The Delaware Statewide Dredging Policy Framework

February 2001

Purpose of the Statewide Dredging Policy Framework

The purpose of this Statewide Dredging Policy Framework is to improve consistency and coordination in the design and review process for dredging projects in Delaware waters. It will ensure that the State's concerns regarding environmental protection, economic value, and stewardship of Delaware's natural, commercial, and recreational resources are addressed.

This document is designed to be a resource for permit applicants and those reviewing applications. It presents the regulations and design and operations standards aimed at ensuring that necessary projects will have minimal environmental impacts and will comply with State Water Quality Standards and other requirements. However, this document is to be used only as a guideline, and applicants should be sure to discuss their individual projects with State and Federal agencies as necessary.

Another purpose of this document is to provide education for those interested in dredging projects from the perspective of an affected public citizen. The authors have attempted to reduce the amount of "technical" language where possible. It also provides an overview of the permit process so that interested citizens can take advantage of opportunities for public input and participation.

About this Document

This document was developed as a result of the coordination and dedication of the Delaware Dredging Working Group, made up of stakeholders representing project applicants, permit review agencies, environmental groups, and public citizens. A list of participants can be found in the Appendices.

The Delaware Statewide Dredging Policy Framework contains background information about dredging in general, existing regulations and guidance from federal and state agencies, and supporting information for many key dredging issues.

In developing this document, the Working Group decided to address only navigation projects and beach nourishment in tidal waters. This Policy Framework will not address policies for tax ditches, drainage projects, or freshwater pond dredging. While the latter three are all important project types, they have unique issues which require specialized attention.

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Executive Summary

This document is designed to provide an overview of factors affecting dredging projects in Delaware. Topics related to Administration (policy), Environmental Evaluation (science), and Operations (engineering) are grouped together in chapters. The information contained herein is provided as an introduction and overview of the process. Applicants for dredging permits should consult with the appropriate Agency or Division to ensure that they are compliant with the most up dated regulations and guidance.

This document is the culmination of work performed by many individuals and agencies with varied backgrounds, expertise, and interests. Together, they formed the Delaware Dredging Working Group, support staff, and stakeholders (see Appendices for full list of participants). The introductory section of the document outlines the steps taken to create the Policy Framework document, the issues identified, strategies developed, and final outcome.

The Administration chapter identifies the agencies involved in reviewing and permitting dredging projects. It also contains a list of applicable laws, programs, or considerations that might affect the permitting process. The purpose of this chapter is to familiarize the reader with the complex permit process required for dredging projects and to encourage consultation with appropriate agency officials at the Joint Pre-Application Meeting. This chapter also includes background information regarding information requirements, maintenance dredging, consequences of permit violations, economic considerations, and potential alternatives to dredging.

The Environmental Evaluation chapter organizes the review of potential environmental impacts from a project into a four-tiered system. The tiers are based upon project size and complexity as well as the location of the work. The level of review that a project requires will be determined by Delaware Department of Natural Resource and Environmental Control (DNREC) staff. Whatever review is undertaken during the pre-dredge evaluation must then be confirmed through during-dredging and post-dredging surveys.

The Operations chapter is intended to provide background on different dredging methods and to encourage applicants to select the method with the least environmental impacts for their particular situation. It also lists general policies regarding dredging location and project design, outlines best management practices, and provides criteria for appropriate dredging and disposal operations.

The Appendices include lists of process participants, additional standards and regulations, information regarding the Port of Wilmington and other material referred to in sections of the document.

The Process

Because issues related to dredging involve differing interests and various levels of project review and regulatory oversight, Delaware Coastal Programs (DCP) has developed this Dredging Policy Framework through a collaborative decision-making process. A Working Group structure was used, with members providing background expertise on the various components of the dredging process and advising DCP on the content of the Policy Framework document. This collaborative decision-making relied fundamentally on the participation, input, and agreement of resource managers, scientists, and commercial and residential interests.

The original goal of this project was as follows:

"The goal of the Dredging Working Group is to develop and implement a Statewide Dredging Policy Framework. This Framework will:

- *Provide clear guidance and early coordination between regulatory agencies and applicants;*
- *Provide a basis to evaluate project justification based upon economic and environmental impacts;*
- *Identify data requirements and provide resources to maximize the use of existing information;*
- *Identify preferred dredging methods and disposal options, including beneficial uses;*
- *Provide a consistent approach to testing and monitoring activities; and*
- *Provide education and public outreach regarding dredging activities in State waters."*

The above goal was clearly defined at the outset by the Working Group and was used to maintain focus throughout the process.

The project was divided into six phases (see Figure i.1), each with a well-defined goal and identified product. The first phase of this project convened the Dredging Working Group, a group of about 25 members representing the stakeholder groups involved with dredging in Delaware waters. The role of the Working Group was to identify issues related to dredging in the State, to explore alternatives and solutions, to advise the DCP regarding the content and themes in the Dredging Policy Framework Document, and to assist in the drafting of that document.

The next phase of this process was a one-day design symposium, which gathered a larger group of experts who have experience with problems and issues similar to those identified by the Working Group. These experts were divided into three focus groups according to their area of expertise – Administration (policy), Operations (engineering), and Environmental Evaluation (science), where they discussed and evaluated alternative approaches to the problems presented. Some groups also developed methodologies for particular components of the issues (i.e. testing protocols, management practices, disposal options, beneficial re-use alternatives, coordination improvements, etc.). The final result of this workshop was a *Workshop Proceedings* document containing recommendations from each focus group.

After this workshop, the Working Group reconvened and reviewed the *Workshop Proceedings*. Small focus groups were formed in order to provide further guidance on particular sections of the Framework. The goal of this phase was to arrive at a means for implementing the priority Dredging Policy Framework components. DCP staff used these recommendations, along with further consultation with the Working Group, to draft this Policy document. The Working Group has had the opportunity to review all interim and

final products related to the Policy Framework.

There are a number of issues that arose during this process that were not able to be fully addressed during the drafting of this document. However, the Working Group felt that many of these issues were valuable and worthy of future consideration. These issues include the following:

- long term dredging priorities
- Best Management Practices for Confined Disposal Facility (CDF) closure
- policies for non-tidal ponds
- more specific monitoring guidelines for during and after dredging
- analysis of technical and administrative capacity to implement the framework outlined in this document and expand its scope
- "National Environmental Policy Act (NEPA)-like" process of alternatives analysis
- education and public outreach efforts
- the role of private and public-owned dredges
- economic policy with respect to dredging
- sediment loading to watersheds (pollution prevention)
- Geographic Information System (GIS) database and analysis system for dredging projects
- review of Inland Bays guidelines
- long term disposal plan
- beach disposal sediment criteria
- abridged version of this document for permit applicants.

The Working Group recommends that the above issues be addressed by future efforts related to the permitting of dredging activities and that the current document be examined with the understanding that these items are missing.

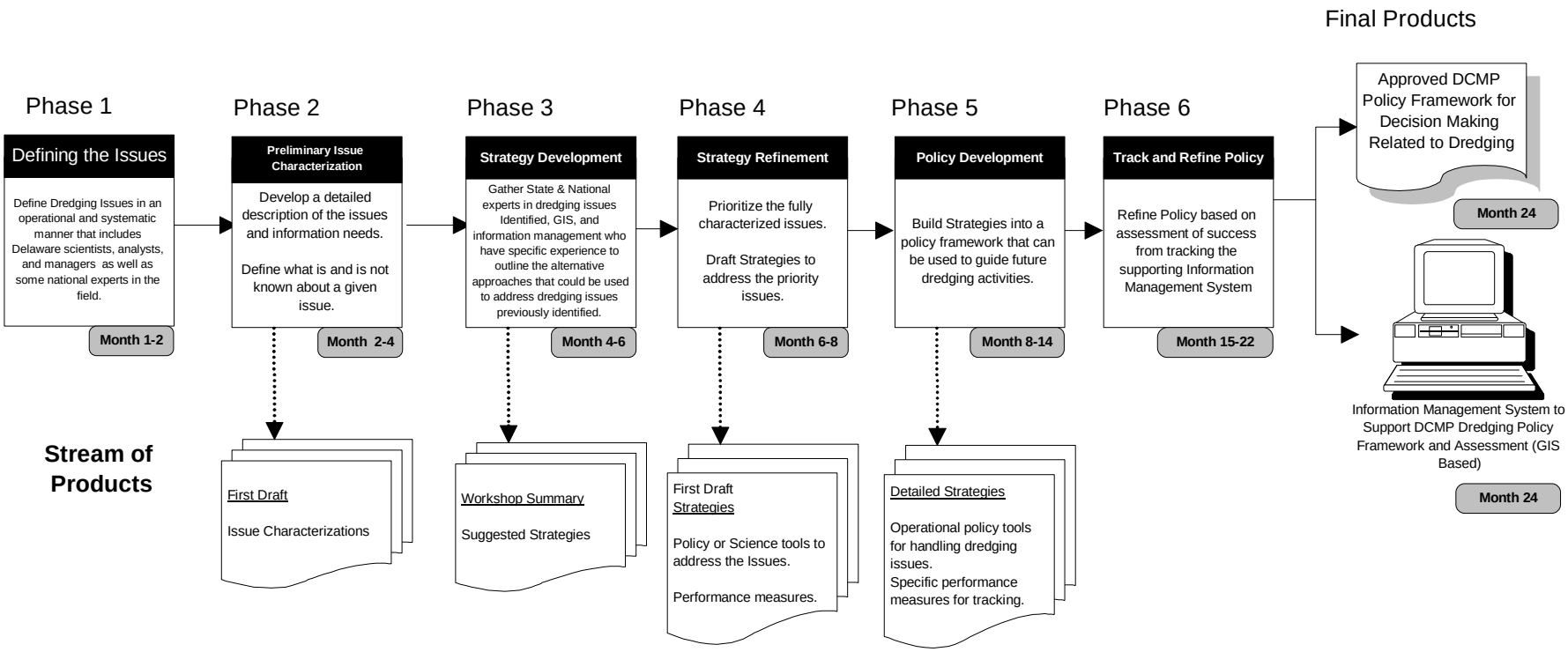


Figure i.1. Dredging Policy Framework Process Diagram

MEETINGS/WORKSHOPS OF THE DREDGING WORKING GROUP

Date/Location	Purpose/Result
4/27/99 *Grass Dale Conference Center* *Delaware City, DE*	Presented overview of project, reviewed initial issue statements and groupings, and added additional members to represent stakeholder groups.
6/3/99 *Grass Dale Conference Center* *Delaware City, DE*	Reviewed current process for dredging applications, reviewed issues and grouping categories, and began issue characterization.
7/13/99 *St. Jones Reserve* *Dover, DE*	Reviewed draft *Issue Characterization* document, refined list of issues, identified additional information needed, and identified individuals to work on issue refinement.
9/28/99 *St. Jones Reserve* *Dover, DE*	Reviewed and finalized *Issues Characterization* document, developed preliminary list of tools or actions to address issues, and began planning Strategy Workshop.
10/13/99 *St. Jones Reserve* *Dover, DE*	Presented, reviewed, and selected process to complete Policy Framework, and began first steps of strategy development phase.
11/10/99 *St. Jones Reserve* *Dover, DE*	Reviewed plans for Strategy Workshop and reviewed issues in preparation for strategy development.
12/7/99 *Clayton Hall,* *University of DE* *Newark, DE*	Reviewed issues developed, brainstormed ideas/solutions to address each issue, and developed detailed descriptions of each strategy.
2/15/00 *St. Jones Reserve* *Dover, DE*	Reviewed workshop results, updated project status, detailed next steps, initiated efforts to finalize document components, and identified key members to complete outstanding tasks.
4/6/00 *St. Jones Reserve* *Dover, DE*	Environmental Evaluation Focus Group met to discuss section.
6/8/00	First draft of Policy Framework mailed to Working Group for comment.
9/19/00 *St. Jones Reserve*	Reviewed final comments on document draft.

INTRODUCTION

Overview of Dredging in Delaware

Appropriate dredging in waters of the State of Delaware is necessary for movement of maritime traffic into ports, movement of recreational traffic in rivers and bays, beach replenishment, coastal hazard mitigation, maintaining water intakes, or removal of contaminated sediment. If accomplished pursuant to established review criteria, this dredging can be an important component to a healthy coastal economy and environment. In certain cases, if dredging activities were to cease, there could be repercussions for local employment or for the economy both regionally and/or nationally, as in the case of the Delaware River Main Channel.

The state's tourism industry is supported in part by the recreational opportunities provided by state beaches and public boat access areas. Dredging associated with beach replenishment and navigation ensures the strength of this important industry.

The diversity of dredging activities in state waters creates a wide range of issues and concerns, and this document will attempt to address and clarify as many as possible.

Right to Navigable Waters

The initial consideration that must be examined in any water-based project is whether the applicant indeed has the authority to conduct the activity. In general, a riparian landowner does have some right of access to navigable waters of the United States. However, this right is subject to the similar rights of access held by nearby riparian landowners and to the general public's right of navigation on the water surface. In the absence of overriding public interest, favorable consideration will generally be given to applications from riparian owners for permits for piers, boat docks, moorings, platforms, and similar structures for small boats.

Delaware is one of only a few states to recognize a coastal landowner's grant seaward to the low water mark. "[A] riparian owner…holds to low water mark and thus its title includes the foreshore" (*State ex rel. Buckson v. Pennsylvania Railroad Co.,* 228 A.2d 587, 600 (1967)). However, despite the private ownership of tidelands extending to the "ordinary low water mark," the public still retains the public trust right to utilize the beach up to the "ordinary high water mark."

"In general, common law riparian rights include a right of access to reach the water, the right to accretions, the right to an unobstructed view, a qualified right to wharf out, the right to make commercial use of water access, the right to make reasonable use of the water, and the right of navigation in common with the public" (Christie, 1994). Riparian rights have long been considered vested property interests. However, "what were previously regarded as riparian 'rights' can be described today as merely riparian 'privileges'" (Slade, 1997), and these must be balanced against public rights and concerns.

Access to the water by waterfront landowners is not unlimited. The right to use the water is in context with the location and must be balanced with the right of the general public to use the waterbody. Rights do not include an unlimited ability to dredge to any depth necessary or desired, nor to wharf out unrestricted. "Dredging to obtain navigable water depths in conjunction with private residential boat docking facilities should be avoided" (Regulations Governing the Use of Subaqueous Lands, 3.03 (B) 13).

"The Department shall consider the public interest in any proposed activity which might affect the

use of subaqueous lands." These considerations include, but are not limited to, the following:

1. The value to the State or the public in retaining any interest in subaqueous lands which the applicant seeks to acquire, including the potential economic value of the interest.
2. The value to the State or the public in conveying any interest in subaqueous lands which the applicant seeks to acquire.
3. The potential effect on the public with respect to commerce, navigation, recreation, aesthetic enjoyment, natural resources, and other uses of the subaqueous lands.
4. The extent to which any disruption of the public use of such lands is temporary or permanent.
5. The extent to which the applicant's primary objectives and purposes can be realized without the use of such lands (avoidance).
6. The extent to which the applicant's primary purpose and objectives can be realized by alternatives, i.e. minimize the scope or extent of an activity or project and its adverse impacts.
7. Given the inability for avoidance or alternatives, the extent to which the applicant can employ mitigation measures to offset any losses incurred by the public.
8. The extent to which the public at large would benefit from the activity or project and the extent to which it would suffer detriment.
9. The extent to which the primary purpose of a project is water-dependent (Regulations Governing the Use of Subaqueous Lands, 3.01 (A)).

CHAPTER 1. ADMINISTRATION

Purpose

This chapter covers a wide range of topics, all related to permitting, project review, and other "pre-project" considerations. Its aim is to present an introduction to important administrative topics that should be addressed when designing a dredging project. This chapter begins with an overview of the agencies involved in the project review process and some of the key regulatory programs and laws or regulations. The bulk of the chapter enumerates information required for each permit, the consequences of supplying false information or not complying with permit conditions, and the guidelines for extensions or modifications. A section on maintenance dredging defines how a "repeat" project may be defined or treated differently than a completely new project. The economics section introduces the policies used to address cost-benefit issues from the Federal, State, and private perspective. The alternatives section emphasizes that the State encourages applicants to find alternative means to accomplish project goals or to minimize the scope of their project.

Agencies involved in the Permitting Process

Federal:

U.S. Army Corps of Engineers, Philadelphia or Baltimore District
NOAA National Marine Fisheries Service
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service

***State*:**

DNREC, Division of Water Resources, Wetlands and Subaqueous Lands Section
DNREC, Division of Soil and Water Conservation, Delaware Coastal Programs
DNREC, Division of Soil and Water Conservation, Sediment and Stormwater Section
DNREC, Division of Fish and Wildlife
State Historic Preservation Office

Required Permits of Certification

In Delaware, dredging activities are regulated by the U.S. Army Corps of Engineers, (Philadelphia or Baltimore District) and the DNREC, Division of Water Resources, Wetlands and Subaqueous Lands Section, but other agencies may also be involved in the process. The location, activities proposed, and applicant all affect which agencies and permits will have jurisdiction. *Applicants are encouraged to attend the Joint Pre-Application Meeting described in this section and/or to contact agency representatives to discuss particular project considerations*.

The regulatory programs of both Federal and State agencies require that an applicant obtain permit approval before undertaking a project. In addition, the Delaware Coastal Programs section, under the DNREC, Division of Soil and Water Conservation, requires an applicant to provide certification that a proposed project complies with the State's coastal zone management program.

An integral part of the permit acquisition process is the public notice and public interest review which affords other federal and State regulatory agencies (e.g. U.S. Environmental Protection Agency, State Historic and Cultural Affairs Office) and the general public an opportunity to review and comment on any given proposal. The Corps and DNREC evaluate each project by balancing

the need and expected benefits against the probable impacts, taking into consideration all comments received and other relevant factors. Below is a brief explanation of the major permit approvals needed for most dredging projects in the state. The contact agency listed can provide additional information.

U.S. Army Corps of Engineers Permits

The regulatory authorities and responsibilities of the Corps of Engineers are based on the following laws: Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403) "prohibits the obstruction or alteration of navigable waters of the United States without a permit from the Corps"; Section 404 of the Clean Water Act (33 U.S.C. 1344) "prohibits the discharge of dredged or fill material into waters of the United States without a permit from the Corps": and Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972, as amended (33 U.S.C. 1413) "authorizes the Corps to issue permits for the transportation of dredged material for the purpose of dumping it into ocean waters." Applicants are required to obtain a Department of the Army (DA) individual permit (see 33 CFR 323). This process involves a public notice period as well as consultation with those Federal and State agencies which govern environmental quality, fish and wildlife, endangered species and historic preservation.

Contact: U.S. Army Corps of Engineers, Philadelphia District, Regulatory Branch.

Federal Consistency

Section 307(c) of the Coastal Zone Management Act of 1972, as amended (16 U.S.C. 1456(c)), requires "federal agencies conducting activities . . . directly affecting a state's coastal zone, to comply to the maximum extent practicable with an approved state coastal zone management program. . . ." The Act also requires any non-federal applicant for a federal license or permit to conduct an activity affecting land or water uses in the state's coastal zone to furnish a determination that the proposed activity will comply with the state's coastal zone management program (33 CFR 320.3(b)).

This means that most persons applying for a department of the Army permit will also be required to obtain a federal consistency determination from the sate Coastal Zone Management Program. Applicants for CZM Federal Consistency are subject to an additional public notice period of either 15 or 30 days. A federal permit cannot be issued if CZM Federal Consistency is denied.

Contact: DNREC, Division of Soil and Water Conservation, Delaware Coastal Management Program

Water Quality Certification

Section 401 of the Clean Water Act (33 U.S.C. 1341) requires "any applicant for a federal license or permit to conduct any activity that may result in a discharge of a pollutant into waters of the United States to obtain a [Water Quality Certificate]from the State in which the discharge originates or would originate . . ." (33 CFR 320.3(a)). The applicant must provide a reasonable assurance that water quality standards will not be violated. A federal permit cannot be issued if Certification is denied. Requirements for Water Quality Certificates are project specific.

Contact: DNREC, Division of Water Resources, Wetlands and Subaqueous Lands Section.

Subaqueous Lands Permits

7 Delaware Code 7205 states that "No person shall deposit material upon or remove or extract materials from, or construct, modify, repair or reconstruct, or occupy any structure or facility upon submerged lands or tidelands without first having obtained a permit, lease or letter of approval from the Department." This means that all dredging projects within State boundaries must

obtain subaqueous permits.

"A person seeking a lease or permit shall submit to the Secretary [of DNREC] a written request, using the appropriate forms available from the Department, stating in detail the type of grant, lease or permit desired, showing the location of the area and containing specifications for any proposed activity" (Regulations Governing the Use of Subaqueous Lands 2.01 (A)).

Contact: DNREC, Division of Water Resources, Wetlands and Subaqueous Lands Section.

State Wetlands Permits

7 Del C. 6604 requires that any activity in tidal wetlands must obtain a permit from the DNREC. Wetlands subject to the provisions of the Wetlands Act are delineated on regulatory maps that were last revised in 1992.

Contact: DNREC, Division of Water Resources, Wetlands and Subaqueous Lands Section.

Other applicable Programs, Laws, and Considerations affecting Permit Processing

Clean Water Act

Section 404 of the Federal Clean Water Act authorized the Corps of Engineers (or a State agency with an authorized permit program) to issue permits for the discharge of dredged or fill material into waters of the United States.

Delaware Natural Heritage Program

The Delaware Natural Heritage Program (DNHP) conducts systematic biological surveys throughout the State of Delaware for the purpose of locating populations of rare or unique plant and animal species, and to identify and describe significant natural communities. The data is then used for a variety of purposes including environmental review services for project applicants. The DNHP staff has the capability to do data searches as well as on-site inventories, and information on these can be acquired by contacting the Program, which is located within the DNREC Division of Fish and Wildlife.

Delaware Sediment and Stormwater Law and Regulations

"After July 1, 1991, unless a particular activity is exempted . . . , a person may not disturb land without an approved sediment and stormwater management plan from the appropriate plan approval agency. A grading or building permit may not be issued for a property unless a sediment and stormwater management plan has been approved that is consistent with the following items:

A. Chapter 40, Title 7, Delaware Code, relating to erosion and sediment control and stormwater management, and;
B. These regulations, or duly adopted county or municipal ordinances that are adopted as a part of the delegation process and relate to the intent of these regulations (Delaware Sediment and Stormwater Regulations, Section 8(1)).

Contact: DNREC, Division of Soil & Water Conservation

Delaware State Historic Preservation Office Review

Section 106 of National Historic Preservation Act (NHPA) requires federal agencies and recipients of federal assistance or permits to take into account the effects which the project may have on significant historic properties and sites. Applicants must preserve, either physically or through extensive documentation, any significant historic properties that may be harmed by these projects. Applicants should consult the Delaware State Historic Preservation Office (SHPO) in order to determine if applicable sites lie in the vicinity of the proposed project area.

Endangered Species Act

The Federal Endangered Species Act provides for the designation and protection of invertebrates, wildlife, fish, and plant species that are in danger of becoming extinct and conserves the ecosystems on which such species depend. The U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS) have jurisdiction under this Act and should be contacted regarding presence of listed Threatened or Endangered Species.

EPA/USACE Inland Testing Manual

The document entitled Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. – Testing Manual (EPA/USACE, 1998) is commonly known as "The Inland Testing Manual." It provides guidance for conducting testing of dredged material to assess the potential for contaminant-related impacts associated with dredged material disposal into open water. It is designed to aid permitting authorities in making determinations regarding whether the discharge will comply with the 404(b)(1) Guidelines for discharge as laid out in the Clean Water Act regulations (see above).

Marine Protection Research and Sanctuaries Act of 1972

The basic objective of the Marine Protection Research and Sanctuaries Act is to "prevent or strictly limit the dumping into ocean waters of any material that would adversely affect human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities." This Act authorizes the Secretary of the Army to issue permits for dredged material disposal, and the EPA to designate appropriate dump sites.

National Environmental Policy Act

The National Environmental Policy Act (NEPA) mandate compels informed decision-making by federal agencies and their departments by requiring consideration of all relevant environmental consequences of proposed actions and involving the public in the decision-making process. All agencies of the federal government must consider the environmental impacts, the short-term and long-term effects, any unavoidable harms to the environment, and feasible alternatives to any proposed action. This review is commonly undertaken through an Environmental Impact Statement (EIS) process.

Essential Fish Habitat, National Marine Fisheries Service Consultation

The 1996 amendments to the Magnuson-Steven Act, which regulates fishing in U.S. waters, included new provisions for protecting the habitats of all federally managed species of marine or anadromous fish. The Act defines Essential Fish Habitat (EFH) as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Any action authorized, funded, or undertaken by a federal agency that may adversely affect EFH requires the federal agency to consult with the National Marine Fisheries Service (NMFS) regarding the effects of the action on EFH.

U.S. Fish & Wildlife Coordination Act

The Fish & Wildlife Coordination Act (FWCA) ensures that fish and wildlife resources receive equal consideration with other values during the planning of water resources development projects. It requires the Department of Energy to consult with the Fish & Wildlife Service whenever it plans to conduct, license, or permit an activity involving the impoundment, diversion, deepening, control, or modification of a stream or body of water. The Act also requires consultation with the head of the state agency that administers wildlife resources in the affected state. The purpose of this process is to promote conservation of wildlife resources by preventing loss of and damage to such resources and to provide for the development and improvement of wildlife resources in connection

with the agency action.

Water Resources Development Act

The Water Resources Development Act (WRDA) authorizes the U.S. Army Corps of Engineers to provide assistance to state, county, or local entities for undertaking certain dredging, restoration, beach nourishment, or beneficial use projects.

Joint Pre-Application Meeting

The Joint Pre-Application Meeting (JPM) meeting provides a forum for permit applicants to present and discuss a proposed project with the major agencies involved in the permitting process prior to submitting formal applications. The intent is for the agencies to explain to applicants how the permitting process works and to provide comments and suggestions to them that might enhance their respective projects (e.g. methods to minimize impacts). In addition, permit applicants are encouraged to use qualified contractors who are familiar with the permitting requirements and process. While a pre-application consultation at the Joint Pre-Application Meeting is not mandatory, it is strongly recommended as a way for applicants to gain a better understanding of the jurisdictions that could impact their particular project. Currently a monthly JPM meeting is held at the DNREC Building in Dover. Agencies that regularly attend include the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, the U.S. Fish & Wildlife Service, the NOAA National Marine Fisheries Service, the DNREC Divisions of Fish & Wildlife, Water Resources, and Soil and Water Conservation, and the State Historic Preservation Office.

To present a project at JPM, applicants need to contact the DNREC, Division of Water Resources to obtain an appointment on the JPM schedule. Projects that can benefit from the JPM include new dredging projects, new projects with a dredging component, and maintenance dredging projects, where the U.S. Army Corps of Engineers and/or DNREC determine that changes in regulatory policies or resource information could affect project design. The process is designed to be mutually beneficial to both the applicant and the permitting agencies. Applicants are made aware of the necessary permits required for individual projects, and modifications which can minimize environmental damage or even provide enhancement can be considered while the project is still in the planning stages.

Administrative and Environmental Information required for Each Application

The following information must be provided with any permit application. The information is intended to assist project review agencies to fully evaluate impacts from a proposed project. Additionally, the checklists for dredging impacts and/or confined disposal facilities should be used as they apply to the project. The majority of this information is already requested in the U.S. Army Corps of Engineers' standard ENG Form 4345 permit application along with the corresponding environmental questionnaire, and the State's Joint Permit Application for Subaqueous Lands along with the appropriate appendices. Any additional requests here should supplement that information in order to provide federal and State regulatory personnel with the maximum information possible to review and assess the impacts associated with each project. Applicants should refer to the Environmental Evaluation Chapter of this document for more information on the tiered approach used to evaluate project data.

- ✓ Project description: 1) purpose, 2) need, 3) benefits.
- ✓ Is the work being done by a public agency or

a private individual/company?
- ✓ Proposed project dimensions, including length, width, depth.
- ✓ Plan drawings (8.5" by 11" with photographs).
- ✓ Dredging volumes (amount to be dredged).
- ✓ Existing depths in project area (hydrographic survey at 100-foot intervals).
- ✓ Method of dredging (hydraulic or mechanical).
- ✓ Dredging site location (name of waterway and coordinates).
- ✓ Disposal method proposed and site location.
- ✓ Sediment type/characterization (sediment composition and grain size).
- ✓ Anticipated number and location of ancillary/ secondary channels.
- ✓ Classification of waterway (for projects in Delaware's Inland Bays region refer to classification criteria established in the "Inland Bays Dredging Study").
- ✓ Alternatives analysis – discuss the effect of not doing the project (i.e. the "no action" alternative) as well as alternative methods of dredging or disposal to minimize impacts.
- ✓ Need for maintenance dredging.
    - For maintenance projects, volume of material dredged within last 10 years during each dredging episode.
    - For new projects, estimate expected frequency/volume for maintenance.

Checklist for Dredging Activities

The following information is needed to address the potential environmental impacts at the dredging site. These should be addressed by the project applicant if at all possible. For more impact-related information needs, refer to the Tier I section in the Environmental Evaluation chapter.

- ✓ Location information adequate to ensure proper siting of the project (e.g. USGS quadrangle maps)
- ✓ Characterize existing biological community (sampling requirements).
- ✓ Characterize existing water quality and designated use areas.
- ✓ Applicable time-of-year restrictions and schedule of project implementation.
- ✓ Does the area qualify as Essential Fish Habitat?
- ✓ Are there threatened or endangered species in the area?
- ✓ Inventory of potential historical/cultural resources.
- ✓ Potential impacts to existing currents.
- ✓ Potential impacts to shoaling patterns.
- ✓ Potential biological impacts to aquatic and semi-aquatic species.
- ✓ Methods to minimize impacts during dredging.
- ✓ Chemical constituents of sediments.
- ✓ Will project result in additional user conflicts?
- ✓ Anticipated length of project.
- ✓ Has the applicant attended (or scheduled) a pre-application consultation at Joint Pre-Application Meeting?
- ✓ Is the applicant committed to maintaining the channel in future?

Checklist for Dredged Material Confined Disposal Facilities

When an upland confined disposal facility is proposed as the management option for the dredged material, the following questions and issues will be necessary for regulatory agency personnel to fully evaluate the project proposal.

- ✓ Site location: including 1) latitude, 2) longitude, 3) tax parcel.
- ✓ Plan drawings of facility (8.5" by 11").
- ✓ Owner(s) of disposal facility.
- ✓ Method of containment.
- ✓ Environmental setting.
- ✓ What contaminants might be (or have been) found in the material to be dredged?
- ✓ What is the potential for these contaminants to end up in the discharge from the CDF as the dredged material dewaters (impacts to surface water)?
- ✓ What is the effluent quality expected in terms of solids, biological oxygen demand, and contaminants?
- ✓ Are there contaminants which may leach and

cause impacts to groundwater?
- ✓ Are there potential impacts on mosquito breeding?
- ✓ List any secondary impacts from transporting the dredged material to disposal facility.
- ✓ Impacts to adjacent lands/properties (safety, land use compatibility).
- ✓ Other approval(s) required.
- ✓ Method of dredging (hydraulic or mechanical).
- ✓ Monitoring requirements (effluent/receiving waters).
- ✓ Can the applicant conclusively demonstrate that they will be able to achieve compliance with water quality standards?
- ✓ Impacts to historical/cultural resources.
- ✓ Potential impacts to ecosystem.

The information above should address the physical, chemical, *and* biological effects from a proposed project. While the USACE/USEPA *Inland Testing Manual* addresses primarily chemical (contaminant) impacts, the State of Delaware intends to extend project reviews to increasingly include impacts to biological communities. This document is the first step in this goal, and future editions will aim to develop this area of review in more specific detail.

Guidelines for Modifications, Extensions, Suspensions and Revocations

Modifications

Examples of modifications to permits that are regularly received by permitting agencies include changes to seasonal restrictions when necessary to complete the work and adding seasonal restrictions based on new biological information. Any modification requires amending the permit. If the modification is major, it is placed on public notice again. If it is minor, the permit can be amended without public notice requirements.

Extensions

If a permit has not expired it can generally be extended by submitting a letter of request. If it has expired, a new application must be submitted. Wetlands permits can receive two extensions of one year each. After that, the existing permit cannot be extended further without a new application submitted and new permit issued.

Suspensions and Revocation

Revocation of an approved permit could occur if new or false information makes a re-evaluation of the permit decision necessary. A permit can be suspended/revoked if any of the conditions in the original permit are violated.

Consequences of Violations

Serious consequences exist for persons violating federal and/or state laws, permits, or other environmental requirements. The Delaware Code states the following with regard to violations:

"No personal shall, without first having obtained a permit from the Secretary, undertake any activity . . . in a way which may cause or contribute to discharge of a pollutant into any surface or ground water" (7 Delaware Code 6003). "Dredged spoil" is included in the list of potential pollutants and thus is regulated under Chapter 60.

Consequences of submitting false information "in any application, record, report, plan or other document filed or required to be maintained . . . [shall] be punished by a fine of not less than $500 nor more than $10,000 or by imprisonment for not more than 6 months, or both." (7 Delaware Code 6013).

With respect to wetland violations, the consequences are similar. "Any person who intentionally or knowingly violates any rule, regulation, order, permit condition or provision of this chapter shall be fined not less than $500 or more than $10,000 for each offense" (7 Delaware Code 6617(a)). "In addition to any penalties imposed under this section . . ., a person who

effects or permits any activity in wetlands in violation of this chapter may be liable to the State for the cost of restoration of the affected wetland to its condition prior to such violation insofar as that is technically feasible" (7 Delaware Code 6620).

Economics of Dredging

Dredging projects in Delaware waters are considered for implementation based upon the assumption that the project will provide public and/or private benefits. These benefits may include economic benefits to commerce or tourism, and/or recreational benefits to public users of the state's waterways. The assessment techniques for benefits vary depending upon whether the project is Federally funded, state-funded, or privately funded. The process for cost-benefit evaluations for each is briefly outlined below.

General Economic Analysis

Several questions need to be asked when dredging projects are presented. These questions include whether the project applicant/sponsor provided proper and adequate economic justification (where applicable), who evaluated the cost-benefit analysis and what type of methodologies were used, how the economic benefits will be divided between local, state, and national entities, and whether the funding source is adequate to cover all project phases, including money for necessary environmental assessments and impact statements.

Evaluating the economic feasibility of a project begins with determining its direct economic benefits (i.e. the value of a widened and/or deepened channel). The economic value would be the (hypothetical) willingness of the additional boaters accommodated by the project to pay for its costs. Other outputs to be considered include increases in the capacity or productivity of natural or recreational resources, increases in property values, reduced occurrences of natural disasters, and improvement in environmental quality. In some cases, these benefits are not normally measured in economic terms, so their value must somehow be translated into dollar units (or "monetized") in order to be weighed against the economic and monetized environmental "costs."

Benefit must then be analyzed to determine what portion constitutes a "public benefit" – benefits which are equally accessible to all members of the public. Since public funds support the cost of Delaware's dredging program, the public must be the primary beneficiary. A significant proportion of the economic benefits of a dredging project must either be equally accessible to all members of the public, or must be in the form of a collective benefit. In some projects, private benefits such as increased property values may be unavoidably produced. However, it is important that the benefit to the general public outweighs that to private individuals and that the purpose of the project begins as a public endeavor.

Likewise, total costs must be calculated, including economic costs, costs of lost opportunities, and environmental damages. As in the case of non-monetary benefits, it is also difficult to calculate costs for environmental damages. While a strict cost-benefit analysis is not required for non-Federal projects, this methodology provides a guide for complete analysis of the direct and indirect impacts (in economic terms) of dredging projects. Additionally, the environmental costs must be at least qualitatively weighed in examination of the cost-benefit of the project.

The following section from the Wetlands Regulations shall be applied generally to all types of dredging activities:

"Economic Impact shall include a short and long-term evaluation of the following factors to the extent the effect is directly attributable to the proposed activity:

A. Jobs created or lost and the net income effects of jobs.
B. Increases in revenues to or increases in expenditures by State, County and local governments (e.g. increased taxes from an increased tax base and increased expenditure for maintaining supporting facilities).
C. Increases or decreases in the value attributable to the wetland [or waterbody] as a source of nutrients to finfish, crustacea and shellfish and as habitats of such species or other flora or fauna of significant actual or potential economic value.
D. Increases or decreases in the value of the land [or water] as a recreational area.
E. Increases or decreases in the cost of flood control or expected flood damage which might be caused by the effect of the activity on the natural capacity of the wetland to reduce flood damage.
F. Increases or decreases in the costs of maintaining navigable harbors and waterways which would result from altering the capacity of the wetlands to absorb silt.
G. The net economic effect, both public and private, of any contemplated supporting facilities.
H. The net economic effect, both public and private, of the proposed activity on neighboring land uses" (Wetland Regulations, Section 7.07).

Federal Dredging Projects

Federal projects require a positive cost-benefit ratio as defined by U.S. Army Corps of Engineers (USACE) regulations. The ratio is based upon the National Economic Development (NED) plan. The NED considers benefits from the national perspective rather than from a regional, state, or local perspective. This can at times lead to confusion at the local level, especially when significant benefits occur in adjacent states or regions or nationally, but not locally. The USACE has economic guidelines and standards for this process.

State Dredging Projects

For State of Delaware dredging and beach nourishment projects, funding is appropriated by the state's General Assembly. Therefore, it is assumed through the appropriations by an elected representative body that public benefits exceed costs. However, no specific cost-benefit analysis is required for state-funded dredging projects, nor does appropriation imply an environmentally sound project. Historically, appropriations have included funding of the Division of Soil & Water Conservation's state dredge program through general legislative mandate and additional special project appropriations.

Under Delaware statute, the state dredging program has the authority to act as a contractor for private dredging projects. However, the Division of Soil & Water Conservation (DSWC) discontinued this activity in 1997.

7 Delaware Code 3905(b)(13) authorized the state to "[c]ooperate with other agencies and departments of the State, federal agencies, or any other landowners for use of the state dredge at the cost of the state agency and/or department, federal agency or the landowners requesting use of the state dredge." As a result of this, DSWC periodically acted as a contractor for private dredging projects. However, in 1997 this activity was discontinued. Therefore the DSWC will no longer enter into contractual agreements with private landowners. However, the Division does maintain an interest in doing work for public or quasi-public entities (e.g. Division Fish & Wildlife, U.S. Coast Guard, University of Delaware,etc.).

A significant portion of work conducted by the state dredge is for beach nourishment. Since coastal property is highly valued, beach erosion associated with major storms is a significant economic problem along the coast and many areas of the Delaware Bay. The state is working closely with the federal government to develop a long-term strategy to deal with shoreline erosion and to discourage development in high-hazard areas.

The Delaware Coastal Management Program has a Coastal Management Policy (CMP) for Beach Management which states that "[t]he public and private beaches of the State shall be preserved, protected, and enhanced to mitigate beach erosion, and to prevent their destruction and despoilation" (Authority – 7 Delaware Code 6801, 6803, and 8610).

Additionally, "[t]he Secretary [of DNREC] may undertake any or all necessary works to restore private beaches as designated by the Department, whenever two thirds or more of the property owners in the project area along the private beach have petitioned the Department to undertake the work." (7 Delaware Code 6810).

Private Dredging Projects

It is assumed that a private applicant perceives an (economic) benefit, which leads him/her to submit a project application. On the surface, such benefits may not be clearly economic, as they would be if commerce were involved. Instead, the benefits may be in the form of recreational enjoyment or ease of access. Property owners invariably do informal calculations, deciding whether the cost of gaining water access is outweighed by the benefits they will receive. Since the perceived benefits will be enjoyed by a private entity or individual, the cost of the project is also to be privately borne.

Since the benefits of "private" dredging are not publicly enjoyed, the cost of maintaining such channels must not be publicly borne. Additionally, the private benefits must not be achieved at a "cost," including environmental damage, to nearby landowners or the general public. Applicants should also be advised that maintenance, monitoring, and mitigation costs may add to the total price of a project.

Maintenance Dredging

Maintenance dredging is defined as the restoration of a channel, berthing area (e.g. marina basin), or cooling-water intake area to a depth no greater than that allowed by a previous project or permit as long as the intended purpose or use of the area has not changed. Maintenance dredging projects undergo critical review of environmental impacts.

Future maintenance requirements, as well as any current, related work should be considered in any permit application for new dredging. Review of maintenance dredging and repeated projects will consider analysis of secondary and cumulative impacts and assessment of long-term impacts.

Subaqueous lands permits are issued for maintenance dredging for a 3 to 5 year limit, depending on the severity of the predicted impacts. The time length is determined on a case-by-case basis by the Wetlands and Subaqueous Lands Section.

Alternatives to Dredging

To define the justification and purpose of proposed dredging projects, practical and feasible methods to accomplish the project purpose should be analyzed. Applicants are required as part of the Corps of Engineers Individual Permit application to provide at least an analysis of the "no action" alternative.

Likewise, the State of Delaware's Subaqueous Lands Regulations also require an analysis of the alternatives to the project in the section quoted here. "The Department [of Natural Resources and Environmental Control] shall consider the public interest in any proposed activity which might affect the use of subaqueous lands. These considerations include, but are not limited to, the following:

1. The extent to which the applicant's primary objectives and purposes can be realized without the use of such lands (avoidance).
2. The extent to which the applicant's primary purpose and objectives can be realized by alternatives, i.e. minimize the scope or extent of an activity or project and its adverse impacts.
3. Given the inability for avoidance or alternatives, the extent to which the applicant can employ mitigation measures to offset any losses incurred by the public" (Regulations Governing the Use of Subaqueous Lands, Section 3.01(A), 5-7).

Some goals can be accomplished without any dredging. Creative analysis concerning the goal of the project can yield recommendations that will satisfy the permit applicant's needs without dredging. For example, a property owner wanting to dredge out a dilapidated boat slip filled with silt might instead build a small pier directly into the channel. In other instances, boaters could use watercraft that can be accommodated with the current channel depth, trailering larger boats to ramps that access deeper waters. Commercial alternatives include the use of offshore terminals, not carrying the full capacity of cargo, coming into port on high tide, "lightering" (offloading part of the load onto smaller barges at an area that can accommodate the depth of the fully loaded carrier), or "topping off" (the reverse of lightering, fully filling a sea-bound carrier when it reaches the deep channel).

In other cases, dredging is required to accomplish at least some of the desired outcome. However, even in this case, the quantity or area to be dredged can be minimized, management practices can reduce impacts, and post-project alterations can reduce the need for further maintenance dredging.

CHAPTER 2. ENVIRONMENTAL EVALUATION

Purpose

This section of the Dredging Policy Framework is designed to outline the required steps and methods for evaluating the environmental effects of dredging projects. It begins with use of existing information, field sampling, and modeling to predict impacts during the pre-dredge evaluation. The predicted impacts are verified and monitored in the during-dredging evaluation, and then any lasting effects or long-term impacts would be examined during a post-dredging evaluation. In addition, during this process, the applicant and review agencies have an opportunity to develop means to minimize, mitigate, or develop alternatives so that a project can reach minimal environmental impacts.

This guidance is applicable to all proposed dredging and material disposal projects in Delaware waters. This includes private and state projects, as well as Federal projects conducted by the U.S. Army Corps of Engineers.

Pre-Dredge Evaluation

This section describes the evaluation methods for projects proposed in Delaware waters. It includes considerations of impacts both at the dredging site and at the disposal site and examines potential chemical, biological, and physical impacts. This evaluation protocol should be undertaken in concert with required activities described in other sections of this document including alternatives analysis, best management practices, and appropriate dredging and disposal methods.

The tiered approach in this section is consistent with the *Evaluation of Material Proposed for Discharge to Waters of the U.S. –Testing Manual (Inland Testing Manual)* (USEPA/USACE 1998), but provides guidance specifically for Delaware and includes evaluation methods for biological and physical impacts. The reader is referred to the national manual for a more detailed discussion of the tiered approach as applied to contaminants.

The objective of the tiered approach is to make optimal use of resources in generating the information necessary to make a determination, using an integrated chemical, physical, and biological approach. To achieve this objective, the evaluation procedures are arranged in a series of tiers with increasing levels of intensity (Figure 2.1). The initial tier uses available information that may be sufficient for completing the evaluation in some cases. Evaluation at successive tiers requires information from tests of increasing sophistication and cost.

The most logical and cost efficient approach is to enter Tier I and proceed as far as necessary to make a determination. There are two possible conclusions that can be made at each of the first three tiers: 1) available information **is not** sufficient to make a determination, or 2) available information **is** sufficient to make a determination. Where information is sufficient, one of the following determinations may be reached: a) the proposed project **will not** have unsuitable, adverse impacts, or b) the proposed project **will** have unsuitable, adverse impacts.

Tier I compiles existing information about the potential for adverse impacts from the proposed dredging project. Operations that are excluded from further testing or evaluation should have historic data sufficient for the determination or may proceed to a determination without additional testing.

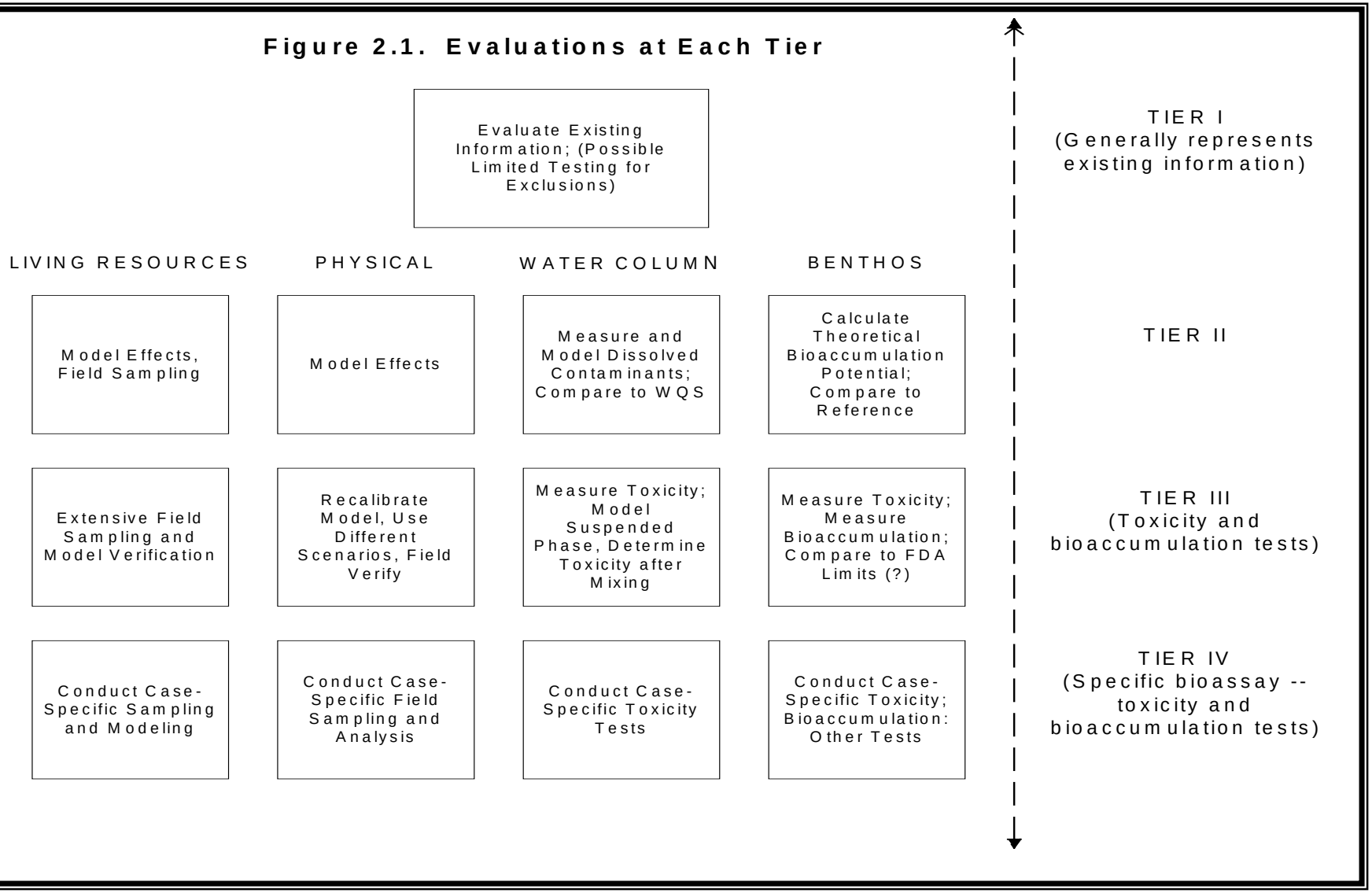
Tier II evaluates the potential impacts on water column and benthic environments using physical, chemical, and biological data collected for this tier, and applied with computer models to project worst-case conditions for water quality impacts and bioaccumulation. Based on the results of Tier II evaluations, additional evaluation may be reduced or eliminated.

Tier III evaluates the potential impacts on water column and benthic environments using effects-based biological [testing]. This section presents recommended procedures for biological-effects tests with a standard group of organisms.

Tier IV is only entered if the information provided by Tiers I through III is not sufficient to make a determination. The procedures used in Tier IV are keyed to site specific issues not resolved by the standardized procedures of earlier tiers.

With this tiered evaluation structure, it is not necessary to obtain data for all tiers to make a determination of potential impacts. The underlying philosophy is that only the data necessary to make a determination should be acquired. (See Figure 2.1 for evaluations used at each tier)

Figure 2.1. Evaluations at Each Tier



TIER I - PROJECT SCOPING

Purpose

One of the purposes of Tier I (See Figure 2.2) is to determine whether a decision regarding potential impacts from a proposed project can be made on the basis of existing information. The compilation of existing information about the excavation and disposal sites will serve as the basis for determining if a decision can be made without additional evaluation. Another purpose of Tier I is to identify potential contaminants of concern in the dredged material. This will help determine what, if any, testing should be conducted in subsequent tiers.

In addition to contaminants, other potential stressors should be identified and evaluated. Many of these will depend upon the scale of the project and the dredging and disposal method proposed. Stressors include habitat disturbances or destruction, elevated turbidity related to dispersion of sediment at both the dredging and disposal sites, geotechnical properties of the sediments, soluble and particulate phase chemistry of excavated sediments, and burial/smothering of biota at the dredging and disposal sites.

Interagency coordination is essential to the development of a 404(b)(1) CWA evaluation and is a legal requirement under the National Environmental Policy Act of 1969 (PL 91-190). Such coordination is critical in the Tier I evaluation process, where available information must be compiled from a variety of sources. Evaluators are encouraged to solicit input from other agencies on data sources, potential contaminants of concern, and proposed sampling and testing. Coordination prior to initiation of sampling and testing will reduce the chance of having to repeat costly procedures and will assist in keeping projects on schedule.

Compilation of Available Information

The following questions should be answered by the applicant after review of existing literature and data sources. The questions should apply to the project as a whole – addressing both excavation and disposal of the dredged material.

Chemical Information

A survey of contaminant sources and pathways should be conducted for the proposed project. A number of factors must be considered, and the following questions should be addressed to the fullest extent possible:

- What are the potential sources of contamination?
- What are the potential pathways of contaminant transport?
- What naturally occurring substances could be harmful to aquatic biota if resuspended or released?
- What are the seasonal ranges of dissolved oxygen, and how would the proposed project modify these?
- What potentially harmful constituents could be part of the effluent from the disposal site?
- Will Delaware Surface Water Quality Standards be met in all cases?

Applicants must keep in mind that there are two critical contaminant release pathways that could increase the local concentrations of contaminants and potentially cause or significantly contribute to violations of Delaware's Surface Water Quality Standards. The first release pathway occurs when contaminants that are sequestered in the sediments become released directly to the water column during the excavation/dredging operation. The second release pathway occurs when water containing dissolved and particulate contaminants is released back into the waterway after the dredged material slurry has undergone dewatering in a confined disposal facility (CDF).

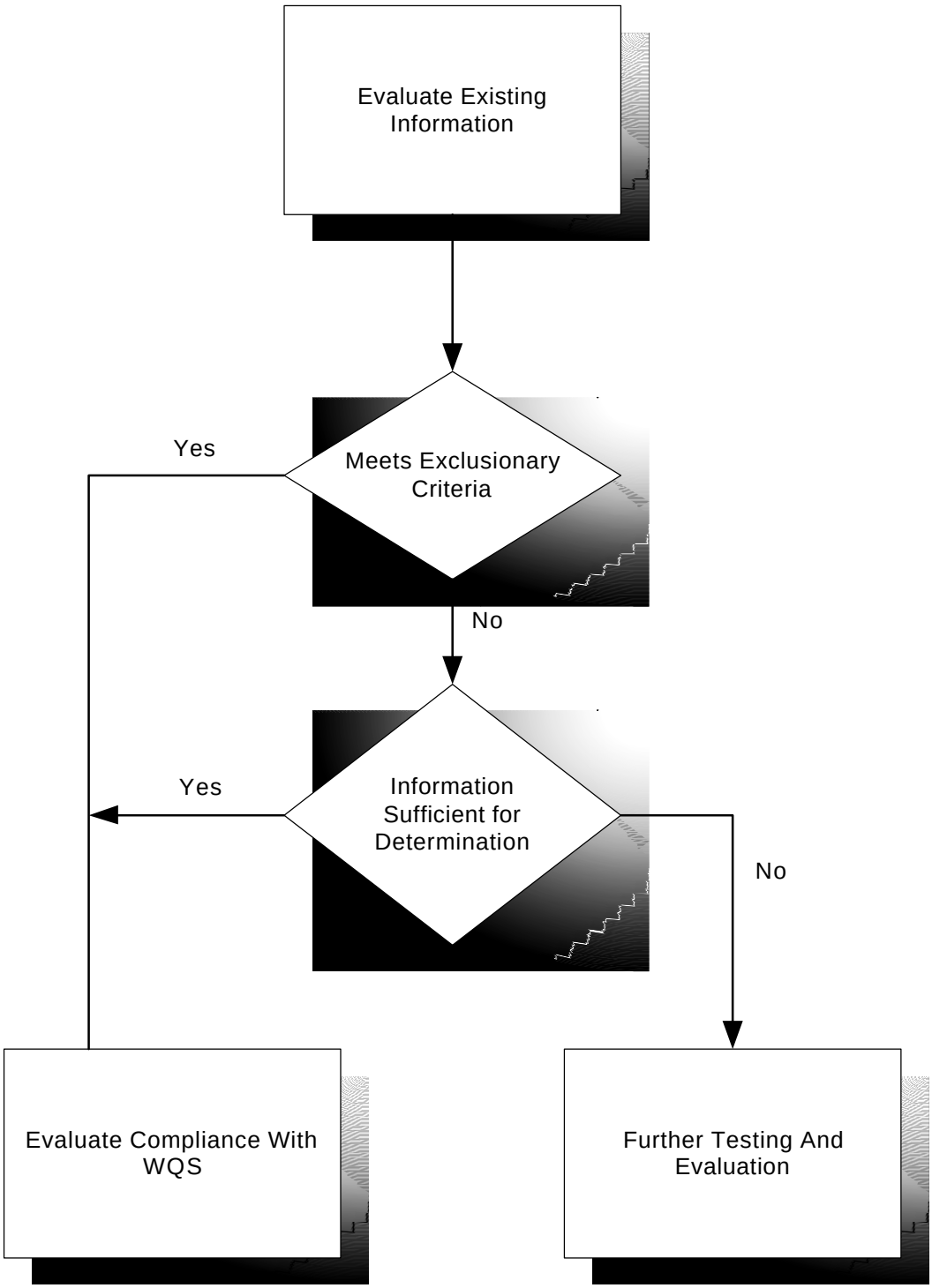


Figure 2.2. Tier I Flow Diagram

Biological Information

Data regarding living resource impacts should also be gathered. The following specific information will aid in evaluating biological impacts from the project and should be collected if at all possible:

- Are there species of special concern to state or federal management agencies?
- Are there Threatened or Endangered species in the vicinity of the site?
- Do commercially or recreationally important fish or shellfish use the area for habitat?
- What organisms, that are important to the food chain or are habitat modifiers, exist nearby?
  - What are the lifestages of organisms identified above?
  - What time of year do they utilize the site and for how long do they remain in the area?
  - What potential impacts (entrainment, smothering, habitat destruction, contamination) from dredging or disposal could affect these organisms?
- What is the vegetation distribution?
- Are there migratory corridors nearby?

The lists of threatened and endangered species, commercially important species, and species of special concern can be found in Appendix C.

Physical Information

The following information concerning physical impacts from the project should be collected to the fullest degree possible:

- What is the sediment type (composition and grain size) in the project area?
- What is the particle size distribution (sieve analysis results)?
- What best characterizes the material in terms of percent solids?
- What is the ambient turbidity and how would that be affected by the project? How long would the duration of any turbidity increase be expected to last?
- Describe (and provide a map) of the excavation site bathymetry.
- Describe (and provide a map) of the disposal site bathymetry (if applicable).
- Describe the hydrologic regime of the region around the project site.
- What past or current projects have taken place in the vicinity?
- Where are nearby groundwater aquifers located?
- Is there a potential for groundwater contamination?
- What is the upland topography of the proposed disposal site (if applicable)?

For additional information needed for routine dredging projects, applicants should refer to the Permit Application Form (formerly known as Joint Permit Application From) for Subaqueous Lands, Wetlands, Marina, and 401 Water Quality Certification Projects. This form can be found in the Appendix D of this document and is available from the DNREC, Division of Water Resources.

Sources of Information

There is a potentially large amount of historical information relevant to dredging projects available from Federal, state, and local agencies, as well as in the open literature. Sediment quality data are routinely collected by the USACE at the sites of their dredging projects (i.e. Delaware River Main Channel, C&D Canal, Port of Wilmington). Much of this database is physical and chemical data with some biological test results. Sediment data has also been collected by other agencies and investigators.

A number of computer databases are maintained by federal agencies that contain information on known sources of chemical contamination. These databases include: STORET (STOrage and RETrieval system), TRI (Toxic Chemical Release Inventory), PCS (Permit Compliance System), RCRIS (Resource, Conservation, and Recovery Act Information System), ESDC (Environmental Sciences Division Clearinghouse), and GRIDS

(Geographic Resources Information and Data System). Some of these can be accessed directly via the internet.

Additionally, there are state sources of water quality data that can be found by contacting the DNREC, Division of Water Resources. Biological and physical information for Delaware can be found by contacting the DNREC, Division of Fish & Wildlife or the Delaware Geological Survey, respectively.

Exclusions from Evaluation under the Tier System

If an evaluation of the extraction (dredging) site indicates that the material to be dredged is not a "carrier of contaminants," the determination of the presence or effects of contaminants can be made without further evaluation and testing. Dredged or fill material is most likely to be free from chemical, biological, or other pollutants where it is composed primarily of sand, gravel, and other inert materials. However, a determination of "no contaminants" may still not exclude the project from being subject to evaluation for other chemical, physical, or biological effects.

Other criteria that may qualify a project for exclusion would include projects involving less than 50 cubic yards of excavated materials and projects where dredged material is placed into an existing, approved disposal site.

Dredged material that are most likely to meet this exclusion include sediments from locations which are far removed from most anthropogenic activities or sediments from depths deposited in pre-industrial times and not exposed to modern sources of pollution. However, the potential impacts from natural mineral deposits should also be considered.

Identification of Contaminants of Concern

The purpose of identifying contaminants of concern in dredged material is to determine parameters for evaluation in later tiers, if necessary. A contaminant of concern should be identified on the basis of the following factors: presence in the dredged material, concentration, toxicological importance, persistence in the environment, propensity to bioaccumulate from sediments, and presence of applicable fish consumption advisory.

Arsenic
Chromium
Copper
Mercury
Zinc
Pesticides
Total Organic Carbon (TOC)
Total volatile solids (TVS)
Ammonia-nitrogen
Total petroleum hydrocarbons (TPH)
Polychlorinated biphenyls (PCBs)
Polyaromatic hydrocarbons (PAHs)
Cadmium
Total phosphorous
Lead
Dioxins
Nickel

Table 2.1. Generic list of chemicals of concern for characterizing sediments

This generic list of contaminants of concern should serve as a starting place and not necessarily as the final list. Information compiled on a specific project, as described above should be used to supplement or reduce the chemical parameters on the generic list. The reasons for supplementing or reducing this list should be fully documented.

In situations where there are fish consumption advisories, the responsible bioaccumulative

contaminants that are the source of the advisory should be considered for the list of contaminants of concern. A summary of recent State fish advisories and a listing of State agency contacts can be obtained from the DNREC, Division of Fish and Wildlife.

Potential Impacts Determination

After consideration of all available information, one of the following two possible **conclusions** can be reached at Tier I:

1. Existing information **does not** provide a sufficient basis for making a contaminant determination. In this case, the applicant may be directed to gather additional information at the Tier I level which could substantiate a determination, or they will be directed to engage in further evaluation at a higher tier as appropriate.
2. Existing information **does** provide a basis for making a contaminant determination. In this case, one of the following three **determinations** may be reached:
   a) The dredged material meets the exclusion criteria and no further information on contaminants is necessary to determine compliance (except for information necessary for Section 401 compliance).
   b) The dredged material does not comply with the exclusion criteria, but the available information is sufficient to show the material is not a carrier of contamination to a degree which will cause an unsuitable, adverse impact.
   c) The dredged material does not comply with the exclusion criteria, and the available information is sufficient to show the material is a carrier of contamination to a degree which will cause an unsuitable, adverse impact.

For projects with recurring maintenance dredging, a Tier I evaluation is not necessarily required for each dredging and discharge operation. A comprehensive Tier I evaluation should require only updating on a periodic basis to determine if additional data or evaluation is necessary. This reevaluation of the Tier I analysis should consist of the collection and examination of available information on any changes in contaminant sources or pathways to the dredging and discharge sites. It is recommended that the Tier I evaluation be updated at least every three to five years for frequently dredged projects and prior to each operation for projects dredged less frequently.

At the completion of Tier I, even if an exclusion is approved or it is decided that existing information is sufficient to make a determination, additional testing may be necessary to obtain a certification of water quality compliance, as required under Section 401 of the Clean Water Act.

Reporting

The report of the Tier I evaluation should summarize the following information:

- potential sources of sediment contamination identified,
- sources of information investigated,
- history of dredging in the area,
- selected method of dredging and disposal,
- historic sediment data (physical, chemical, biological),
- contaminant pathways to dredging and discharge sites,
- reasons for applying exclusions from testing,
- timing of project and any time of year restrictions,
- results of any confirmatory testing,
- contaminants of concern list,
- benchmarks or other criteria for biological, physical, or chemical data,
- reasons for the final list of contaminants of concern,
- habitat present and potential for its disturbance,
- potential for wildlife exposure,
- monitoring plans,
- impact area – any acute or chronic effects,

- potential for secondary impacts,
- source reduction efforts,
- Quality Assurance/Quality Control documentation supportive of critical data

All data should be submitted in digital format as well as in printed form, if applicable. All measurements should be recorded in dry weight.

This documentation should be developed into a report that can be distributed for State and Federal agency review and if necessary, inserted as an appendix to the 404(b)(1) evaluation public review document. A well documented Tier I evaluation will expedite future 404(b)(1) evaluations for the same project or any new dredging projects in the vicinity.

Tier II - Physical and Chemical Testing

Purpose

The purpose of Tier II (See Figure 2.3) is to use physical, biological, and chemical data collected for this tier as well as calculations and models to provide a reliable, rapid screening tool to determine potential impacts. It is also designed to determine whether more costly biological effects-based testing is necessary.

There are two situations under which a project will be evaluated under Tier II.

1) Having completed Tier I with insufficient information to reach a determination.
2) Having completed Tier I with sufficient information for a contaminant determination, but requiring additional data for Section 401 Water Quality certification. The testing in Tier II will provide information necessary to determine water quality compliance for Section 401 and may reduce the scope of future testing.

Planning and Coordination

The purpose of sediment sampling and analysis in Tier II is to obtain the necessary physical, chemical, and biological data for evaluating potential water column and benthic impacts. The sampling should take into consideration impacts from the project as a whole – both at the excavation site and at the material disposal location. The information gathered in Tier I should, in most cases, be adequate to determine the scope of sediment sampling and analysis as well as the chemical parameters of concern.

Evaluations should include predictions of contaminant concentrations expected in the mixing zone surrounding the excavation, in the mixing zone of the disposal site, and after complete mixing with the waterway. The near-field predictions should be compared to aquatic life criteria and the complete mix concentrations should be compared to human health criteria.

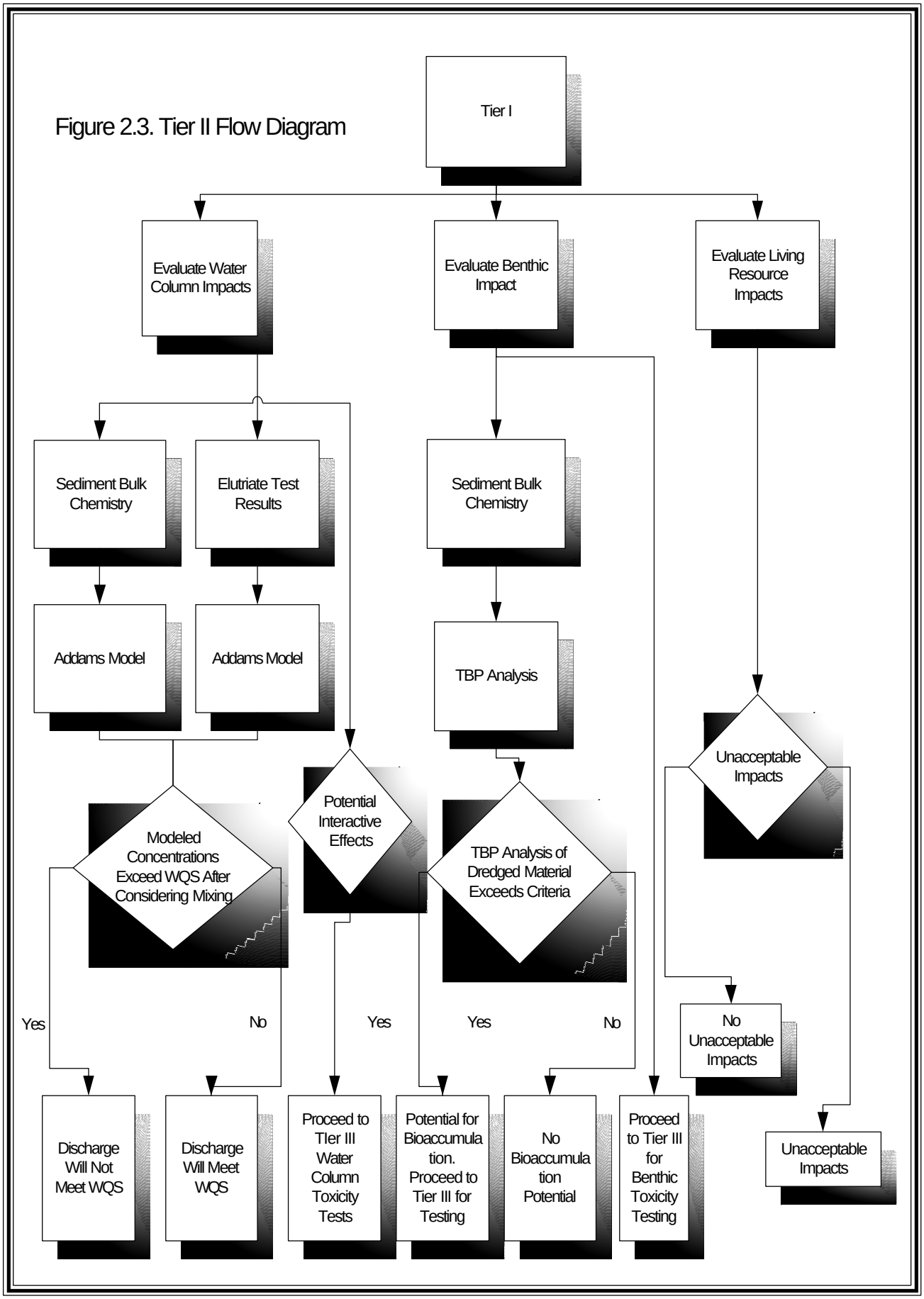
It is recommended that a written plan for sediment analyses or field sampling be prepared and provided to the appropriate Federal and State agencies for coordination prior to sampling. This coordination will reduce the chance of having to repeat costly procedures and will assist in keeping projects on schedule. The information recommended for submission to the DNREC includes the following:

- Summary of Tier I results;
- Objectives of Tier II review;
- Sampling protocols (type of sample, number, location, method of sample, QA/QC, etc.);
- Laboratory methods (handling, preservation, storage, QA/QC, etc.);
- Data assessment methodology;
- Sampling schedule.

Sampling Methods and Locations

Standards and methodology for appropriate sampling and field survey techniques can be found in the USACE/USEPA *Inland Testing Manual.* Sediment sampling plans are so site specific that guidance on the number, type, and location of samples is necessarily quite general.

Figure 2.3. Tier II Flow Diagram



In any sampling program, a finite number of samples are used to represent some larger area or volume, possibly with some consideration of time. Factors that should be considered in selecting the number, type and locations of sediment samples include: distribution of sediments to be dredged, known or suspected contaminant distribution, dredging methods, disposal methods, and tests to be performed.

Physical, Chemical, and Biological Analyses

Guidance on laboratory procedures for physical and chemical analysis of sediments is provided in the USACE/USEPA *Inland Testing Manual*. Any variation from these procedures should be coordinated with the USACE District, USEPA Region 3, and the DNREC.

Also included in the above document are the accepted procedures for the preparation and chemical analysis of an elutriate. The elutriate test (USACE 1976) is a procedure developed to simulate the release of dissolved contaminants from a hydraulic dredged disposal operation in open waters, and may be considered a worst case analysis for the release of dissolved contaminants from a mechanical dredged disposal operation. The elutriate test is used to evaluate water quality compliance for Section 401 certification. Elutriate concentrations should be reduced to reflect dilution resulting from mixing and dispersion at the proposed disposal site.

Field surveys for benthic and pelagic organisms should be coordinated with DNREC, Division of Fish & Wildlife or Division of Water Resources.

Quality Assurance

Quality assurance (QA) is a critical element within any 404(b)(1) contaminant evaluation. The importance of QA is not limited to the laboratory, but extends throughout the evaluation. General QA guidance and the data quality objectives (DQOs) for dredged material testing and evaluation are provided in the *Inland Testing Manual*.

Living Resource and Benthic Impact Evaluations

The evaluation of living resources and communities begun at the Tier I level should continue in Tier II. Where data collected in Tier I was inadequate to determine potential effects, sampling projects should be developed and initiated. The sampling protocol should take into account seasonal variations and distributional considerations, and all sampling proposals should be coordinated with DNREC.

One objective of the Tier II benthic evaluation is to determine if dredged material contaminants have the potential to cause an unacceptable adverse impact on benthic organisms, or on other aquatic organisms through bioaccumulation. This tier uses sediment chemical data with calculations and/or models to predict potential benthic and bioaccumulation impacts.

Benthic invertebrates constitute a major biological component of aquatic ecosystems. The benthic fauna serve as important forage sources for estuarine fish, waterfowl, and larger invertebrates. As such, benthic invertebrates represent a principal link between the primary producers and higher level consumers. In addition, the benthos exert major influences on the flux of materials across the sediment-water interface, playing principal roles in nutrient recycling, sedimentation, sediment chemistry and oxygen dynamics. Because of their limited mobility, benthic invertebrates are particularly vulnerable to local changes in water and sediment quality, as well as, modifications to habitat due to such activities as dredging.

Potential for Bioaccumulation

Bioaccumulation is the uptake and retention of contaminants by organisms. In aquatic systems, sediment contaminants may bioaccumulate to levels having ecological and human health consequences. Not all sediment contaminants will bioaccumulate. Some are readily metabolized, or

degraded, within the organism's body. Others are simply not taken up. A listing of critical pollutants, some of which are bioaccumulative, is provided in Table 2.1 in the Tier I text.

The following factors should be considered to determine which (if any) contaminants should be evaluated for bioaccumulation potential: presence in the dredged material, propensity to bioaccumulate from sediments, and presence of applicable fish consumption advisories.

The currently available Tier II procedure for evaluating potential benthic impact consists of evaluating the Theoretical Bioaccumulation Potential (TBP). A comparison is made between the TBP calculated for the nonpolar organic contaminants of concern in dredged material and for the same constituents in the reference sediment. At present, this calculation can be performed for nonpolar organic compounds, but not for polar organic compounds, organometals, or metals. If such constituents are contaminants of concern in a dredged material requiring bioaccumulation evaluation, further evaluation must take place in Tier III.

Water Column Impact Evaluations

Another objective of the Tier II evaluation is to determine if the dredged material contaminants will cause an unacceptable adverse impact on organisms within the water column and comply with applicable water quality standards, using chemical data. The dredging and discharge operation cannot cause the Water Quality Standards to be exceeded outside the mixing zone. There are two primary pathways for toxic substances to be available to aquatic life. The first route would be at the point of excavation when the dredge head disturbs sediments. As the sediment is resuspended, some substance previously sorbed to particles could dissolve and be available in the water column. The second pathway for toxic substances to be available to organisms would be in the dewatering effluent at the confined disposal facilities.

Contaminant Mobilization at the Point of Dredging

Equilibrium Partitioning Theory is a mathematical method of estimating the proportion of a chemical bound to sediment to the chemical dissolved in water. When the concentration of chemical per unit weight of sediment and the total weight of the sediment are known, then using this method, the concentration of the chemical in the water can be calculated. Multiplying the bulk sediment concentrations by the expected total suspended solids (TSS) level will yield the sorbed concentrations in the water column. Once the sorbed pollutant concentration in the water column has been calculated, the amount of pollutant that leaves the particulate phase and becomes dissolved in the water column may be calculated. The dissolved concentrations of various constituents in the water column should be compared with applicable water quality criteria.

An elutriate test (in which sediment and water are mixed and contaminant concentrations are measured in the water after allowing the sediment to settle out) can be used to gather further information or to verify the Equilibrium Partitioning approach above. In some cases, the elutriate test may be more accurate since it uses actual observations; however, each method is considered to yield a fairly conservative estimate of potential to water quality impacts or effects to aquatic life (Versar, 2000).

Modeling Confined Disposal Facility Discharge

The most common disposal method used in Delaware is the upland confined disposal facility (CDF). As the material placed in the site begins to dry, water is discharged into the adjacent surface water over a weir used to control the rate of discharge and to maximize the retention of sediments in the site.

A mixing zone is used to evaluate the geographical range of the impacts from CDF runoff. The mixing

zone is the limited area or volume where the initial dilution of a discharge occurs, and water quality standards must be met at the edge of the zone rather than within it. The standards for mixing zone calculations can be found in the Delaware Surface Water Quality Standards.

The Cornell Mixing Zone Expert System (CORMIX) is a software package with a series of modules for the analysis, prediction, and design of aqueous toxic or conventional pollutant discharges into diverse water bodies. The system's major emphasis is on predicting the geometry and dilution characteristics of the initial mixing zone so that compliance with acute and chronic regulatory constraints can be evaluated. The EPA's CORMIX distribution page is ftp://ftp.epa.gov/epa_ceam/wwwhtml/softwdos.htm. The CORMIX-GI homepage is http://steens.ese.ogi.edu; this is the most useable version of the model and has Windows interface for interacting with the model. By modeling the plume behavior, CORMIX can be used to evaluate how the effluent will dilute in the ambient water under a variety of conditions.

Section 401 Certification

Section 401 of the Clean Water Act requires that any applicant for a 404 permit must provide the permitting agency a certification from the State that the discharge complies with applicable State water quality standards. Part 230.10 (a)(5)(b) of the Code of Federal Regulations states that, "No discharge of dredged or fill material shall be permitted if it: (1) Causes or contributes, after consideration of disposal site dilution and dispersion, to violations of any applicable State quality standards."

Other Considerations

In the absence of site-specific data on exposure risks, information about impacts can be obtained from guidance literature. This includes modeling of the predicted dredged material footprint and plume dispersion modeling, contaminated sediment transport modeling, modeling of the toxicity and bioaccumulation potential of benthic organisms exposed to contaminants data on survivorship of planktonic/nektonic organisms exposed to elutriates of contaminated sediments, data on the critical burial depth of smothered benthos, results of studies on the effects of suspended silt on impacts on both planktonic and benthic organisms, regional data on seasonal spawning, larval settlement, and migration of species-of-interest, or generic features of benthic succession following dredging and disposal.

Physical, chemical, and biotic data gaps may be filled using existing information, or the existing information can be amended with field sampling. The following describe some data gaps that could be supplemented in Tier II.

Physical data gaps may include information about the distribution of sediment types, hydrologic/hydrographic setting (currents, waves, tides, overall kinetic energy, salinity regimes, seasonal water column stratification and hypoxia), predicted dredged material thickness over the dredged material footprint, predicted plume dispersion, and overall sediment transport.

Some chemical and biochemical data gaps can potentially be addressed by reviewing regional sediment quality databases, with identification of specific contaminants of concern and their association with particular sediment types (organic content, grain-size, mineralogy).

Biotic data gaps include a regional review of critical ecosystem components that are likely to be exposed to risk. Impacts can be generically predicted by referring to existing literature on the response of exposed organisms to organic contaminant loading in bottom sediments, survivorship of water column organisms exposed to elutriates, tolerance of different species to suspended solids loadings, and predicted responses of benthos to burial, smothering, and expected rates of recolonization.

If a literature search in Tier I was inconclusive regarding the presence of species of interest, field surveys should be employed in Tier II. This would include benthic grabs, trawls, etc. These sampling events should take into consideration the seasonality of the species in question and should be properly coordinated and permitted through the DNREC, Division of Fish & Wildlife. The information gathered from the sampling should be used to enhance the answers to the questions laid out in Tier I.

Impacts Determination

After consideration of all available information, one of the following two possible **conclusions** can be reached at Tier II:

1. Existing information **does not** provide a sufficient basis for making a contaminant determination. In this case, further evaluation at Tier III is appropriate.
2. Existing information **does** provide a basis for making a contaminant determination. In this case, one of the following two **determinations** can be reached:
   a) The proposed dredged material discharge will not cause unsuitable, adverse, contaminant-related impacts.
   b) The proposed dredged material discharge will cause unsuitable, adverse, contaminant-related impacts.

The current state-of-the-art technology will provide adequate information for a contaminant determination at the end of Tier II in only a limited number of situations. If the only cause for proceeding into Tier II was the presence of a single contaminant, of which the toxicology and bioaccumulation potential are well understood, a determination may be completed in Tier II. In addition, if Tier II testing was performed solely for determining 401 compliance, a determination may be completed here.

Reporting

All data should be submitted in standard, electronic format. The DNREC will require roughly forty-five days to review the data and report submission. Comments from DNREC will be returned to the applicant about forty-five days after the time of submission unless otherwise negotiated with the applicant.

Information gathered under Tier I and Tier II must be summarized and condensed in the 404(b)(1) evaluation document. Because a comprehensive tiered evaluation will likely gather far more information than can be presented in the 404(b)(1) evaluation, and because of the importance of the decisions made at this tier, it is recommended that this information be documented and filed as a backup to the 404(b)(1) evaluation. This documentation should be developed into a report that can be distributed for State and Federal agency review and if necessary, inserted as an appendix to the 404(b)(1) evaluation public review document.

A summary of the results from Tier II analysis should include the following, along with the summary of results developed from the Tier I analysis discussed above:

- Sampling results of sediment bulk chemistry and physical testing program;
- QA/QC documentation;
- Water column impact evaluations (where appropriate), including water quality screen/ model results, or elutriate/model results;
- Mixing zone determination; and
- Benthic impact evaluations, including list of potentially bioaccumulative contaminants, TBP calculation results, and evaluation of non-hydrophobic, bioaccumulative contaminants.

Tier III - Biological Testing

Purpose

The purpose of Tier III is to make impact determinations through the use of effects-based biological tests or field verifications of modeled effects (See Figure 2.4). The testing in Tier III assesses the impacts of dredging and disposal operations on appropriately sensitive and benchmark organisms to determine if there is the potential for an unacceptable (toxicity or bioaccumulation) impact. Biological evaluations serve to integrate the chemical and biological interactions of the suite of contaminants which may be present in a dredged material sample, including their availability for biological uptake, by measuring their effects on test organisms.

Planning and Coordination

Planning and coordination is needed in all stages of a 404(b)(1) evaluation, but the need is especially critical in Tier III because of the high costs of biological effects testing. For most dredging projects, these high costs will necessitate that each sample represent a larger portion (e.g., management unit) of the area to be dredged. Coordination with other agencies conducted in earlier tiers should be continued in Tier III. A written plan for sediment sampling and analyses should be prepared and provided to the appropriate Federal and State agencies for coordination prior to sampling.

Sediment Sampling

Detailed guidance on acceptable sediment sampling methods and procedures is provided in the *Inland Testing Manual* (USACE/USEPA, 1998). Included in this document is information on acceptable sediment collection and handling procedures. Also included is guidance on how to plan and execute a sampling program. Sediment sampling plans are so site specific that guidance on the number, type, and location of samples is necessarily quite general. The guidance provided in the Tier II description is generally applicable

Effects-Based Tests

The Tier III assessment methods are bioassays (toxicity and bioaccumulation tests). Guidance for these tests can be found in the USACE/USEPA *Inland Testing Manual* and in the USEPA *Short-Term Methods for Estimating The Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms*.

Effects-based biological tests are laboratory procedures (bioassays) in which organisms are exposed to a contaminated medium. Most of the water quality standards and criteria for specific contaminants were developed from effects-based tests. These types of tests used direct exposures of organisms to known levels of a single contaminant. Example of test exposures include a mouse fed a contaminant in its food, or a fish placed in a tank with the contaminant dissolved in its water. The biological effects which may be measured by such tests include mortality (death) of the organism, growth, reproduction, and others.

The type of organism, exposure media, exposure conditions, and measured effects or end-points are all specific to the questions being addressed. In general, three sensitive species are recommended for the water column and whole sediment toxicity tests. In the case of the latter, two species can be used, provided they cover three functional characteristics: filter feeder, deposit feeder, burrower. In both cases, at least one of these species must be a sensitive "benchmark" species. For assessing bioaccumulation, adequate tissue biomass and the ability to ingest sediments is more important than taxon sensitivity. Where possible, two species should be used to assess the potential bioaccumulation unless adequate regional data are available to justify single species testing.

Biological-effects tests for dredged material

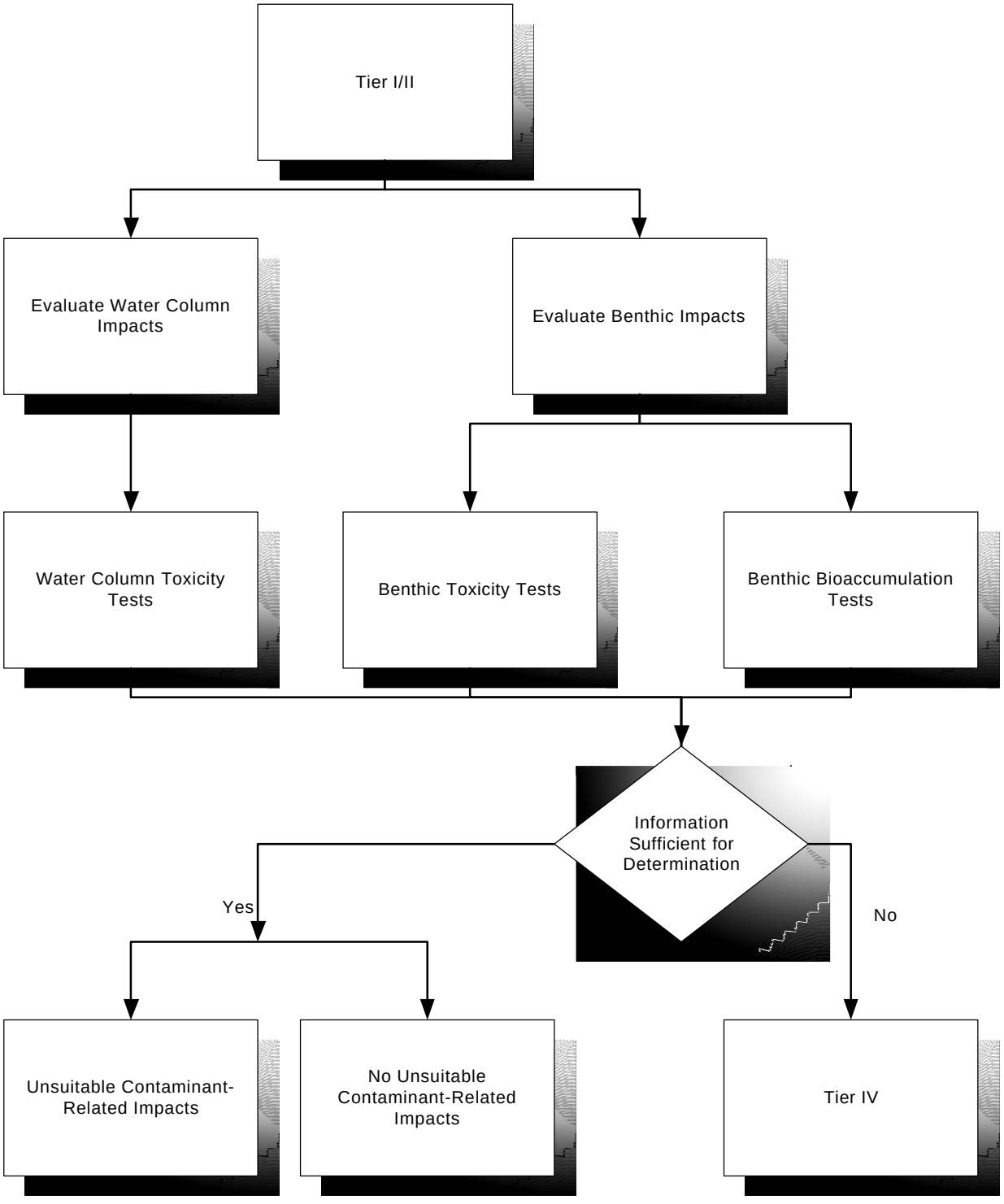


Figure 2.4. Tier III Flow Diagram

testing and evaluation must represent the physical and chemical conditions of contaminant exposure during dredging and disposal. For a 404(b)(1) evaluation, there are two exposure conditions to be tested; water column and benthic. The water column exposure is directed at the impacts of contaminants released into the water from dredged material as they are discharged and settle to the bottom. The benthic exposure is directed at the impacts of contaminants deeper in the bottom profile and at the disposal site (if open water).

The USEPA and USACE have developed effects-based biological tests for dredged material evaluation. They include water column tests, which utilize sediment elutriate preparations and benthic tests, which utilize whole sediment as test media. Complete methodologies for the tests are provided in *The Great Lakes Dredged Material Testing and Evaluation Manual* (USACE/USEPA, 1998). Guidance on species to be used and appropriate methodology can be found in the *Inland Testing Manual* (USACE/USEPA, 1998) and in the *Short-Term Methods for Estimating The Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms* (USEPA, 1994).

Quality Assurance

Quality assurance is a critical element in all tiers of a contaminant evaluation. General QA guidance and the data quality objectives for testing and evaluation is provided in the *Inland Testing Manual.*

Benthic Impact Evaluations

The Tier III benthic evaluation will determine if dredged material contaminants have the potential to cause an unacceptable adverse impact on benthic organisms. Two benthic toxicity tests and one benthic bioaccumulation test have been developed.

Benthic Toxicity Tests

The specific methodologies for data generation, sampling, and laboratory procedures can be found in Section 11 of the *Inland Testing Manual* (USACE/USEPA, 1998). Species selection should take into consideration the unique characteristics of the potential dredged site and the region, and this selection as well as all other methodology choices should be coordinated with a representative from the DNREC. An overview of the procedures is provided here for general reference.

Benthic toxicity tests are conducted by placing the test organisms into small beakers which are filled with water and have a layer of the test sediment at the bottom. The water overlying the sediment is renewed periodically. Organisms are fed during the exposure. The tests are completed in ten days, at which time the organisms are examined for response.

These toxicity tests have been developed to measure lethal or sublethal responses. The lethal response is measured as mortality or survival of organisms. The sublethal response measured is growth. The results of these toxicity tests for the dredged material and the control site sediment are compared statistically for the contaminant determination.

The results of the benthic toxicity tests must first be evaluated in light of the QA objectives described above. If the responses of organisms in control exposures are within acceptable limits, the test results with the dredged material and the disposal site sediment may be evaluated using the statistical methods described in the *Inland Testing Manual* (USEPA/USACE 1994).

Dredged material is considered **not** to meet the testing Guidelines when:

1. the mortality of test organisms exposed to the dredged material is more than 10 percent greater (20 percent for *C. tentan*s) than the

Freshwater Species	Test Type[1]	Endpoint(s)	Test Duration (days)[2]
Daphnia magna	E	Survival/Survival and reproduction	2/21
Ceriodaphnia dubia	E	Survival/Survival and reproduction	2/7
Pimephales promelas	E	Survival/Survival and growth	4/7
Chironomus tentans	S	Survival and growth	10
Hyalella azteca	S	Survival and growth	10
Lumbriculus variegatus	S	Bioaccumulation	28
Estuarine/Marine Species	**Test Type[1]**	**Endpoint(s)**	**Test Duration (days)[2]**
Cyprinodon variegatus	E	Survival and growth	7
Menidia beryllina	E	Survival and growth	7
Mysidopsis bahia	E	Survival, growth and fecundity	7
Arbacia punctulata	E	Fertilization	1 hr. 20 min.
Champia parvula	E	Reproduction	7-9

[1] Elutriate (E) or Solid phase (S)
[2] Only short-term tests recommended for Tier III application

Table 2.2. Effects-based biological tests (for Tier III evaluation)

mortality of test organisms exposed to the control site sediment **or**

2. when the mean weight of organisms exposed to the dredged material is more than 10 percent less than the mean weight of organisms exposed to the control site sediment,

and is statistically different at the 95 percent confidence level.

If the results of any of these evaluations are negative, the dredged material discharge is considered not to meet the Guidelines. If negative test results are suspected to be the result of non-contaminant impacts, additional benthic toxicity testing using sublethal end points or other organisms may be considered in Tier IV.

Benthic Bioaccumulation Test

The methodology for the benthic bioaccumulation test with *Lumbriculus variegatus* is detailed in the *Great Lakes Dredged Material Testing and Evaluation Manual* (USACE/USEPA, 1998) . *L. variegatus* is a freshwater oligochaete worm (aquatic earthworm) that is 1-1.5 mm in diameter and 40-90 mm long. It burrows in sediments, is an important food item for bottom feeding fish, and is commonly cultured and harvested for fish food in pet stores. Other species that may be appropriate for bioaccumulation testing as well as methodology for the test can be found in Section 12 of the *Inland Testing Manual* (USACE/ USEPA, 1998).

The benthic bioaccumulation test is conducted by

placing a large number (500-1000) of organisms into a 5.5 liter aquarium with a layer of sediment and overlying water. The water is renewed periodically, but the organisms are not fed during the exposure (other than organic matter already in the sediments). The tests are completed in 10-28 days, at which time the organisms are prepared for chemical analysis.

Benthic bioaccumulation testing is **not** necessary if the proposed dredged material has no bioaccumulative contaminants of concern (as determined in Tier 1) or if the TBP analysis conducted in Tier II conclusively indicates that there is no potential for bioaccumulation of contaminants relative to the disposal site sediment.

If the contaminant of concern list for the dredged material includes bioaccumulative contaminants, and if analysis for potential bioaccumulation conducted in Tier III was inconclusive, the dredged material should be tested using the benthic bioaccumulation test. The results of bioaccumulation tests with the dredged material are compared statistically to the results with the control site sediment.

Dredged material is considered **not** to meet the Guidelines when the mean concentration of bioaccumulative contaminant(s) in test organisms exposed to the dredged material is statistically greater than the concentration of these contaminant(s) in test organisms exposed to the disposal site sediment.

Water Column Impact Evaluations

The Tier III evaluation will determine if the dredged material contaminants cause an unacceptable adverse impact on organisms within the water column. Water column toxicity tests (elutriate-based tests) have been developed for this Tier. A list of species appropriate for these tests as well as guidance for their selection can be found in Section 11 of the *Inland Testing Manual* (USACE/USEPA, 1998).

Water column toxicity tests use elutriate preparations prepared by mixing sediment and water (on a 1:4 ratio) into a slurry. The slurry is allowed to settle and the supernatant decanted. The supernatant is then centrifuged to remove suspended particles. This supernatant is the elutriate, which is diluted in series and used as the test solution for water column toxicity tests.

The test organisms are exposed to the elutriate in beakers or small aquaria. The elutriate is renewed periodically and the organisms are fed during the exposure. The elutriate tests were developed to measure lethal and sub-lethal responses, with short-and long-term exposures. The *D. magna* tests are completed in two (short-term) or twenty-one (long-term) days. The *C. dubia* tests are run in two or seven days, and the *P. promelas* test in seven or twenty-one days. The lethal response is measured as mortality or survival of organisms. The sublethal response measured is reproduction for *D. magna* and *C. dubia* and growth for *P. pimephale*s. The results of these toxicity tests for the dredged material are evaluated to determine if an unacceptable toxicity risk will occur outside the mixing zone.

One potential cost-saving measure during the implementation of water column tests that might be considered is to perform the test only with the full-strength elutriate, and not conduct the dilution series. Experience with similar tests and marine sediments has shown that undiluted elutriates infrequently produced mortality greater than 50 percent. While it must be recognized that there is a risk of having to repeat the test, the potential cost-savings outweigh this risk in most cases.

The results of the water column toxicity test must first be evaluated in light of the QA objectives defined earlier in this section. If the responses of organisms in control exposures are within acceptable limits, the test results with the dredged material may be evaluated using the statistical methods in the "Inland Testing Manual" (USEPA/ USACE 1998) and the water quality screen model employed in Tier II.

Dredged material is considered **not** to meet the Guidelines when the concentration of dredged material contaminants at the boundary of the mixing zone statistically exceeds 0.01 of the concentration (LC) causing 50 percent mortality of test organisms exposed to the dredged material elutriate. The screening model is used to calculate the dilution of the elutriate within the mixing zone.

Other Considerations

Tier III concentrates on linking observed characteristics in the water column and benthic environments to potential impacts on living resources. Therefore, it involves the integration of the chemical, biological, and physical data collected. In addition to the bioassay tests, it may be necessary to do field verification tests of the effects modeled in Tier II. For example, if smothering of benthic organisms is a concern, in Tier II the applicant would have run a model to predict the potential for sedimentation. In a Tier III extension, the applicant would actually deploy sediment traps into the water near the dredge site and determine the actual and stochastic sedimentation rates.

New physical data requirements may include bathymetry baseline data, wave and current climate, sediment transport, or ambient sedimentological conditions. Field measurements of transient plume behavior may also be included in such a field survey.

Additionally, biological information from tissue analysis for indigenous species may be necessary in order to determine background levels of toxic burden or presence of contaminants of concern. New data on ambient distribution of benthic, planktonic, nektonic, and demersal species at the dredging site (or disposal site) may be required.

Impacts Determination

After consideration of all available information, one of the following two possible **conclusions** can be reached at Tier III:

1. Existing information does not provide a sufficient basis for making an impacts determination. In this case, further evaluation at Tier IV may be appropriate.
2. Existing information does provide a basis for making an impacts determination. In this case, one of the following **determinations** can be reached:
   a) The proposed dredging and disposal will not cause unsuitable, adverse impacts.
   b) The proposed dredged material discharge will cause unsuitable, adverse impacts.

The information obtained in Tier III and earlier tiers should be sufficient to reach a determination in almost all cases. Therefore, the first conclusion (information not sufficient) should be reached only in unusual circumstances.

Reporting

Information gathered during Tiers I, II and III must be summarized and condensed in the 404(b)(1) evaluation document. Because a comprehensive tiered evaluation will likely gather far more information than can be presented in the 404(b)(1) evaluation, and because of the importance of the decisions made at this tier, it is recommended that this information be documented and filed as a backup to the 404(b)(1) evaluation. This documentation should be developed into a report that can be distributed for State and Federal agency review and if necessary, inserted as an appendix to the 404(b)(1) evaluation public review document.

Tier IV - Case-Specific Testing

Purpose

The purpose of Tier IV is to make determinations through the use of case-specific testing and evaluation. It is anticipated that the information obtained from testing and evaluations in Tiers I, II and III will not be sufficient for a contaminant

determination in very few cases. For example, Tier IV testing may be appropriate where Tier III test results are conflicting or inconclusive.

In these rare cases, testing procedures that have not been adopted for regional application, and those that are more research-oriented may be employed, as necessary. Because any testing and evaluation conducted in Tier IV is entirely case-specific, limited guidance can be offered. Further, it must be recognized that Tier IV is not an invitation to conduct basic research, but a mechanism for obtaining the information necessary to address case-specific dredged material contaminant impacts.

Tier IV testing should be focused on issues not resolved in earlier tiers. If Tier III testing for water column toxicity and benthic bioaccumulation were conclusive but the benthic toxicity testing was not, Tier IV testing should be limited to the unresolved benthic toxicity impacts of dredged material contaminants. Similarly, if Tier III testing produced conclusive determinations for some management units of a proposed dredging area, but not others, Tier IV evaluations should be limited to those management units in question.

Planning and Coordination

Because there are no hard-and-fast rules in Tier IV, it is imperative that the testing and evaluation be coordinated with the DNREC. When using testing procedures which have no established interpretive guidance, case-specific evaluative criteria must be developed in advance.

Testing and Evaluation Procedures

The tools that are used in Tier IV to evaluate dredged material contaminant impacts may include toxicity and bioaccumulation tests which differ from the Tier III tests in both the level of intensity and in cost. Examples of these differences include: different end points, different test species, and varying exposure conditions to reflect case-specific field conditions.

The USEPA and USACE have developed methodologies for the sub-lethal benthic toxicity tests with *Chironomus tentans* and *Hyalella azteca* and sub-lethal water column toxicity tests with *Daphnia magn*a, *Ceriodaphnia dubi*a, and *Pimephales promela*s. These tests are developed for measurement of growth as a sublethal response, and the procedures are provided in Appendix G of the *Great Lakes Dredged Material Testing and Evaluation Manual*. Since the interpretation guidance for these tests has not been completed and accepted by the USEPA and USACE, the use of these sub-lethal toxicity tests remains an option under Tier IV.

The *Inland Testing Manual* (USEPA/USACE 1998) lists a number of organisms for which toxicity and bioaccumulation tests have been developed. Although few of these tests were developed or used for regulatory decision making, this list can be used to identify potential species for Tier IV testing.

Tier IV may also require tools to evaluate the exposure and impacts of dredged material contaminants in the field, away from the disposal site, or on higher trophic levels. Examples of these tools include: field biota collection, field exposures (caged organisms), contaminant transport/ contaminant fate modeling, and human health/ ecological risk analysis.

When planning a Tier IV evaluation, it is recommended that the evaluator review the Guidelines and keep the following principles in mind throughout: a benthic evaluation is made of contaminant impacts relative to the disposal site sediment, a water column evaluation must consider the effects of mixing, and a contaminant determination is directed at whether or not an impact will occur, and not why.

Determination

At the conclusion of Tier IV, there are two possible **determinations** which can be reached:

a) The proposed dredged material discharge will not cause unsuitable, adverse impacts.
b) The proposed dredged material discharge will cause unsuitable, adverse impacts.

During-Dredging Analysis

In addition to the predictions described above, the DNREC will require actual monitoring to be conducted during the excavation and dewatering to verify compliance with applicable standards. The amount and degree of depth necessary for the during-dredging sampling will depend upon the level (Tier) of review for the pre-dredge evaluation. Additionally, it will depend upon the degree of certainty determined in the pre-dredge phase.

For more complex projects, sampling in the water column surrounding the excavation will require, at a minimum, collection of data on total suspended solids concentrations, dissolved oxygen, ammonia, and any contaminants of concern identified in the pre-dredge evaluation. Sampling for CDF effluent should follow the general approach taken by the Corps of Engineers, Philadelphia District, in evaluating the Pedricktown CDF (i.e. "Pedricktown Confined Disposal Facility Contaminant Loading and Water Quality Analysis," June 1999).

Post-Dredge Monitoring

In addition to the maintenance and monitoring requirements discussed in the Operations chapter, there may be supplemental requests by the DNREC for post-dredge monitoring. This will depend upon the size and location of the project, as well as the results and certainty involved in the pre-dredge and during-dredging analyses. Post-dredge monitoring should be coordinated with the DNREC since each project will have different parameters and requirements.

CHAPTER 3. OPERATIONS

Purpose

The purpose of the Operations chapter is to address the project design criteria for dredging operations. It begins with general policies that apply to site characteristics, engineering criteria, and management protocols. The dredging methods section begins with an overview of the types of dredging in order to provide some background information and to assist in selection of the appropriate equipment to satisfy engineering and environmental considerations. The disposal methods section describes the most commonly used disposal methods and the benefits and drawbacks of each. Since confined upland disposal is the most commonly used method of disposal in Delaware, there is significantly more detail in that section. Beach nourishment is also highlighted as a common practice in Delaware. Following the disposal information, a list of best management practices is presented for each phase of a dredging/disposal project. These practices are not mandates but rather may be encouraged based upon specific facets of individual projects.

General Policies Regarding Dredging Operations

Minimization of Impacts

"Dredging shall be limited to the minimum dimensions necessary for the project and shall avoid sensitive areas such as wetlands, shellfish resources, and submerged aquatic vegetation. *Delaware Surface Water Quality Standards* must not be violated because of dredging operations excluding whatever temporary and minimal turbidity is unavoidable when using sound dredging practices" (DCP CMP Policies Specific to Marinas #7. Authority — State of Delaware Marina Regulations, Section II(E)(2)(b) and II(E)(4)(a), revised February 22, 1993).

Assessment of Benthic Resources

"Benthic resources are protected because of their importance in the food chain and their value as commercial and recreational food sources. [If required by a regulatory agency] the status of a benthic community must be assessed by the applicant using frequency, diversity, and abundance measures approved by the DNREC. As a part of this determination, the rapid bioassessment techniques of Luckenbach, Diaz and Schaffner (1989) will be used by the Department to characterize benthic communities. The DNREC may modify this methodology as experience is gained in applying these techniques to Delaware waters. The DNREC may require monitoring of the benthos as a permit condition" (DCP CMP Policies Specific to Marinas #8. Authority – State of Delaware Marina Regulations, Section II(D)(6)(a)(b) & (c), revised February 22, 1993).

Critical Habitat

"Construction of marinas shall not be permitted at sites that are recognized by the DNREC as critical habitat. 'Critical Habitat' includes areas classified by the DNREC and serving an essential role in the maintenance of sensitive species. Areas may include unique aquatic or terrestrial ecosystems that support rare endangered or threatened plants and animals. Rare, endangered or threatened species are defined by both state and/or federal listings" (DCP CMP Policies Specific to Marinas #9. Authority – State of Delaware Marina Regulations, Section II(D)(7), revised February 22, 1993 and DNREC Regulations Governing the Use of Subaqueous Lands dated

September 2, 1992, Definition #10).

Water Quality

"The following concerns for protecting water quality shall be specifically considered by the Department in evaluating applications for dredging projects:

1. All dredging is to be conducted in a manner consistent with sound conservation and water pollution control practices. Spoil and fill areas are to be properly diked to contain the dredged material and prevent its entrance into any surface water. Specific requirements for spoils retention may be specified by the Department in the approval, permit or license.
2. All material excavated shall be transported, deposited, confined, and graded to drain within the disposal areas approved by the Department. Any material that is deposited elsewhere than in approved areas shall be removed by the applicant and deposited where directed at the applicant's expense, and any required mitigation [for the damage caused] shall also be at the applicant's expense.
3. Materials excavated by hydraulic pipeline dredge shall be transported by pipeline directly to the approved disposal area. All pipelines shall be kept in good condition at all times and any leaks or breaks shall be immediately repaired. [Additionally, pipes and other equipment should be removed as soon as feasible after completion of a project or during extended periods of idleness.]
4. Materials excavated and not deposited directly into an approved disposal area shall be placed in scows or other vessels and transported to either an approved enclosed basin, dumped and then re-handled by hydraulic dredge to an approved disposal area, or to a mooring where scows or other vessels shall be unloaded by pumping directly to an approved disposal area.
5. When scows or other vessels are unloading without dumping, they shall have their contents pumped directly into an approved disposal area by means sufficient to preclude any loss of material into the body of water.
6. In approved disposal areas, the applicant may construct any temporary structures or use any means necessary to control the dredge effluent, except borrowing from the outer slopes of existing embankments and/or hydraulic placing of perimeter embankments. For bermed disposal sites, a minimum freeboard of two (2) feet, measured vertically from retained materials and water to the top of the adjacent confining embankment, shall be maintained at all times.
7. The applicant shall not obstruct drainage or tidal flushing on existent wetlands or [adjacent] upland areas. The applicant shall leave free, clear, and unobstructed outfalls of sewers, drainage ditches, and other similar structures affected by the disposal operations. The dredged materials shall be distributed within the disposal area in a reasonably uniform manner to permit full drainage without ponding during and after fill operations.
8. The dredging operation must be suspended if water quality conditions deteriorate [as a result of dredge operations] in the vicinity of dredging or spoil disposal site. Minimum water quality standards may be included as an element of the permit and shall be monitored by the applicant. Violation of these conditions shall be cause for immediate suspension of activity and notification of the Department. Dredging shall not be resumed until water quality conditions have improved and the Department has authorized resumption" (Regulations Governing the Use of Subaqueous Lands, 3.05 (C)).

Prohibited Activities

"The following types of dredging projects are prohibited.

1. Dredging of biologically productive areas, such as nursery areas, shellfish beds, and

submerged aquatic vegetation, if such dredging will have a significant or lasting impact on the biological productivity of the area [i.e. if biomass or biodiversity will be reduced significantly].

2. Dredging of new dead-end lagoons, new basins and new channels, which have a length to width ratio greater than 3:1 [since long. narrow channels allow less mixing and aeration] and for which the applicant cannot prove, by clear and convincing evidence, that such dredging would not violate State Surface Water Quality Standards [either during the dredging process or as a result of the newly created hydrography of the area]. This subsection shall not apply to marina projects governed by the Marina Regulations.
3. Dredging channels, lagoons, or canals deeper than the existing controlling depth of the connecting or controlling waterway, unless otherwise approved under Subsection 3.03B(8) of these Regulations [which reads: "Slips, lagoons, basins, and access channels should be no deeper than the parent waterbody (i.e. no sill), and the depth should slope upward toward the landward extent from the parent waterbody. Exception may be allowed only by individual review of the potential environmental impacts and approval granted by the Secretary of the Department"].
4. Dredging channels, cleaning marinas, of other subaqueous areas by using propeller wash from boats" (Regulations Governing the Use of Subaqueous Lands, 3.04(D)).

Fee Schedule

"No person shall remove any material from public subaqueous lands without Department approval and receipt by the Department of full payment of the fee for the amount of material estimated to be removed. The Department reserves the right to determine the amount of material to be removed in dredging and/or filling projects" (Regulations Governing the Use of Subaqueous Lands, 3.05(E)).

Restrictions

No permit will be issued to:

A. Dredge any channel through the wetlands deeper than the existing depth or the controlled channel depth specified by the Corps of Engineers at the point of connection to the adjacent navigable waterway to which the dredge channel is directly connected. The Secretary in furtherance of the purposes of the Act may specify a lesser depth.
B. Dredge any channel through the wetlands that has only one outlet to navigable water through which the normal daily tide ebbs and flows unless the channel is equipped, by aerators or other means, to maintain the Water Quality Standards for Streams that are issued . . . by the Department.
C. Dredge channels through the wetlands with sides more nearly vertical than a slope that rises one foot vertically for each three feet of horizontal distance except where conditions of soil composition prevent slope stabilization, so that bulkheading must be used.
D. Utilize wetlands for any activity unless it:
   (1) Requires water access or water for the central purpose of the activity; and
   (2) Has no alternative on adjoining non-wetland property of the owner.
E. Building bulkheads on wetlands higher in elevation than the surface of the natural land. Navigational aids that do not prevent the ebb and flow of the tide may be higher" (Wetlands Regulations, 2.01).[1]

[1] Applicants should refer to the updated version of the Wetlands Regulations, which were not available at the time of this printing, to familiarize themselves with the most recent information regarding bulkheading in wetlands.

DREDGING METHODS AND EQUIPMENT

Sediment removal is accomplished generally by two mechanisms: hydraulic and mechanical dredging.

Hydraulic dredges are generally used to remove loosely compacted materials. Cutterhead suction, dustpans, hoppers, plain suction, and sidecasters are types of hydraulic dredges where the dredged material is transported in a liquid slurry form. They are usually barge mounted and carry diesel or electric-powered centrifugal pumps with discharge pipes ranging from 6 to 48 inches in diameter. The pump produces a vacuum on its intake side, and hydrostatic pressure forces water and sediments through the suction pipe to the main pump. The slurry is then pumped through a pipeline to a disposal/discharge area. Hopper dredges are generally self-propelled ships, which are also included in the hydraulic category even though they operate independent of a pipeline. The material is simply pumped into a self-contained hopper on the dredge. The hopper is opened at the disposal site to discharge the material or, if equipped with pump-out capability, the hopper can hook up to a monobuoy and pump the material through an anchored pipeline to the disposal/ discharge area.

Mechanical dredges remove loose or hard, compacted materials by clamshell, dipper, or ladder dredges, either for maintenance or new-work projects. These dredges remove bottom sediment through the direct application of mechanical force to dislodge and excavate the material at almost in-situ densities. Backhoe, bucket (such as clamshell, orange-peel, and dragline), bucket ladder, bucket wheel, and dipper dredges are types of mechanical dredges. Sediments excavated with a mechanical dredge are generally placed into a barge or scow for transportation to the disposal site (EPA, USACE, *Evaluating Environmental Effects of Dredged Material Management Alternatives – A Technical Framework*, November 1992).

Dredge Type	Percent Solids in Slurry by Weight [b]	Turbidity Caused	Vessel Draft (ft)	Dredging Depths (ft)	
				Minimum	Maximum
Mechanical					
Dipper	In situ	High	d	0[e]	50
Bucket	In situ	High[c]	d	0[e]	100[f]
Hydraulic (non-hopper)					
Dustpan	10-20%	Avg.	5-14	5-14	50-60[g]
Cutterhead	10-20%	Avg.	3-14	3-14	12-65[g]
Hydraulic Hopper					
Hopper	10-20%	Avg.	12-31	10-28	80
Other					
Sidecasting	10-20%	High	5-9	6	25
Special Purpose	10-20%	Avg.	5-8	8	20

[a] Prepared by USACE – Waterways Experiment Station
[b] Percent solids could theoretically be 0, but these are normal working ranges.
[c] Low, if watertight bucket is used.
[d] Depends on floating structure; if barge-mounted, approximately 5 to 6 ft. draft.
[e] Zero if used alongside of waterway, otherwise, draft of vessel will determine.
[f] Demonstrated depth, theoretically could be used much deeper.
[g] With submerged dredge pumps, dredging depths have been increased to 100 ft. or more.

(from USACE, EM 1110-2-5025, 1983)

Table 3.1. Summary of Dredge Operating Characteristics. [a]

Table 3.1 outlines some of the engineering features of various types of mechanical and hydraulic dredges and is intended to general reference only.

The State of Delaware owns two hydraulic dredges, which are used by the DNREC, Division of Soil and Water Conservation to carry out its mission under 7 Delaware Code 3905. Under this statute, the Department shall "[f]ormulate policies and general programs to be carried out by the Department and by soil and water conservation districts for the prevention of erosion, floodwater and sediment damages and for the conservation, protection, development and utilization of the State's soil and water resources, including the impoundment and disposal of water, and removal of sediment from waterways, lakes, ponds, and other bodies of water." More information on the state dredge program can be found in the Economics Section of the Administration chapter.

The specifications on the state dredges are as follows:

"**Blue Hen**"

Type: 10-inch hydraulic, pipeline cutterhead

Model/Manufacturer: 370 Dragon Dredge, Ellicott Machine Company

Minimum/Maximum Swing: 20' - 60'

Minimum/Maximum Dredging Depth: 3.5' – 20'

Maximum Pumping Distance without Booster Pump: 5,000 feet (silt), 4,000 feet (sand) (Booster pump will add approximately 2,500 – 3,000 feet of distance)

"**Diamond State**"

Type: 14-inch hydraulic, pipeline cutterhead

Model/Manufacturer: 970S Dragon Dredge, Ellicott Machine Company

Minimum/Maximum Swing: 45' – 100'

Minimum/Maximum Dredging Depth: 4' – 26'

Maximum Pumping Distance without Booster Pump: 4,500 feet (silt), 4.000 feet (sand) (Booster pump will add approximately 2,000 feet of distance)

Disposal Methods

Alternatives for the management of dredged material must be carefully evaluated from the standpoint of environmental acceptability, technical feasibility and economics. Three management alternatives are discussed for dredged material: open-water disposal, confined disposal, and beneficial use. Open-water disposal is the placement of dredged material in rivers, lakes, estuaries, or oceans via pipeline or release from hopper dredges or barges. Confined disposal is the placement of dredged material within diked nearshore or upland confined disposal facilities (CDFs) via pipeline or other means. Beneficial use involves the placement or use of dredged material for some productive purpose (e.g. beach nourishment or stabilization projects).

Potential environmental impacts resulting from dredged material disposal may be physical, chemical, or biological in nature. Because many waterways are located in industrial and urban areas, sediments often contain contaminants from these sources**.** Unless properly managed, dredging and disposal of contaminated sediment can adversely affect water quality and aquatic or terrestrial organisms. Sound planning, design, and management of projects are essential if dredged material disposal is to be accomplished with appropriate environmental protection and in an efficient manner.

The primary factors determining the most appropriate form of disposal are sediment characteristics and contaminant profile of the material. For example, some clean material is suitable for beneficial use projects including habitat creation or wetland restoration, whereas contaminated material must be disposed of more carefully due to presence of toxicants. (See Figure 3.1. for Dredge Material Management Decision Support Tree)

Most dredged material in Delaware can be managed in upland confined disposal facilities

(CDFs) which de-water into adjacent waterways. However, at some sites there are concerns about leachate impacts on groundwater and water quality violations in nearby surface waters. Finally, there is a persistent problem of finding available and appropriate tracts of land to ensure adequate disposal capacity for future dredging needs.

Each method of material disposal has various benefits and drawbacks that must be taken into consideration along with the unique features of individual projects or regions. This section provides a general overview of site characteristics and design standards while the Environmental Evaluation chapter outlines the testing criteria necessary for each option.

Open Water Disposal

Open-water disposal is the placement of dredged material in rivers, lakes, estuaries, or oceans via pipeline or release from hopper dredges or barges. Such disposal may also involve appropriate management actions or controls such as capping. Physical behavior and the resulting environmental impacts are dependant on the type of dredging and disposal operation used, the nature of the material (physical characteristics), and the hydrodynamics of the disposal site.

To evaluate open-water disposal a detailed assessment of the method including testing procedures, management options and control measures must be performed. Knowledge of site characteristics is necessary for assessments of potential physical impacts and contaminant impacts. Information on site characteristics needed for assessments may include the following:

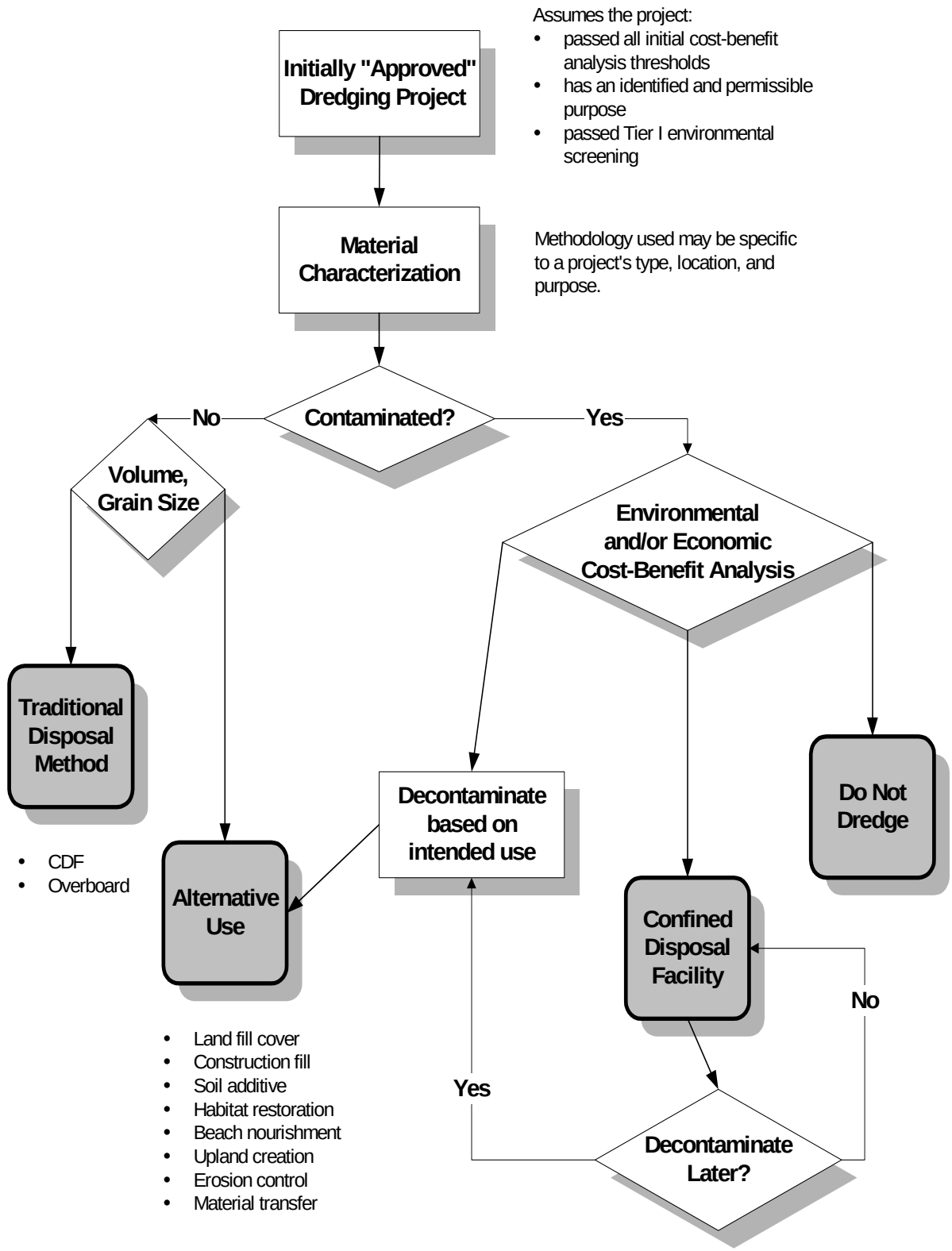
- Currents and wave climate;
- Water depth and bathymetry;
- Potential changes in circulation patterns or erosion patterns related to refraction of waves around disposal mound;
- Bottom sediment physical characteristics including sediment grain-size differences;
- Sediment deposition versus erosion;
- Salinity and temperature distributions;
- Normal levels and fluctuations of background turbidity;
- Chemical and biological characterization of the site and environs (e.g. relative abundance of various habitat types in the vicinity, presence of submerged aquatic vegetation, and presence of unique, rare or endangered, or isolated populations);
- Potential for recolonization of the site;
- Previous disposal operations;
- Availability of suitable equipment for the disposal site;
- Ability to monitor the disposal site adequately for management decisions;
- Technical capability to implement management options should they appear desirable;
- Ability to control placement of the material;
- Volumetric capacity of the site;
- Other site uses and potential conflicts with other activities (e.g., sport or commercial fisheries, shipping lanes, and military uses);
- Established site management or monitoring requirements;
- Public and regulatory acceptability to use of the site (USEPA/USACE, 1992).

In Delaware, open water disposal is legal, but it is strongly discouraged due to the turbidity and potential water quality impacts. Projects using open water disposal will be carefully scrutinized to ensure environmental protection, as will projects with material disposal into the surf zone. In these situations the applicant must justify the choice of disposal with clear and convincing evidence that the disposal method will neither violate State Water Quality Standards or cause lasting environmental damage.

Economic Loading or "Barge Overflow"

"Economic loading" is the term used to describe the practice where dredge hoppers and scows are filled past the point of overflow to increase the load of solids. There is little debate that the load can be increased by overflow if the material

Figure 3.1. Dredge Material Management Decision Support Tree



dredged is coarse grained or forms clay balls, as commonly occurs with new-work dredging. For the fine-grained maintenance material, significant disagreement exists as to whether a load gain can be achieved by overflow. Environmental considerations of overflow may be related to aesthetics, potential effects of water column turbidity, potential effects of deposition of solids, or potential effects of sediment-associated contaminants. Applicants wishing to use economic loading techniques must consult with DNREC regarding location, sediment type, and necessary testing and restrictions in order to evaluate the appropriateness of economic loading for the particular project. Due to uncertainties regarding the impacts from this practice, economic loading proposals will receive very careful consideration and a high threshold for review.

Confined Disposal

Confined disposal is placement of dredged material within diked nearshore or upland confined disposal facilities (CDFs) via pipeline or other means. CDFs may be constructed as upland sites, nearshore sites with one or more sides in the water (often called intertidal sites), or as island containment areas. The two objectives inherent in design and operation of CDFs are to provide adequate storage capacity to meet dredging requirements and to maximize efficiency in retaining solids. However, if contaminants are present, control of contaminant releases must also be an objective.

Hydraulic dredging adds several volumes of water for each volume of sediments removed, and this excess water is normally discharged as effluent from the CDF during filling operation. When the dredged material is initially deposited in the CDF, it may occupy several times its original volume. The settling process is a function of time, but the sediment will eventually consolidate to its in-situ volume, or less if desiccation occurs. Adequate volume must be provided during the dredging operation to contain the total volume of sediment to be dredged (including transient water), accounting for any volume changes during placement (USACE/USEPA, 1992).

To evaluate confined disposal a detailed assessment of the method including testing procedures, management options and control measures must be performed. Knowledge of site characteristics is necessary for assessments of potential physical, biological, and contaminant impacts.

Information on site characteristics needed for assessments may include the following:

- Available area and volumetric storage capacity to contain the material for the required life of the site;
- Real estate considerations;
- Site configuration and access;
- Proximity to sensitive ecological environments;
- Topography to include potential changes in elevation, runoff patterns and adjacent drainage;
- Ability of the dredged material to dry and oxidize;
- Groundwater levels, flow direction, and potential impact of groundwater discharge and recharge;
- Meteorology and climate;
- Foundation soil properties and stratigraphy;
- Potential groundwater receptors;
- Potential alteration of the existing habitat type;
- Potential for effluent, leachate, and surface runoff impacting adjacent ground and surface water resources;
- Potential for direct uptake and movement of contaminants into food webs;
- Potential for volatilization of contaminants;
- Potential for dust, noise, or odor problems;
- Potential accessibility of the site to the public;
- Potential for creation of acid sulfate soils (discussed below under Material Characteristics);
- Contamination history of proposed site

(USEPA/USACE, 1992).

Design, Operations and Management (new and existing) of Confined Disposal Facilities

When material is placed in a confined disposal facility (CDF), it must be demonstrated that the placement of the dredged material will not have significant adverse impacts to terrestrial or aquatic ecosystems or pose risks to public health. In order to minimize potential risks, the following must be considered: Location of the Facility and Site-specific Conditions; Material Characteristics; Design and Construction of Facility; Operation of the Facility; and Closure and use of the Facility.

- Location of the Facility and Site-specific Conditions

  The location of a proposed confined disposal facility must be analyzed with consideration of the flow returning to surface and groundwater systems. The siting is subject to review under the Coastal Zone Management Act, Wetlands Act, local/county zoning board, and the Corps of Engineers through their permitting authority for dredging projects.

- Material Characteristics

  The main concerns regarding confined disposal of dredged material is the potential for surface or ground water contamination. Testing of materials for confined disposal and evaluations of the risks of contamination are discussed in the Environmental Evaluation chapter.

  One concern that is becoming increasingly well understood is that of acid sulfate soils. If sulfidic soils (those containing oxidizable sulfur compounds) are exposed to oxidizing conditions such as atmospheric or dissolved oxygen, the sulfur compounds oxidize and produce acid. This can result in the soil pH dropping to about 4.0. Acidity restricts the growth of plants since it generates high amounts of aluminum and iron, which are toxic to plants.

  If acid sulfate soils are potentially present, these soils must be reclaimed in order to prevent environmental damage. While introducing the common reed *Phragmites australis* is one option to accelerate the reclamation process, this reed is considered a nuisance in Delaware, and thus this practice is not recommended. Another method that may be more promising is the application of lime on the soils. More information regarding acid sulfate soils can be found in the materials listed in the references section by Dr. Delvin Fanning.

- Design and Construction of the Facility

  Design of the CDF site is similar to that for any earthen berm or dike. It must be capable of enduring under the forces of the dredged material placed inside as well as the hydraulic forces from the adjoining surface water, underlying ground water, stormwater discharges, and dewatering effluent. The containment structure must be able to withstand the effects of erosion, settlement, provide a stable platform for the operation of equipment, and allow for the potential vertical expansion of the containment structure. Refer to the "General Policies Regarding Dredging Operations" section for additional parameters guiding site design and construction.

  In addition, an Erosion and Sediment Control plan is required from the Division of Soil & Water Conservation for any upland soil disturbance of 5000 square feet or more. Several of the principles regarding erosion and sediment control are included for general reference:

  – An approved erosion and sediment control plan must be followed. Any modifications to the plan must be approved as revisions to the approved plan.

- Any site or portion thereof on which a land-disturbing activity is completed or stopped for a period of fourteen days must be stabilized either permanently or temporarily following the specifications and standards in theErosion and Sediment Control Handbook.
- Unless an exception is approved, not more than [20 acres] may be cleared at any one time in order to minimize areas of exposed ground cover and reduce erosion rates.
- A land-disturbing activity shall not cause increased sedimentation or accelerated erosion off-site. Off-site means neighboring properties, drainageways, public facilities, public rights-of-ways or streets, and water courses including streams, lakes, wetlands, etc.

More specific criteria for vegetation and berm stabilization can be found in the *Delaware Erosion and Sediment Control Handbook for Development.*

DNREC Sediment & Stormwater Regulations do not differentiate between different types of land disturbing activities. Therefore, CDFs would require the same types of controls as other activities. The *Delaware Erosion and Sediment Control Handbook for Development* contains practices which should be adequate for perimeter control and stabilization of CDFs. There is one function of CDFs, however, which is unique. DNREC's Erosion and Sediment Control practices are intended to control periodic rainfall events up to about 1" of runoff. Since CDFs are operated on a more continuous basis, dewatering operations using standard E&S practices would not be appropriate. The applicant must consult with the Division of Soil & Water Conservation to determine applicable construction and operating procedures.

A permit regulating the discharge of effluent from the CDF is likely. Additional National Pollution Discharge Elimination System (NPDES) Storm Water Regulations apply, since a NPDES certification is required for land disturbing activities. The "Regulations Governing Storm Water Discharges Associated with Industrial Activity, Part 2 – Special Conditions for Storm Water Associated with Land Disturbing Activities" (1998) states that "Land disturbing activities shall not commence and coverage under this Part shall not apply until the Sediment and Stormwater Management Plan for a site has been approved, stamped, signed and dated . . .". Applicants should consult DNREC, Division of Water Resources for specific requirements.

The Department will use the technical standards of the following documents as the basis for its engineering review of the design and construction of the proposed CDFs:

Confined Disposal of Dredged Material – Engineering Manual (EM 1110-2-5027), U.S. Army Corps of Engineers, 1987.

Confined Disposal Guidance for Small Hydraulic Maintenance Dredging Projects – Design Procedures, Environmental Effects of Dredging Technical Note EEDP-02-8, U.S. Army Corps of Engineers, 1988.

- Operation of the Facility

The operation of the CDF must be monitored to ensure the stability and integrity of the containment structure and to prevent uncontrolled release of material, ponded water, and associated contaminants. Oversight must also ensure that the site is filled at a rate that allows efficient functioning of the facility and moderates the discharge of dewatering effluent. Potential impacts to human and terrestrial ecosystems must also be considered.

An annual report must be submitted by the CDF owner/operator to the Department of

Natural Resources and Environmental Control. The report will summarize the past year's activities and the projected activities for the next five (5) years. The report shall document the following information:

1. Conditions of containment berms, dewatering and stormwater discharge weirs, and other engineering structures critical to the operation of the CDF. Any changes to the CDF must be first approved by the Department and revised "as built" plans documenting any significant changes submitted.
2. Summary of disposal operations at the CDF, including a listing of all dredging projects and their volumes.
3. Summary of maintenance and management activities conducted at the CDF, including regrading, ditching, crust management, and interim closure procedures, if required.
4. Summary of any dredged material removed from the CDF and its final use/ destination.
5. An analysis of available disposal capacity in the CDF. This will be compared with the projected disposal activities for the next five (5) years and a running total of available capacity for the next five years estimated.
6. Summary of surface and ground water discharge monitoring programs for all required parameters.
7. Any additional monitoring or certifications required.

In addition, the following sections from the *Regulations Governing the Use of Subaqueous Lands* (repeated from "General Policies" section above) are included here as they address disposal site design:

- In approved disposal areas, the applicant may construct any temporary structures or use any means necessary to control the dredge effluent, except borrowing from the outer slopes of existing embankments and/or hydraulic placing of perimeter embankments. For bermed disposal sites, a minimum freeboard of two (2) feet, measured vertically from retained materials and water to the top of the adjacent confining embankment, shall be maintained at all times.
- The applicant shall not obstruct drainage or tidal flushing on existent wetlands or upland areas adjacent thereto. The applicant shall leave free, clear, and unobstructed outfalls of sewers, drainage ditches, and other similar structures affected by the disposal operations. The dredged materials shall be distributed within the disposal area in a reasonably uniform manner to permit full drainage without ponding during and after fill operations (Section 3.05(c), 9-10).

- Closure and use of the Facility

Interim Closure

Any site or portion thereof on which a land-disturbing activity is completed or stopped for a period of fourteen days must be stabilized either permanently or temporarily following the specifications and standards in the Erosion and Sediment Control Handbook.

Concerns at interim closure include minimizing potential for human or plant/ animal exposure to contaminated dredged material. For that reason, testing of the exposed (surface) dredged material within the site may be necessary.

Measures must be put in place to control dust and to limit access to the site for public safety reasons, as the material will not have solidified to hard ground. It may also be necessary to cap the exposed material with clean fill or to lime in order to encourage plant growth.

During periods of non-use, requirements of all permits including NPDES, State Water Quality Certification, and Sediment and Erosion Control plan must be satisfied. If the period of non-use is to last longer than five years, the site operator must implement the procedures for final closure.

Final Closure

The goal of final CDF closure is to ensure containment of potentially contaminated dredged material. The owner of record of the property on which the upland CDF is constructed is ultimately responsible for the final closure of the facility and any required post-closure monitoring.

Formal plans must be submitted to address final closure, post-closure maintenance and monitoring, and site development or use for all upland CDFs. The Final Closure Plan must propose all engineering controls designed to contain the contaminated dredged material and prevent direct contact with, and off-site transportation of, contaminants of concern. Another major component of the Plan will relate to cap design. In general, a minimum thickness of two feet of cover, consisting of 18 inches of clean fill overlain by 6 inches of topsoil, with a complete vegetative cover, will be required.

Because CDF closure designs vary significantly, it is important that the CDF owner or operator consult with DNREC, Division of Soil & Water, regarding the closure plans for a particular site. This will enable the Final Closure Plan to reflect the unique situation of location, material content, and future purpose of the site.

Alternative Disposal Methods and Beneficial Use

Beneficial use of dredged materials includes a wide variety of options for utilizing dredged material for some productive purpose. Dredged material is potentially a manageable soil resource with beneficial uses that could be incorporated into project plans and goals. Additionally, by using the dredged material for some constructive purpose, it keeps clean fill from being placed into upland disposal facilities where it may mix with contaminated material, thereby rendering it unusable. Use of valuable coastal land for constructing new confined disposal facilities can also be reduced.

At the outset, it is important to note that there is some concern regarding the term "beneficial," as some projects may not be perceived to yield a positive environmental benefit. For the purpose of this document, the term "beneficial" will be used, since it is the standard term for describing any uses where material is considered a resource.

Below are the ten broad categories of beneficial uses that have been identified by the USEPA and USACE, based on functional use of the dredged material or site area. These are presented here to give a broad idea of possible uses of material; however, not all of these categories may be appropriate or approved for specific projects in Delaware.

1. Habitat restoration/enhancement (wetland, upland, island, and aquatic sites including use by waterfowl and other birds);
2. Beach nourishment;
3. Aquaculture;
4. Parks and recreation ;
5. Agriculture, forestry, and horticulture;
6. Strip mine reclamation and landfill cover for solid waste management;
7. Shoreline stabilization and erosion control (fills, artificial reefs, submerged berms, etc.;
8. Construction and industrial use (including port development, airports, urban, and residential);
9. Material transfer (fill, dikes, parking lots, and roads);
10. Multiple purpose (USEPA/USACE,1992).

	fine	*coarse*
Habitat Restoration	x	x
Beach Nourishment		x
Aquaculture	x	x
Parks & Rec. (upland creation)	x	x
Ag, forestry, horticulture	x	
Strip mines & landfills	x	x
Erosion and shoreline	x	x
Construction & urban	x	x
Material transfer	x	x
Multiple purpose	x	x

Table 3.2. Material Uses by Grain Size

One factor that influences disposal methods is the grain size of the material. Fine material is defined by the Wentworth Sediment Size Classification System as less than 0.0625 mm in diameter, while coarse material is greater than 0.25 mm. The following table indicates the classification of sediment types that would be most suitable for particular beneficial use projects.

When considering habitat re-creation as a beneficial use for dredged material, it is necessary to weigh what will be lost against the potential "gain." In some cases, the habitat already existing in an area may be fairly valuable, especially when compared with the risk of failure that is taken with any habitat restoration project. One example would be a shallow water habitat, which can be populated with shellfish and provides feeding grounds for birds, being filled to create a wetland. For example, the "cost" of smothering benthic organisms in a shallow water habitat must be weighed against the "benefit" of a wetland habitat for a particular area.

Developing appropriate sites and projects for beneficial use of material is an important consideration. Areas that are already high-value habitats (shellfish beds, SAV, Essential FishHabitat) should be avoided – they are already functional habitat.

Recommended factors for evaluation would include:

- Quantity of clean material;
- Sediment quality (physical and chemical characteristics);
- Suitability of material to proposed use;
- Habitat assessment (what is gained and/ or lost);
- Evaluation of proposed use with traditional disposal methods;
- Past historical success (or failure and reasons);
- Has monitoring been conducted? Is the new habitat functional?;
- Is there an acceptable candidate site?;
  - Does it already have a valuable habitat?;
  - Will it support the intended use (bird rookery, etc)?;
  - Is design/engineering/monitoring adequate? feasible?;
  - Is cost of construction and maintenance/management/monitoring justified?;
- Is the project truly beneficial or subject to failure? Or is the risk of failure acceptable?;
- Will the project be sited in a place where it will persist? (i.e. wetland on east side of estuary) or where erosion will remove it (west side)?

Alternative/beneficial use should be considered if at all possible, although it shall not be used as the sole justification for the project. Applications with these uses should be subject to the same review procedures and requirements as the parent project. It may also be necessary to foresee and deal with adverse public opinion on some projects. Additionally, the project sponsor must take responsibility for the management and monitoring of the site and be prepared to make necessary

modifications in order to maintain its uses and functions.

Beach Nourishment

Placing sand from a navigational dredging project onto an eroding beach can provide an opportunity for beneficial use of dredged material. However, in other cases, sand is dredged for the expressed purpose of beachfill, and the following section addresses the unique features of beach nourishment projects. Dredging offshore sand and placing it on Atlantic Coast and Delaware Bay beaches has provided shoreline stabilization, preserved recreational opportunities, and protected coastal properties. It is the policy of the State to protect its beach resources, and several economic studies have indicated that the policy is cost-effective.

In some cases, material from Inland Bays navigation projects can provide suitable material for Atlantic Coast nourishment. However, there have also been instances of grain size or material incompatibilities (i.e. silt-clay or mud). Careful testing for grain size, and more testing cores per location, should determine whether or not material is suitable for placement on beaches. The sediment composition and grain size should be very similar to that on the recipient beach, and any variation should be statistically valid. An applicant will work with DNREC to develop a project design that optimizes beach nourishment objectives. Material slated for beach nourishment, regardless of whether it is a beneficial use of material from a navigational project or excavated expressly for nourishment, should have grain size characteristics very similar to the intended placement site.

Disposal Selection Summary

The grain size, contaminant profile, amount, location, etc. all influence the selection of a disposal alternative for dredged material. The following chart outlines the general arguments for and against certain disposal methods. This is intended for general reference in the early stages of project planning as the alternative analysis is undertaken.

DISPOSAL ALTERNATIVES

Beneficial Use

pro

- Avoids the need for new disposal capacity
- Yields a marketable commodity
- Usually good for public relations
- Reclaims brownfields
- Creates/restores wildlife habitat
- Meets two needs – 1) disposal, and 2) habitat creation, beach nourishment, etc.

con

- Usually more expensive than traditional disposal
- Potential for impacts to existing habitat
- Results in increased handling with management requirements
- Possibility that the project will not meet expectations or will fail

Leave Alone (don't dredge)

pro

- No cost
- No environmental disturbance or potential for degradation of wateway

con

- Navigational or other need not met

Confined Disposal

pro

- Can handle contaminated sediments safely
- Can offer long-term disposal
- Normally cheaper per unit in existing sites
- Provides material for re-use

con

- Limited life span
- New sites expensive
- Environmental impacts are possible

- Double-handling creates additional expense
- Potential for changes in land use

Overboard Disposal

pro

- Inexpensive and easy method
- Creates future borrow sites

con

- Cannot be used for contaminated material
- Potential environmental impacts (DO, resuspension, bioavailability, habitat degradation)
- Requires double-handling if used for borrow material

Transport of Dredged Material

Methods used to move dredged material include pipelines, barges or scows, and hopper dredges. Pipeline transport is the method most commonly associated with cutterhead, dustpan, and other hydraulic dredges. Dredged material may be directly transported by hydraulic dredges through pipelines for distances of up to several miles, depending on conditions. Barges and scows, used in conjunction with mechanical dredges, have been one of the most widely used methods of transporting large quantities of dredged material over long distances. Hopper dredges are capable of transporting the material for long distances in a self-contained hopper. Hopper dredges normally discharge the material from the bottom of the vessel by opening the hopper doors; however, some hopper dredges are equipped to pump the material from the hopper much like a hydraulic pipeline dredge (USEPA/USACE, 1992).

BEST MANAGEMENT PRACTICES (BMP'S) FOR DREDGING OPERATIONS

Best Management Practices, commonly referred to as BMPs, are methods for carrying out a task that minimize the potential for, and magnitude of, any adverse impacts that may result from a particular project. Authorized best management practices exist for a wide-range of activities including agriculture and construction projects of all types. Numerous BMPs have also been identified that address specific concerns resulting from the operation of a dredge. The main concerns usually include suspended solids (including the re-suspension of contaminated sediments) and disruption of aquatic habitats and fish and wildlife. It is the goal of the Department to regulate projects in such a way as to minimize the potential for adverse environmental impacts to occur.

A permit for any dredge operation may require that certain BMPs be used in order to minimize adverse environmental impacts to the area. The BMPs required for each permitted project will be different based upon site conditions (sediment contamination, sediment type, and location), scope of the project, type of dredge to be used and habitat concerns.

The following is a list of common Best Management Practices used in Delaware, broken down by category. This list is not intended to be a comprehensive list of all BMPs in Delaware, thus additional practices not listed here may be required or recommended for certain projects.

Practices that reduce suspended sediments at the dredge site:

Silt Curtains

The use of silt curtains can minimize the dispersal of sediments from the upper water column in the dredging area. It is also useful for protecting tidal creeks adjacent to the dredge site from excess sedimentation. This BMP is practical for use in areas where the water current is less than 1 knot.

Hydraulic Dredging

Hydraulic dredging reduces the amount of suspended sediments generated at the dredging

site. However, this method produces a dredged material slurry that has a high water percentage and thus it is preferable only when an approved confined disposal facility (CDF) is available for the disposal of sediments.

Closed Clamshell Dredging

Dredging using a closed, watertight clamshell reduces the amount of suspended sediments generated at the dredging site. This BMP is suggested when the sediments to be dredged are known to be contaminated at levels warranting concern.

When using a clamshell dredge, the following practices should also be followed:

1. Maximize the size of the "bite" of the clamshell to reduce the overall amount of "bites" needed for completion of the project;
2. Slowly withdraw the clamshell through the water column to minimize spillage;
3. Do not rinse sediments off the sides and gunwales of the barge.

No-Barge-Overflow

No-barge-overflow can reduce the creation and dispersal of suspended sediments when finer-grained sediments are to be dredged. Once a hopper dredge is filled to capacity, dredging is stopped immediately so that material does not overflow the sides of the hopper. It is especially encouraged when those sediments are known to have contaminant levels that warrant concern.

Shunting

Shunting can reduce turbidity in the upper water column. This method involves actively pumping free water in a barge to the bottom of the water column at the dredging site. The discharge end of the shunting system must include a diffuser in order to minimize the potential for additional disruption of benthic sediments. Additionally, the pumping rate and location of the discharge must not result in the disruption of in-place sediments.

Dredging during the in-coming tide

In certain semi-enclosed water bodies, dredging on only the in-coming tide can provide additional time for suspended sediments to settle. This will minimize the dispersal of sediments out of the water body.

Practices that minimize impacts to aquatic habitat and dwellers:

Use of seasonal windows

Dredging operations are prohibited in specific areas during certain times of the year to minimize any potential impacts to anadromous or other migratory finfish, nesting shorebirds, etc.

The Delaware Basin Fish and Wildlife Management Cooperative give guidance for seasonal restrictions for the mainstem of the Delaware River. Hydraulic pipeline and hydraulic hopper dredging is prohibited in non-Federal areas from the Delaware Memorial Bridge northward from April 15 – June 21. Bucket dredging is prohibited in all areas north of the Delaware Memorial Bridge from March 15 until May 31. Blasting/ overboard disposal is prohibited in all areas north of the Delaware Memorial Bridge from March 15 until November 30. Hydraulic hopper dredging in all areas from Delaware Bay to the Delaware Memorial Bridge requires turtle monitoring, as per the National Marine Fisheries Service Biological Opinion, Nov. 26, 1996.

Applicants should consult the DNREC, Division of Fish and Wildlife to determine appropriate windows for their particular

project location and season.

Practices for beach nourishment projects:

Use of large dredges or more booster pumps for beach nourishment projects

The use of larger dredges or more booster pumps for beach nourishment projects would permit sediment collection further from the shoreline. This might allow nearshore shoals to remain intact, although mobilization costs must also be taken into consideration.

Selection of borrow areas

Borrow areas for beach nourishment projects should be located far enough offshore to ensure that sand washing off the beach would not go back into the area. Borrow areas should also be far enough offshore to preclude injury to beach-goers. The average adequate distance along Delaware Bay beaches is about 1,000 feet. Along the Atlantic beaches the distance offshore would be dictated by the "depth of closure" which is approximately –25'MLW.

Inspect material being discharged

Visually inspect the material being discharged along the shoreline at all times during the project. If unsuitable material (e.g. silt/mud) is observed, notify the dredge immediately for shutdown. Relocate the dredge within the approved borrow area where suitable material (sand) is located and resume operations.

Adhere to special conditions

Adhere to any special conditions placed upon projects via State and Federal permit approval.

Other practices:

Minimize volume of dredged materials

Plan, design, and implement projects to dredge the minimum possible volume to attain the goals set forth by the project proposal.

Employment of dredging inspectors

Dredging contractors may be required to employ independent, on-board dredging inspectors certified by the U.S. Army Corps of Engineers. These inspectors will observe dredging and disposal operations to ensure compliance with all permit conditions. The federal government requires such inspectors for all ocean disposal projects. More information regarding these requirements can be found in the Delaware Bay Fish and Wildlife Cooperative guidance pertaining to dredging windows.

Dredged material pumping systems

The use of a number of pumping systems including positive displacement pumps and vortex type pumps, can provide for more precise dredging operations and minimize the re-suspension of sediments at the dredging site. These systems can also reduce the volume of the de-watering discharge from a CDF, reducing the potential impacts to surface water quality.

Positive displacement pumps move material at in situ moisture levels, resulting in the greatest percent solids transfer. These devices are typically used for concrete and can achieve pumping capacities in excess of 140 cubic yards per hour.

Use of vortex type pumps can result in reduced water content of the dredged material. This, in combination with a directional control system serves the same function as a closed clamshell or hydraulic cutterhead. However, the material removed has an increased solids content compared to typical hydraulic dredges and is similar to a closed clamshell, but with far less sediment disturbance and turbidity generation.

GLOSSARY

Accretions – an increase of land along the shores of a body of water.

Ambient conditions – those physical, chemical, and biological conditions present in the surrounding area of the project site

Anadromous fish – fish that migrate from oceanic to coastal waters, or from salt water to fresh water

Benthic – the bottom of a water body

Benthos – see benthic; the organisms living on the bottom of a water body

Best management practices (BMPs) – methods and measures employed to reduce the adverse environmental impacts resulting from a dredging or dredged material management/disposal activity

Bioaccumulation – the accumulation of contaminants in the tissues of organisms through any route, including respiration, ingestion, or direct contact with sediment or water; indicates the biological availability of contaminants

Bioassay (test) – acute or sublethal/chronic toxicity or bioaccumulation tests using organisms representative of the water column, benthic, and terrestrial environment(s) at the dredging or dredged material disposal site.

Clamshell dredge – a dredging bucket comprised of two hinged jaws; a boat or barge equipped with such a machine

Confined disposal facility - Confined disposal is placement of dredged material within diked nearshore or upland confined disposal facilities (CDFs) via pipeline or other means. CDFs may be constructed as upland sites, nearshore sites with one or more sides in the water (often called intertidal sites), or as island containment areas.

Containment area – any site used for the permanent disposal or temporary confinement of dredged material, and which may or may not have a permanent retaining structure, located in an open water or wetland area directly adjacent to an upland area

Dewatering – the practice of actively or passively removing water from dredged material, usually occurring in a barge or upland confined disposal facility

Effluent – particular reference to the quality of water coming over a weir from a dredged material upland confined disposal facility during and after a disposal operation

Elutriate (test) – involves mixing dredged material with dredging-site water and allowing the mixture to settle, the potential release of dissolved chemical constituents from the dredged material is determined by chemical analysis of the supernatant (elutriate) remaining after undisturbed settling

Freeboard – the distance between the waterline and the upper most full deck

Hopper dredge – self-propelled seagoing ships equipped with sediment containers (hoppers), dredge pumps, and other special equipment. Dredged material is raised by dredge pumps through drag arms in contact with the bay/ocean bottom and discharged into hoppers built in the vessel.

Hydraulic dredging – Hydraulic dredges are generally used to remove loosely compacted materials. Cutterhead suction, dustpans, hoppers, plain suction, and sidecasters are types of hydraulic dredges where the dredged material is transported in a liquid slurry form.

Mechanical Dredge - Mechanical dredges remove loose or hard, compacted materials by clamshell, dipper, or ladder dredges, either for maintenance or new-work projects. These dredges remove bottom sediment through the direct application of mechanical force to dislodge and excavate the material at almost in-situ densities. Backhoe, bucket (such as clamshell, orange-peel, and dragline), bucket ladder, bucket wheel, and dipper dredges are types of mechanical dredges.

Mitigation – the replacement or substitution of a habitat in repayment for habitat that has been degraded or destroyed

Mixing zone – an "allocated impact zone" where numeric water quality criteria can be exceeded as long as acutely toxic conditions are prevented. A mixing zone is a limited area or volume where the initial dilution of a discharge occurs (Versar, 1996).

Ocean disposal – the practice of dredged material disposal via oceangoing barge into a designated disposal site in deep, open water, often miles from shore.

Open water disposal – the practice of dredged material disposal anywhere into open water, exclusive of disposal into a subaqueous disposal pit or containment area

Permit – an authorization, license, or equivalent control document issued by the U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, or approved State agency to implement the requirements of an environmental regulation

Plankton – plant and animals that float or drift in fresh or salt water

Planktonic – see plankton; of or relating to the organisms of the plankton

Pollutants – any gaseous, chemical, or organic waste (natural or man-made) that contaminates air, soil, sediment, or water, and has the potential for harm to human health, to any aspect of human or natural ecosystems, or to environmental aesthetics or vitatlity

Riparian landowner – the landowner of a bank of a natural course of water

Nekton – marine organisms that swim independently of currents

Nektonic – see nekton; of or relating to the organisms of the nekton

Sorbed – to take up and hold as by absorption of adsorption

Subaqueous – found or occurring underwater

Supernatant – the clear fluid floating on the surface over a sediment or precipitate

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ACRONYMS

BMP	Best Management Practices
CCMP	Comprehensive Conservation Management Plan
CDF	Confined Disposal Facility for dredged material
CIB	Center for the Inland Bays, DE
COE	U.S. Army Corps of Engineers
CORMIX	Cornell Mixing Zone Expert System
CWA	Clean Water Act
CZM	Coastal Zone Management (Act)
DAWM	DNREC, Division of Air & Waste Management
DCP	DNREC, DSWC, Delaware Coastal Programs
DNREC	Delaware Department of Natural Resources and Environmental Control
DFW	DNREC Division of Fish & Wildlife
DGS	Delaware Geological Survey
DPR	DNREC, Division of Parks & Recreation
DRBC	Delaware River Basin Commission
DSWC	DNREC, Division of Soil & Water Conservation
DWR	DNREC, Division of Water Resources
EFH	Essential Fish Habitat
EPA	U.S. Environmental Protection Agency
GIS	Geographic Information System
MAFMC	Mid-Atlantic Fishery Management Council
NED	National Economic Development (Plan)

Acronyms

NMFS	NOAA, National Marine Fisheries Service
NOS	NOAA National Ocean Service
NOAA	National Oceanic & Atmospheric Administration
RHA	Rivers & Harbors Act
STORET	Storage and Retrieval system database (EPA)
TBP	Theoretical Bioaccumulation Potential
TSS	Total Suspended Solids
U of D	University of Delaware
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish & Wildlife Service
UD-CMS	University of Delaware, College of Marine Studies
USGS	U.S. Geological Survey
WES	Army Corps Waterways Experiment Station (Vicksburg, MS)
WRDA	Water Resources Development Act

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Federal Listing of Threatened and Endangered Species

(Source: U.S. Fish and Wildlife Service)

Status Codes
T Threatened
E Endangered
XN Experimental population Non-essential

Animals

Status	Common Name	Scientific Name
T	Eagle, bald	*Haliaeetus leucocephalus*
T	Plover, piping	*Charadrius melodus*
E	Puma, eastern	*Puma concolor couguar*
T	Sea turtle, green (except where endangered)	*Chelonia mydas*
E	Sea turtle, hawksbill	*Eretmochelys imbricata*
E	Sea turtle, Kemp's ridley	*Lepidochelys kempii*
E	Sea turtle, leatherback	*Dermochelys coriacea*
T	Sea turtle, loggerhead	*Caretta caretta*
E	Squirrel, Delmarva Peninsula fox (except Sussex Co., DE)	*Sciurus niger cinereus*
XN	Squirrel, Delmarva Peninsula fox [XN]	*Sciurus niger cinereus*
E	***Sturgeon, shortnose***	*Acipenser brevirostrum*
T	Turtle, bog (northern)	*Clemmys muhlenbergii*
E	Whale, finback	*Balaenoptera physalus*
E	Whale, humpback	*Megaptera novaeangliae*
E	Whale, right	*Balaena glacialis*

Plants

Status	Common Name	Scientific Name
T	Pink, swamp	*Helonias bullata*
T	Pogonia, small whorled	*Isotria medeoloides*
E	Dropwort, Canby's	*Oxypolis canbyi*
T	Beaked-rush, Knieskern's	*Rhynchospora knieskernii*

State Listing of Endangered Species of Delaware

(Source: Delaware Natural Heritage Inventory *June 12, 2000*)

Amphibians

Common Name	Scientific Name
Eastern Tiger Salamander	*Ambystoma tigrinum tigrinum*
Barking Treefrog	*Hyla gratiosa*

Birds

Common Name	Scientific Name
Brown Creeper[BR]	*Certhia americana*
Bald Eagle	*Haliaeetus leucocephalus*
Pied-billed Grebe[BR]	*Podilymbus podiceps*
Northern Harrier[BR]	*Circus cyaneus*
Cooper's Hawk[BR]	*Accipiter cooperii*
Black-Crowned Night-Heron	*Nycticorax nycticorax*
Yellow-Crowned Night-Heron	*Nyctanassa violacea*
Northern Parula[BR]	*Parula americana*
Piping Plover	*Charadrius melodus*
Short-eared Owl[BR]	*Asio flammeus*
American Oystercatcher	*Haematopus palliatus*
Black Rail	*Laterallus jamaicensis*
Upland Sandpiper	*Bartramia longicauda*
Loggerhead Shrike	*Lanius ludovicianus*
Black Skimmer	*Rynchops niger*
Sparrow, Henslow's	*Ammodramus henslowii*
Common Tern[BR]	*Sterna hirundo*
Forster's Tern[BR]	*Sterna forsteri*
Least Tern	*Sterna antillarum*
Cerulean Warbler	*Dendroica cerulea*
Hooded Warbler[BR]	*Wilsonia citrina*
Swainson's Warbler	*Limnothlypis swainsonii*
Red-headed Woodpecker	*Melanerpes erythrocephalus*
Sedge Wren	*Cistothorus platensis*

Fish

Common Name	Scientific Name
Atlantic Sturgeon	*Acipenser oxyrhynchus*

Insects

Common Name	Scientific Name
Little White Tiger Beetle	*Cicindela lepida*
White Tiger Beetle	*Cicindela dorsalis*
Seth Forest Scavenger Beetle	*Hydrochus spp.*
Frosted Elfin	*Incisalia irus*
Bethany Firefly	*Photuris bethaniensis*
Hessel's Hairstreak	*Mitoura hesseli*
King's Hairstreak	*Satyrium kingi*
Rare Skipper	*Problema bulenta*
Mulberry Wing	*Poanes massasoit chermocki*

Mammals

Common Name	Scientific Name
Delmarva Fox Squirrel	*Sciurus niger cinereus*

Mollusks

Common Name	Scientific Name
Yellow Lampmussel	*Lampsilis cariosa*
Eastern Lampmussel	*Lampsilis radiata*
Dwarf Wedgemussel	*Alasmidonta heterodon*
Eastern Pondmussel	*Ligumia nasuta*
Brook Floater	*Alasmidonta varicosa*
Tidewater Mucket	*Leptodea ochracea*

Reptiles

Common Name	Scientific Name
Leatherback Sea Turtle	*Dermochelys coriacea*
Atlantic Ridley Sea Turtle	*Lepidochelys kempii*
Green Sea Turtle	*Chelonia mydas*
Loggerhead Sea Turtle	*Caretta caretta*
Bog Turtle	*Clemmys muhlenbergii*
Corn Snake	*Elaphe guttata guttata*

PERMIT APPLICATION FORM

For Subaqueous Lands, Wetlands, Marina and 401 Water Quality Certification Projects

State of Delaware
Department of Natural Resources
and Environmental Control
Division of Water Resources
Wetlands and Subaqueous Lands Section

DELAWARE DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL

DELAWARE
DIVISION OF WATER RESOURCES
Working for YOU to Provide "Clean Water for Today and Tomorrow"

Revised November, 2000

PERMIT APPLICATION FORM

FOR SUBAQUEOUS LANDS, WETLANDS, MARINA AND 401 WATER QUALITY CERTIFICATION PROJECTS

IS NOT AVALIABLE IN PDF FORMAT.

PLEASE CONTACT THE DEPARMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL, DIVISION OF WATER RESOURCES, WETLANDS AND SUBAQUEOUS LANDS SECTION TO OBTAIN THIS FORM.

PORT OF WILMINGTON

Background

The Port of Wilmington was purchased from the City of Wilmington by the State of Delaware in September 1995. The Diamond State Port Corporation (DSPC) was established as a public instrumentality of the State to own, operate, and maintain the Port. The Corporation's mission statement is:

> ***"To contribute to Delaware's economic vitality by sustaining and promoting the Port of Wilmington as a competitive and viable full service, multi-modal operation providing for the efficient, economic, and safe handling of cargo."***

The Port is an important part of the local and regional economy, generating over 4,000 jobs and contributing over $14 million in annual tax revenues to State and local governments.

The Port of Wilmington is situated on the southern bank of the Christina River, where it joins the Delaware River. Along the Delaware River, it is the major inland port closest to the Atlantic Ocean. The berthing facilities of the port consist of a marginal wharf (3,060 feet long), a floating berth for vehicles loading and unloading (510 feet long), and a tanker berth (960 feet long).

The Port services container, break-bulk, ro/ro and bulk commodities, through a combination of open storage areas and over 810,000 square feet of warehousing. The majority of the warehousing holds fruit and other chilled cargoes. In addition to the on-site storage, several commodities, including dry and liquid bulk products, as well as some ro/ro, are transferred off-site for storage by independent operators.

Dredging

The Wilmington Harbor includes a shipping channel approximately 6200 feet in length and 440 feet wide. A ship turning basin to the north side of the channel measures 2900 feet long and 320 feet wide.

The channel and turning basin are dredged to a depth of 38 feet from the Delaware River west for a distance of 4240 feet. The remainder of the channel is dredged to 35 feet. Approximately 1.1 million cubic yards of maintenance material are removed annually from the Christina River by the Corps of Engineers, Philadelphia District in order to maintain the depths necessary for ships using the Wilmington Marine Terminal. The dredging occurs on an eight or nine-month cycle, and is performed by contracted hydraulic pipeline dredges.

The Port of Wilmington dredges approximately 125,000 cubic yards of material annually between the Federal channel and their docking facilities. This dredging, like the Federal work, is performed by hydraulic pipeline dredges. The material is confined in the Federally owned sites at Wilmington Harbor. The Port pays the Corps a fee for private utilization of these areas.

Currently, two projects disposal areas, both Government owned, are available for the containment of

dredged material removed from the project. These sites are Wilmington Harbor (North) and Wilmington (South) disposal areas.

The table below reflects estimated capacity of each disposal area.

	Acres	Estimated Capacity (cu yd)	% Filled	Last yr. to be filled
Wilmington Harbor	145	3,500,000	90%	2005
Wilmington South	240	13,000,000	40%	2019

The Port is currently working with the Corps to investigate the feasibility of deepening the channel to 40 feet.

Recent costs to the Port of Wilmington for dredging and disposal have averaged $1.75 to $1.85 per cubic yard. This has generally equated to an expense of $225,000 per dredge cycle. It should be noted that this cost per cubic yard is extremely low compared to other ports.

Dredging Issues

1. With the impending loss of one disposal area, a replacement area or means for disposal of dredged material is essential to continued operations at the Port of Wilmington. The Corps of Engineers is currently evaluating alternatives for a new disposal area to replace Wilmington Harbor North. Informal discussions indicate that alternatives range from construction of a new upland confinement facility, to pumping dredged material a greater distance to existing Government-owned disposal sites. Depending upon the Corps' solution pursued, very significant cost impacts can accrue to the Port and the State of Delaware over many years.

2. Reduction in the rate of siltation in the Christina shipping channel can directly lead to reduced volumes requiring confinement in disposal areas and lengthen useful life of a facility. The Corps of Engineers is completing a hydrological study of current velocities, vectors, and other conditions which affect siltation in the Wilmington shipping channel. The purpose of this study is to determine whether cost-effective solutions may exist to reduce siltation.

Beneficial re-use of dredged material could also lead to reducing volumes contained in disposal areas. Beneficial re-use should be pursued as a means to lengthen the life of Wilmington Harbor disposal areas. The Corps of Engineers has done extensive research into dredged material re-use to include establishment of pilot programs. Additionally, private firms are involved in exploring this arena. Successful beneficial re-use would benefit the Port of Wilmington and could potentially become a revenue source.