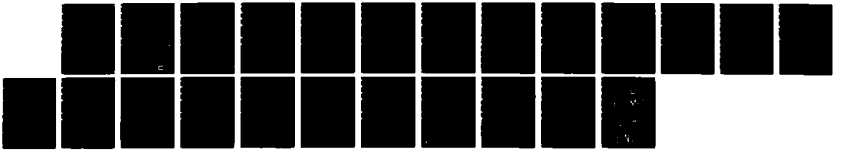
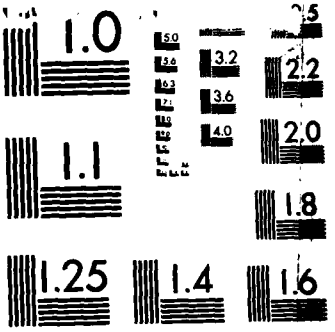
AD-A165 353 EVALUATION OF NORFOLK HARBOR DEEPENING PROJECT (A STUDY 1/1
ON ITS POSSIBLE I (U) VIRGINIA INST OF MARINE SCIENCE
GLOUCESTER POINT D S HAVEN 20 JUN 84 DACW65-84-M-0056
UNCLASSIFIED F/G 6/6 NL





Final Report

on

Evaluation of Norfolk Harbor Deepening Project

(A study on its possible impact on

Oysters, Hard Clams and Oyster Drills)

by

Dexter S. Haven

Virginia Institute of Marine Science

and

School of Marine Science

The College of William and Mary

Gloucester Point, Virginia 23062

20 June 1984

Contract No.

DACW65-84-M-0056

Norfolk Dist. Corp Engineers

US Army Corps Of Engineers
Norfolk District

Report B-14

Unclassified
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release, distribution unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	5. MONITORING ORGANIZATION REPORT NUMBER(S) B-14
6a. NAME OF PERFORMING ORGANIZATION Virginia Institute of Marine Science 6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION U.S. Army Corps of Engineers, Norfolk District
6c. ADDRESS (City, State, and ZIP Code) Gloucester Point, VA 23062	7b. ADDRESS (City, State, and ZIP Code) Norfolk, Virginia 23510-1096
8a. NAME OF FUNDING/SPONSORING ORGANIZATION U.S. Army Corps of Engineers, Norfolk District 8b. OFFICE SYMBOL (If applicable) NAOPL; NAOEN	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER DACW65 84 M-0056
8c. ADDRESS (City, State, and ZIP Code) Norfolk, Virginia 23510-1096	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO. / WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification)
Final Report on Evaluation of Norfolk Harbor Deepening Project (A Study on its Possible Impact on Oysters, Hard Clams, and Oyster Drills)

12. PERSONAL AUTHOR(S)
Haven, D.S.

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Final	FROM _____ TO _____	1984, June 20	22

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Norfolk Harbor Deepening, oysters, hard clams, oyster drills, environmental impact

19. ABSTRACT (Continue on reverse if necessary and identify by block number)
No impact to hard clams anticipated. No adverse impact is associated with channel deepening on drill distribution; MSX, or oyster nutrition, spawning, setting or growth.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☐ UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL Craig L. Seltzer	22b. TELEPHONE (Include Area Code) (804) 441-3767/827-3767 22c. OFFICE SYMBOL NAOPL-R

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted. All other editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE
Unclassified

INTRODUCTION

By letter dated 9 November 1982 we were requested by the U.S. Fish and Wildlife Service to evaluate the impact associated with the Corps of Engineers proposal to deepen the navigation channel from 45 to 55 feet in Lower Chesapeake Bay and Hampton Roads and to suggest possible mitagation procedures (Appendix A).

In response to this memorandum VIMS submitted a proposal to the Norfolk Corps of Engineers to evaluate this project for its possible impact. In this proposal (Appendix B) VIMS agreeded to evaluate the impact of dredging on oysters Crassostrea virginica, Hard Clams, Mercenaria mercenaria, and Oyster Drills, Urosalpinx cinerea. This study was to be completed on the basis of data supplied by the Corp of Engineers and the Fish and Wildlife Service.

The proposal submitted by VIMS was accepted by the Corps on 19 October, 1983 (Contract No. DACW65-84-M-0056).

METHODS

Sources of Data

Our analysis of the impact of channel deepening in the lower James River is based on three sources.

A. Technical Report HL-83-12; Norfolk Harbor and Channels Deepening Study Report 1. Physical Model Study - Chesapeake Bay Hydraulic Model Investigating by D. R. Richards, and M. R. Morton. Final Report, June 1983. Hydrographic data extracted from this report on the Steady State Velocity Tests appears in Table 1.

B. Salinity data from the above report (Part IV - Dynamic Salinity Testings) was utilized by the Fish and Wildlife Service along with data supplied by VIMS (Haven et al, 1981) related to the distribution of productive and unproductive areas of oyster grounds in the James River to develop computer-based maps which showed:

1) The maximum upriver extent of the 15 ppt. isohaline for base and plan conditions for spring, summer, fall and winter flows; and
2) Acreages of productive and unproductive areas of seed oyster grounds impacted under conditions outlined under the above (1) - (Table 2).

C. Ecological data on salinity tolerance and distribution of oyster was supplied to the Fish and Wildlife Service by VIMS (Table 3).

Aspects of the Ecology of Oysters, Oyster Drills, and Hard Clams used in the Evaluation of the Impact of Channel Deepening

Oysters

The James River, Virginia is the most important seed oyster growing area in the state, and today (as in the past) it produces from 75-85% of all the seed oysters planted on leased grounds in Virginia. Prior to 1960 production averaged from 1-2.7 million bushels annually. After 1960 annual harvest dropped and production ranged from about 400,000 to 800,000 bushels annually. The cause of this decline has been associated with the impact of Haplosporidium nelsoni (MSX) on the oyster and the oyster industry, and low demand for seed due to adverse economic conditions (Haven et al, 1978).

Oysters in the James River are widely tolerant to salinity changes, and growth and reproduction (spawning and setting) occurs over a range of from about 7.5 to 34 ppt, (Table 3).

A major reason why the James River is such a good seed producer is that oysters set therein (attach to shell substrate) in sufficient numbers to produce a volume of seed necessary to support the private oyster industry. Prior to setting, oyster larvae (originating from adults in the seed area) are planktonic for a period of about 2 weeks. During this time they are widely distributed by currents, but

sufficient numbers are usually retained within the James River by its unique circulation patterns to produce a new year class each year.

A major consideration in evaluating the impact of channel deepening on oyster populations in the James is the oyster disease MSX (H. nelsoni). This organism entered Chesapeake Bay in late 1959 and by late 1960 had killed most adult oysters in regions where fall salinities exceeded about 15 ppt. Its impact was especially severe in the lower James River (below the seed area) from Newport News Point to the mouth of the James (Andrews, 1962; Hargis, 1966; and Andrews, 1968).

The hydrography of the James is complex. In the lower layer the net movement of bottom water is upriver, while the surface layer has a net movement down estuary. However, on this relatively simple pattern is superimposed a complex system of counterclockwise currents in the lower and mid-sections of the seed area along with upwelling over the shallow seed rocks. Other major factors involve variation in neap-spring tidal velocities, etc.

It is not the purpose of this report to describe the complexities of the James River circulation, but it is important to note here that any significant modification of the system of circulation could in theory adversely impact on the transport of the larval oysters and hard clams during their planktonic stage.

Oysters and hard clams are widely tolerant to high salinity in respect to nutrition, spawning, attachment of larvae (setting) and

growth). Consequently, any changes noted in salinities in this report (HL-83-13) between base and plan conditions should have no adverse impact on these four parameters.

OYSTER DRILLS

A major predator on developing oysters and some adults in the lower James River is the Oyster Drill Urosalpinx cinerea. This gastropod kills oysters by boring a small hole through the shell and ingesting the meat inside. Prior to 1972, drills were present in the lower-most sections of the James River seed area. However, in 1972 almost all of them were killed by low salinities associated with Tropical Storm Agnes (Haven et al, 1978). However, since they may return (at some future date) to their old range, they must be considered here.

Oyster drills move slowly over the bottom and if killed in an area (as they were in 1972) it takes several years for population to become reestablished from a downriver source.

Oyster drills need a salinity range of about 12.5-34.0 ppt to grow and reproduce; salinities lower than about 10.0 ppt. are lethal (Table 2). However, in the James and elsewhere the upriver range of this species is controlled not by the average salinity or a slight increase in salinity as between base and plan, but by the low salinities which usually occur in late winter or early spring. For this reason no adverse impact is associated with channel deepening on drill distribution.

HARD CLAMS

Hard Clams Mercenaria mercenaria live in the James River from about Newport News Point downriver to the mouth of the estuary. As shown in Table 2 they are tolerant of high salinity. Hard clams are not susceptible to any known disease associated with salinity levels. For these reasons no adverse impact is expected due to a salinity increase associated with channel deepening on growth, spawning, nutrition, setting, and survival.

The larvae of the hard clam are planktonic for about 2 weeks and during this period are transported by currents. This latter aspect will be covered later in our discussion on oysters.

EVALUATION OF DATA

Steady State and Velocity Tests

Tests 1, 2, 3 and 4 in the Steady State and Velocity section (Richards and Morton, 1983) (Table 1) indicate that channel deepening will have no significant change on; 1) tide elevation; 2) tidal amplitudes; 3) tidal phasing.

An overall average decrease in velocity amplitude of about 0.13 fps was observed in the plan test, but this overall change (due to the increased cross section of the estuary due to deepening) will have no forseeable adverse impact on net larval transport. That is, it is difficult to see how a 0.10 fps decrease in maximum ebb and flood

velocities (due to deepening) could impact on net transport of larvae of oysters or hard clams.

On a theoretical basis a change in ebb or flood predominance could impact on transport of larvae of oysters and hard clams. In respect to this point the report (Richards and Morton, 1983) states:

"During the high discharge tests, the overall ebb predominance increases slightly. During the 70,000 cfs discharge tests, which represent the long-term average annual flow into Chesapeake Bay, the overall ebb predominance decreased slightly."

However, the report concludes:

"It should be mentioned, however, that the sampling stations represent a finite number of points and do not portray the entire cross sections. Other stations across the section, if they were sampled, might have refuted these observations".

On the basis of the preceeding statement there is no firm evidence that channel deepening will adversely impact net transport of larval oysters or hard clams in the seed area.

Dynamic Salinity Testing

Data extracted from this report and summarized by the contractor (Table 2) indicates that under plan conditions, the location of the 15

ppt isohaline will be moved upriver so it will cover the following additional acreage (over base) of productive oyster bottoms:

Spring	1760 acres
Summer	1210 acres
Fall	530 acres
Winter	1020 acres

An inspection of the report indicates that the magnitude of salinity changes are not large (Plates 222-236). In respect to this the report (P.69) states:

"In fact, outside of the Elizabeth River and the lower James channel areas, increases were rarely as great as 1 ppt for any tide or hydrograph tested."

However, the salinity changes noted above while small could theoretically have an impact on the oyster pathogen MSX and alter oyster drill distribution. In relation to this aspect, we have previously stated however, that the natural annual variations and the extreme flows generally occuring in spring, control drill populations (and not the average salinity). Therefore, we see no reason to indicate greater drill damage under the plan conditions.

There remains to be considered here the possible impact of MSX in relation to the slight salinity increase. For reasons given below however, we see no evidence which would suggest an adverse impact associated with channel deepening.

Our reasons follow:

A. Since 1960, MSX has been active in the lower James River below Newport News Point (from JG01 to about 1 mile above JN02). However, since 1960 when the disease first appeared until the present, it has not caused sigificant mortalities above this location (JN03-JN04). (Andrews, 1962; Haven, pers. comm.). During the long period (1960-1984) flows have fluctuated widely from very low during the 1960s, to wet periods in the late 1970s.

B. In the lower river where MSX is active its annual fluctuations in intensity are related to the natural changes in salinity which far exceed the changes between base and plan.

C. In relation to natural factors controlling MSX, a previous report on channel deepening in the upper James (Hargis, 1966) states:

> "Studies of MSX distribution....(In the James River)... indicate that low salinities in early sping.....control the upriver intrusion and lethality of MSX because oysters are able to "throw off" the pathogen when spring salinities fall to about 10 °/oo" (Hargis, 1966). That is, the impact of this disease on populations of oysters is lessened during the summer if overwintering stages of the disease are eliminated in spring by low salinities."

D. From the above we conclude that fluctuation in natural conditions (over the years) and especially during spring will largely govern the impact of MSX in the James River. That is, high flow

regimes of late winter and early spring will act to control MSX to a far greater extent than the small changes noted between base and plan.

POSSIBLE MITIGATING STEPS

In the event an impact is noted due to channel deepening there are certain procedures which may be taken.

1. Increase repletion activities by planting shells in the upper part of the estuary.

2. Decrease shell planting where MSX is active.

ADDENDUM

The Dynamic salinity testing was done only under a total Bay discharge of 70,000 cfs. This was the flow representation of a drought (low flow) period from 24 May 1963 to 17 August 1965. Therefore our analysis is based on these data, and it does not necessarily apply to higher flow conditions.

BIBLIOGRAPHY

Andrews, J. D. 1962. Oyster Mortality Studies in Virginia. IV. MSX in James River Public Seed Beds. Proc. Nat. Shellfish. Assoc. 53:(1962):65-84.

Andrews, J. D. 1968. Oyster Mortality Studies in Virginia. VII. Review of epizootiology and origin of Minchinia nelsoni. Proc. Nat. Shellfish Amer. 58(1967)823-36.

Hargis, W. J., Jr. 1966. Final Report on the Results of Operation James River (An evaluation of the Physical and Biological Effects of The Proposed James River Navigation Project). Spec. Rept. in App. Mar. Sci. and Ocean. Eng. The Va. Inst. Mar. Sci., Gloucester Point, Va.

Haven, D. S., W. J. Hargis, Jr. and P. C. Kendall. 1978. The Oyster Industry of Virginia: Its Status, Problems and Promise. VIMS Spec. Papers in Mar. Sci. No. 4. The Virginia Inst. Mar. Sci., Gloucester Point, Va.

Haven, D. S., J. P. Whitcomb and P. C. Kendall. 1981. The Present and Potential Productivity of the Baylor Grounds in Virginia. Vol. II. Va. Inst. Mar. Sci. and The College of William and Mary. Spec. Rept. No. 246 in App. Mar. Sci. and Ocean. Eng. Gloucester Point, Va. April 1981.

Richards, D. R. and M. R. Morton. 1983. Technical Report HL-83-12; Norfolk Harbor and Channels Deepening Study Report 1. Physical Model Study-Chesapeake Bay Hydraulic Investigation. U. S. Corp. Eng. Norfolk, Va.

Table 1

Summary of Corps Model Study Results

Tidal Amplitude

Test 1 - High flow (200,000 cfs) spring tide - there was an increase in tidal amplitude.

Test 2 - High flow (200,000 cfs) neap tide - there was a decrease in tidal amplitude.

Test 3 - Average Flow (70,000 cfs) spring tide - there was a decrease in tidal amplitude

Test 4 - Average Flow (70,000 cfs) neap tide - there was no change in tidal amplitude.

WATER LEVELS

No change seen in Bay water levels.

TIDAL PHASING

No change noted.

VELOCITY PHASING

Changes noted in Elizabeth River at confluence of East and Southwestern branches - plan arrived earlier than base.

VELOCITY AMPLITUDE

There will be a decrease in plan overall of about 0.13 f/s.

At the entrance to the James River (JG01) there is a decrease at the out-of-channel stations, and an increase in bottom of channel. This is apparently due to redistribution of flow patterns at the mouth of the James River.

MEAN VELOCITIES

As a whole there is no change in mean current velocities. Station showing an increase in velocity and JG 0103 at 22-66 ft. and JN0204 at 48 ft.

MAXIMUM EBB AND FLOOD VELOCITIES

There will be an overall decrease in these velocities after deepening due to an increased cross sectional area.

FLOW PREDOMINANCE

In general pertinent changes for oysters, hard clams and oyster drills are as follows:

1. An increase in ebb predominance during high flow conditions.

2. A decrease in ebb predominance during average flow conditions.

Table 2

Additonal Acres of Productive and Unproductive Oyster Bottoms in the James River which would be impacted if the 15 ppt. isohaline was moved upestuary under the proposed Channel deepening.

	Productive Oyster Bottom	Non Productive Oyster Bottom	Total
Spring	1760	440	2200
Summer	1210	100	1310
Fall	530	250	780
Winter	1020	220	1240

Table 3

Biological data supplied by VIMS to the Fish and Wildlife Service on depths, salinity and substrate requirements of various species. There data were used by the Fish and Wildlife Service to determine range of various species in the James River, Virginia in relation to salinity changes.

Oysters

Depth Range = 0 - 30 ft.

Salinity Range = 7.5 - 34 ppt.

Substrate Range = All types where suitable hard bottoms exist

Oyster Drills

Depth Range = 0 - 30 ft.

Salinity Range = 12.5 - 34 ppt.

Substrate Range = all types where suitable hard bottom exists

Hard Clams

Depth Range = 3 - 49 ft.

Salinity = 17 - 34 ppt

Range (reproductive) = 17 - 34 ppt

Substrate = Sand, Muddy Sand and Sandy Clay

APPENDIX

memorandum

DATE: November 9, 1982

REPLY TO ATTN OF: Karen Mayne
U.S. Fish & Wildlife Service

SUBJECT: Proposed Contract to Evaluate the Norfolk Harbor Deepening Project

TO: Dexter Haven
VIMS

This will confirm our conversation of November 8th regarding your participation in an evaluation of impacts associated with the Corps of Engineers proposal to deepen the navigation channels in the lower Chesapeake Bay and Hampton Roads from 45 to 55 feet.

The Norfolk District Corps of Engineers has used their hydraulic model of the Chesapeake Bay at Matapeake, Maryland to predict the hydrodynamic and salinity changes which could occur if the channels are deepened. The Fish and Wildlife Service will use the information from the Corps' model, along with resource information, in our computerized Map Overlay Statistical System to evaluate the impacts of the predicted salinity changes on the aquatic resources of the lower Chesapeake Bay and James River.

We are requesting that you analyze the salinity and affected resource information and provide an evaluation of the extent and significance of the predicted salinity changes on oysters and hard clams, as well as measures that could mitigate any significant adverse effects. We will provide you with maps showing the location and acreage of the areas where salinity changes will occur and the Corps report on the hydrodynamic model results. We would anticipate providing you with this information in April and would expect a written report within one month of your receipt of the information.

This memo will serve to solicit a bid from VIMS for the costs of your services to provide such an evaluation. The contract would be issued by the Corps of Engineers; however, the Fish and Wildlife Service will participate in writing the scope of work and monitoring the contract. The contract will be sole source.

If the proposed work is acceptable to you and VIMS, I suggest that we discuss the scope of work and the amount of the contract as soon as possible so that I can pass the information on to the Corps.

Karen L. Mayne

A Proposal Submitted to

Norfolk District Corps of Engineers
803 Front Street
Norfolk Virginia 23510

by

Virginia Institute of Marine Science
of the College of William and Mary
Gloucester Point, Virginia 23062

entitled

"Evaluation of the Norfolk Harbor Deepening Project"

Proposed Duration: One month
Amount Requested: $2,166.00

Dexter S. Haven
Professor, Fisheries
Principal Investigator

Herbert M. Austin, Ph. D.
Department of Fisheries Science

Frank O. Perkins, Ph. D.
Dean/Director

George C. Grant, Ph. D.
Division of Fisheries & Biological
Oceanography

Thomas J. Kuchinka
Associate Director for
Finance and Administration

Project Proposal

Evaluate the Norfolk Harbor Deepening Project

Introduction

I have been requested by memoranda dated November 9 and December 6 1982 (attached) to evaluate "The Norfolk Harbor Deepening Project".

Scope of Work

The Corps of Engineers and the U. S. Fish and Wildlife Service will provide the results of the Corps of Engineers' hydraulic model test on salinity, currents and tides as well as maps showing the location and extent of salinity changes in the study area. We will accomplish the following job on the basis of written material, charts and tables supplied:

1. Analyze and provide a written report on the effect of salinity changes on the oyster and hard clam resources of the James River and lower Chesapeake Bay predicted to result from the proposed deepening of navigation channels.
2. Suggest measures that could mitigate any significant adverse effects on these resources.

Starting and completion dates

The work will begin as soon as VIMS is supplied with all the material to be evaluated, and the report will be submitted within one month.

DTIC

FILMED

4-86

END