isolated individual structures.

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