FINAL REPORT TO THE WORCESTER COUNTY COMMISSIONERS OF THE WEST OCEAN CITY DRAINAGE SURVEY

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NOVEMBER 1987

BAY COUNTRY CONSULTANTS

Maryland. Coastal Zone Management Program
TL977.M3 F56 1987 c.1

Funding for the

WEST OCEAN CITY

DRAINAGE STUDY

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National Ocean & Atmospheric Administration
U.S. Dept. of Commerce

was made jointly by

Maryland Department of Natural Resources
Water Resources Administration

and

National Oceanic and Atmospheric Administration
Office of Coastal Resources Management

CONTENTS

INTRODUCTION

Worcester County, in its efforts to grow and develop its economic base, has established through zoning laws and site improvement, West Ocean City as a prime development area within the county.

Recently the Ocean City Sanitary District was expanded to encompass approximately 2500 acres west of the Isle of Wight Bay. **EXHIBIT 1.1** shows a map of this area known as the West Ocean City Sanitary Service Area. After construction of the sanitary sewer was completed, the prime concerns became property drainage and safeguarding the environment. One hundred percent (100%) development, which is the projection for West Ocean City, would necessarily increase flooding potential and therewith encompass greater danger to property and life. Environmental parameters also concerned include effects on water quality, sedimentation and storm water control. Loss of or pollution of valuable fish and wildlife habitats is also generally the "norm" with rapidly growing urban areas throughout the country.

For these reasons this study was enacted and titled the "West Ocean City Drainage Survey." The exact purpose of this report is to assist the planners and policy makers of Worcester County to develop and implement programs to accomplish the following goals:

1) Identify the current drainage problems and project how they will be affected by 100% urbanized development of the area.
2) List and discuss alternative systems to eliminate, to the fullest extent possible, the hazards of flooding while allowing the fullest development possbile.
3) Develop plans to ensure that proper and necessary environmental safeguards are responsibly dealt with.

I. THE STUDY AREA IN OVERVIEW

The purpose of this section of the report is to present the data which describes the study area and its developability as it currently exists.

EXHIBIT 1.1 is titled the Base Map and shows the overall area as studied in its entirety.

EXHIBIT 1.2 overlays the Base Map with a Tidal Wetlands Map. There are approximately 500 acres of tidal wetlands in the study area. These lands may not be altered without permit, as they are protected by state and federal law. Therefore, they are not considered to be developable in this report.

EXHIBIT 1.3 overlays the Base Map with an Interior Wetlands Map. Interior Wetlands are described by the U.S. Army Corps of Engineers as an.."area that has hydric soil, a hydrologic connection to surface or groundwater, and a predominance of hydrophytic vegetation."

These Interior Wetlands are also considered to be waters of the United States and all planned activities within them is regulated by the Clean Water Act Sections 401 and 404.

The Board of Supervisors for the Worcester Soil Conservation District has established a policy whereas any plans for development in these areas will not receive a sediment and erosion control or storm water management approval without documentation of such determination by either or both the Corps of Engineers and the Water Quality Certification Program of the Maryland Department of the Environment as to the permissibility of said development. There are approximately 230 acres of Interior Wetlands within the bounds of the study area.

EXHIBIT 1.4 shows a map compiled from two (2) maps published by the National Flood Insurance Program of the United States Department of Housing and Urban Development. They are the Flood Boundary and Floodway Maps (panel numbers 240083 0050A & 240083 0125A effective date February, 1979). This map shows areas prone to flooding during both 100 year and 500 year storm extents. Insurance study reports and maps are primarily used to determine flood insurance premiums and selling policies by brokers. Though insurance against flood damage is available, it is not mandated that the owner purchase or maintain it. Generally the lienholder of the property will elect to require insurance and federally insured banks must require it by law, as long as the lien is in effect only.

EXHIBIT 1.5 is a map which delineates existing zoning classifications and boundaries. These classifications include:

A-1 Agricultural District

R-1 Rural Residential District

R-3 Multi-Family Residential District

R-4 Hotel/Motel District

R-5 General Residential District

B-1 Neighborhood Business District

B-2 General Business District

M-1 Light Industrial District

EXHIBIT 1.6 overlays the Base Map and shows the current land use. It is shown as having:

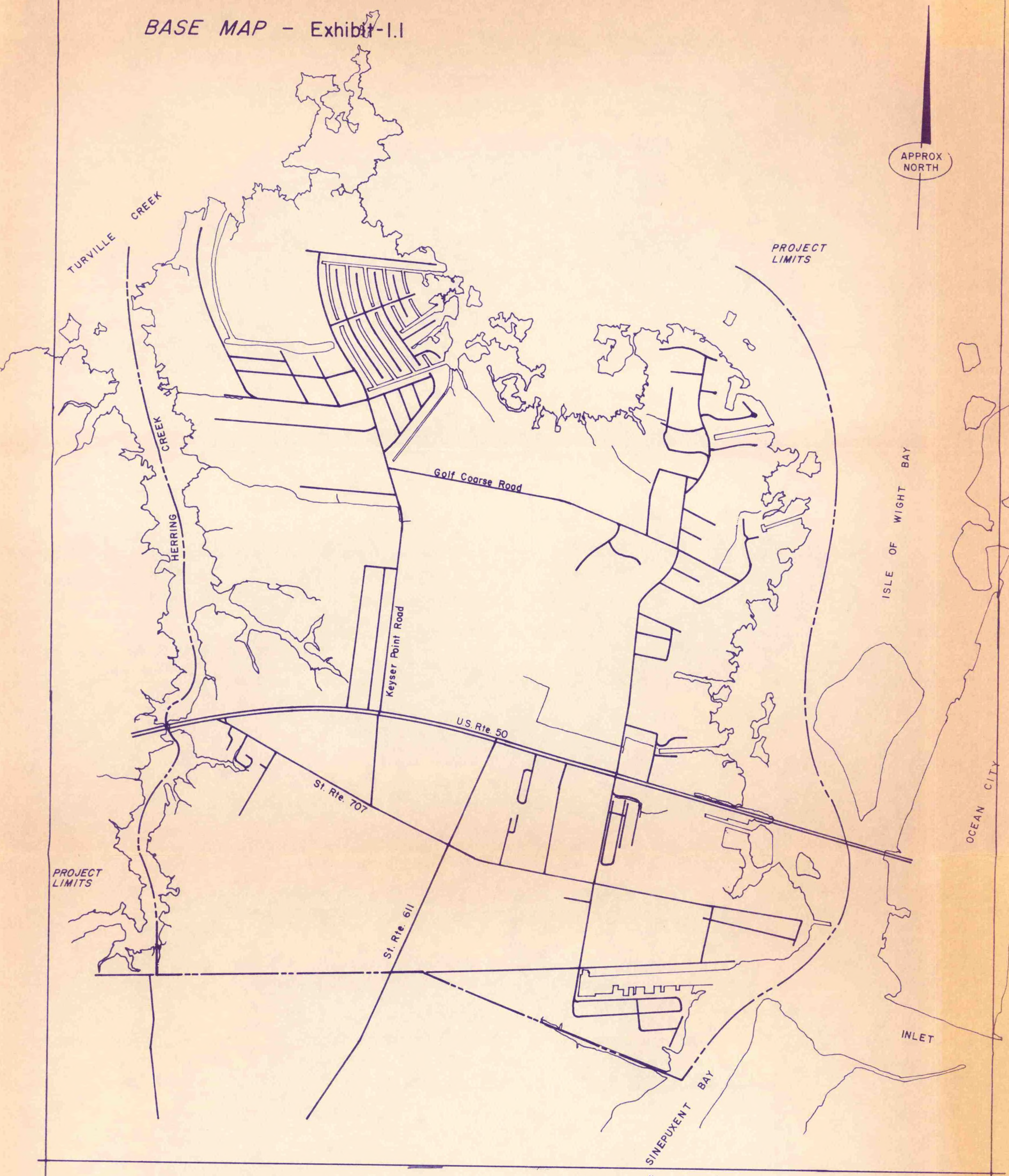
1. Tidal Marsh
2. Wooded
3. Residential
4. Commercial
5. Cultivated and idle

Also shown on this exhibit are the watershed boundaries (see section 4).

EXHIBIT 1.7 is a compiled United States Department of Agriculture, Soil Conservation Service (USDA SCS) Soil Map showing the soil groups we are dealing with in the study area. Attached to this exhibit you will find a list and explanation of the abbreviations used thereon.

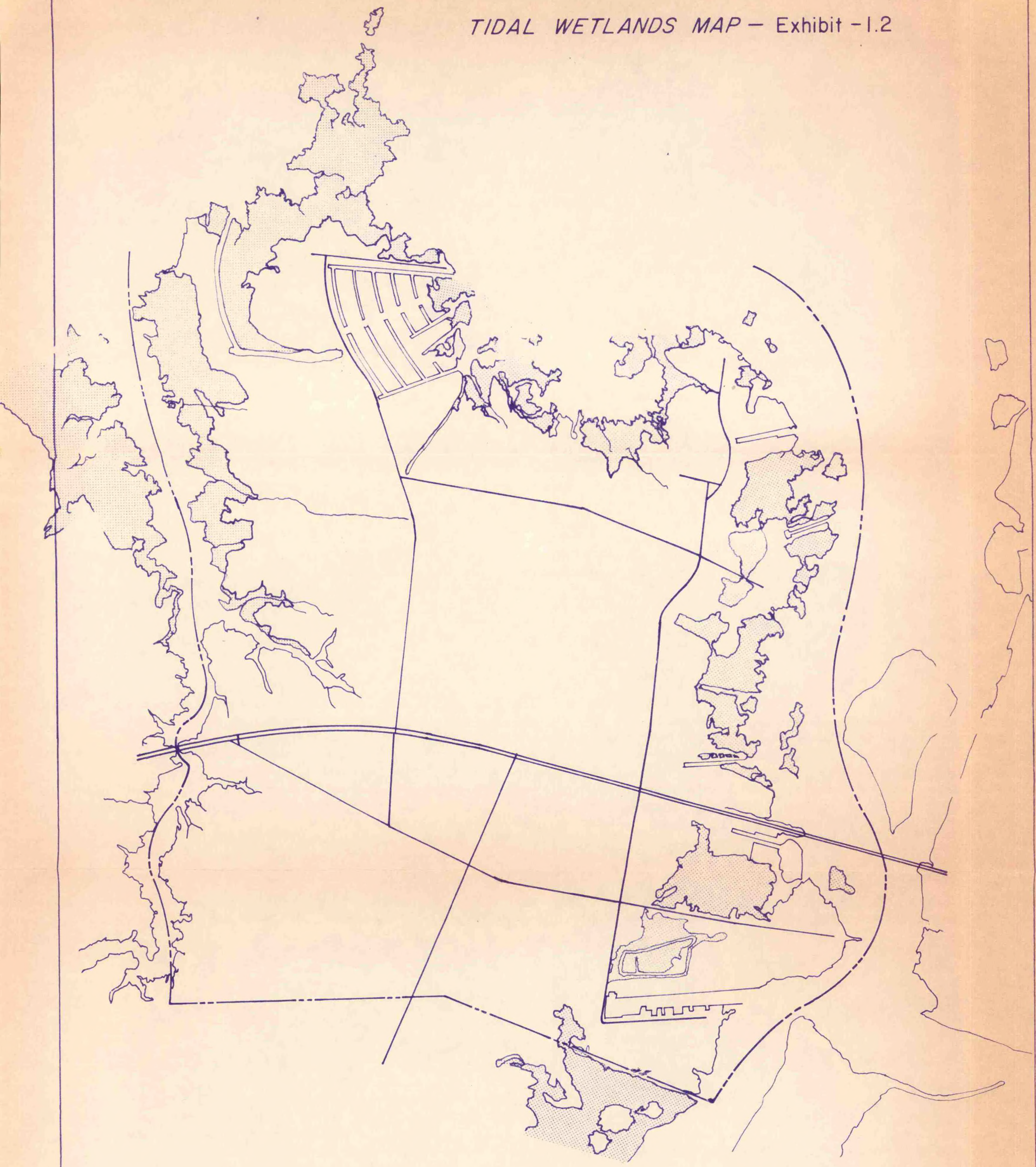
BASE MAP

BASE MAP - Exhibit-1.1



SCALE : 1" = 1320'

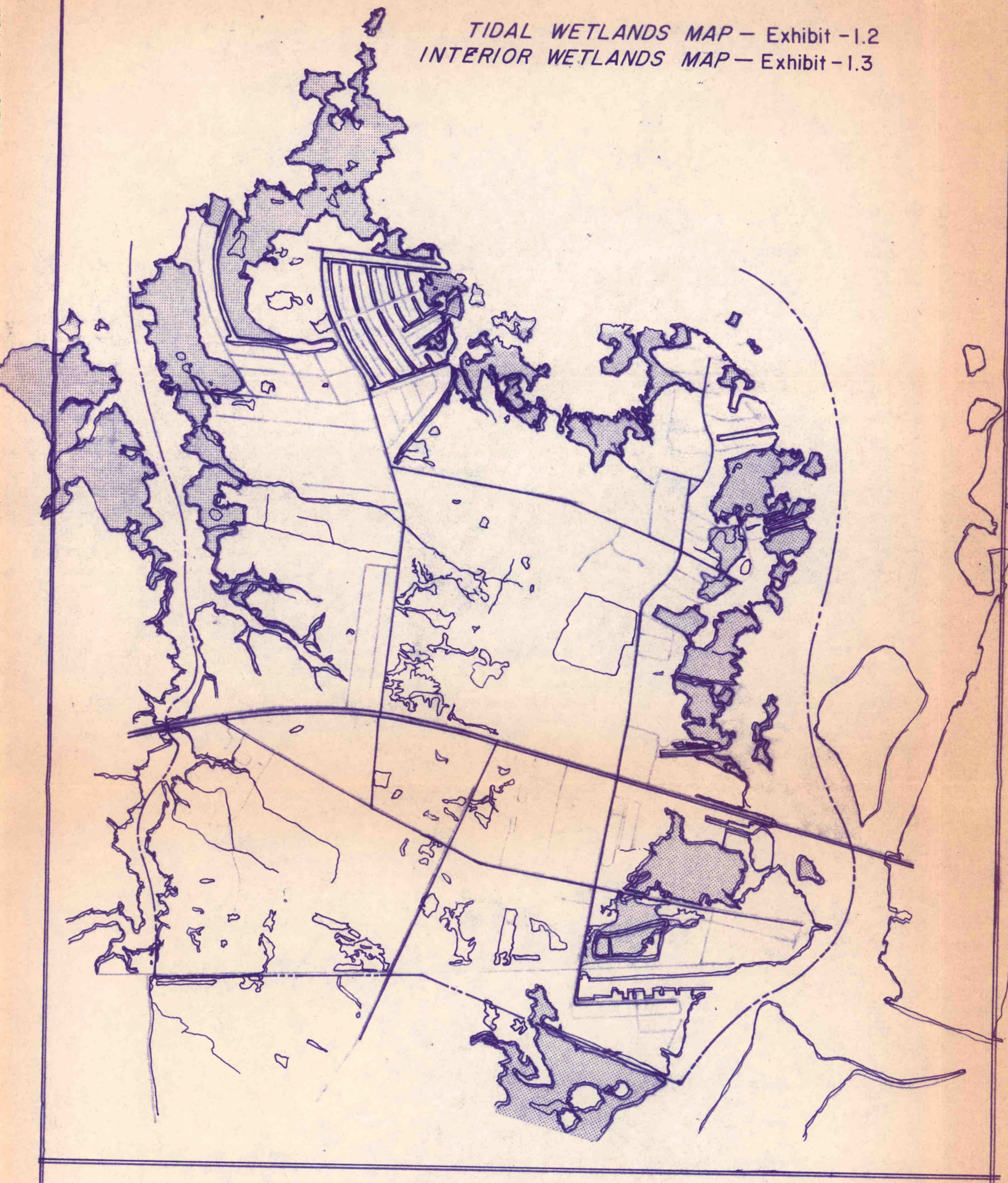
TIDAL WETLANDS MAP — Exhibit -1.2



INDICATES TIDAL MARSH

TIDAL WETLANDS

TIDAL WETLANDS MAP — Exhibit - 1.2
INTERIOR WETLANDS MAP — Exhibit - 1.3

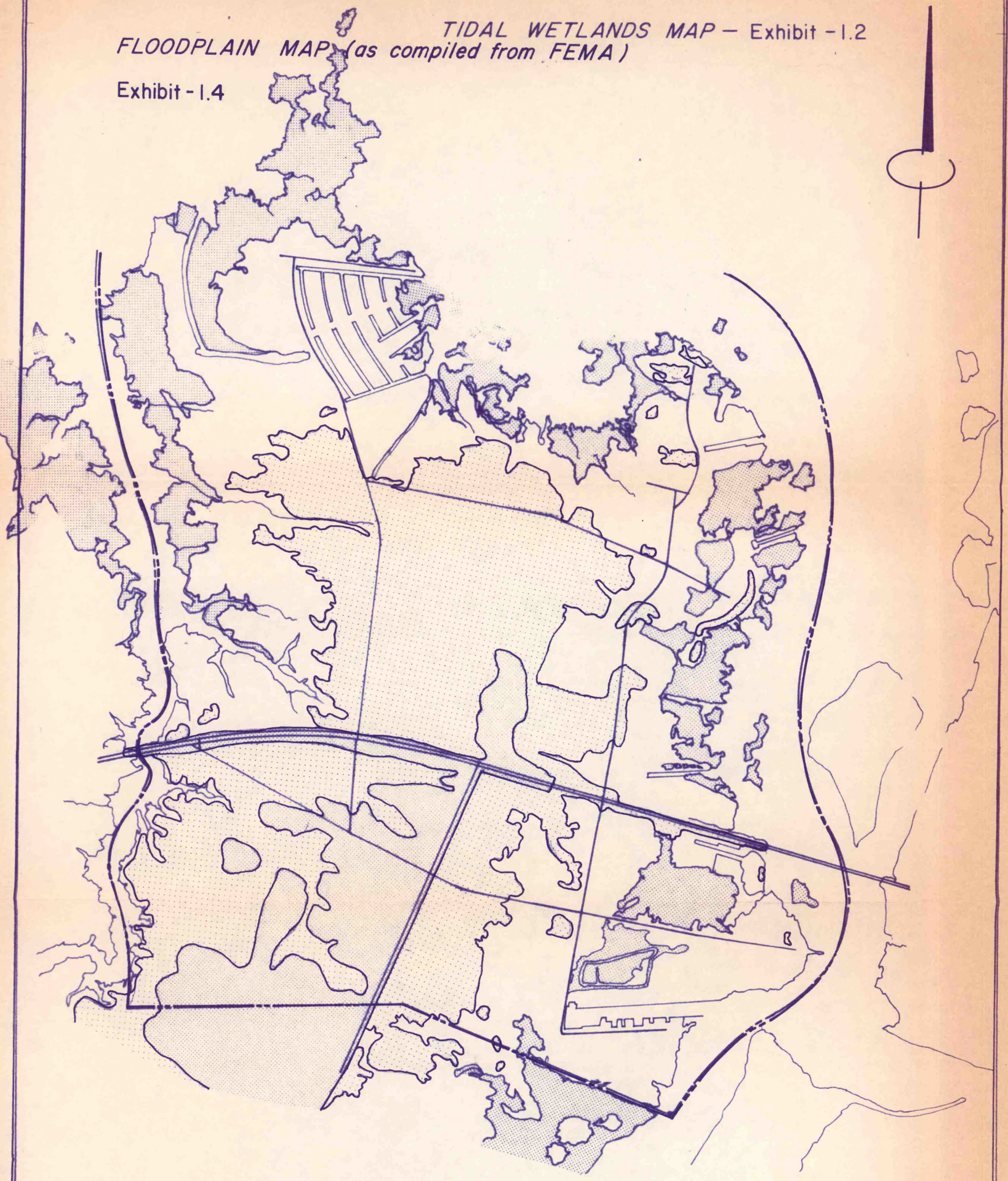


INDICATES TIDAL MARSH

FLOODPLAIN MAP (as compiled from FEMA)

Exhibit - 1.4

TIDAL WETLANDS MAP — Exhibit - 1.2



INDICATES ZONE A ; areas of 100 year flood

INDICATES ZONE B ; areas between 100 and 500 year flood

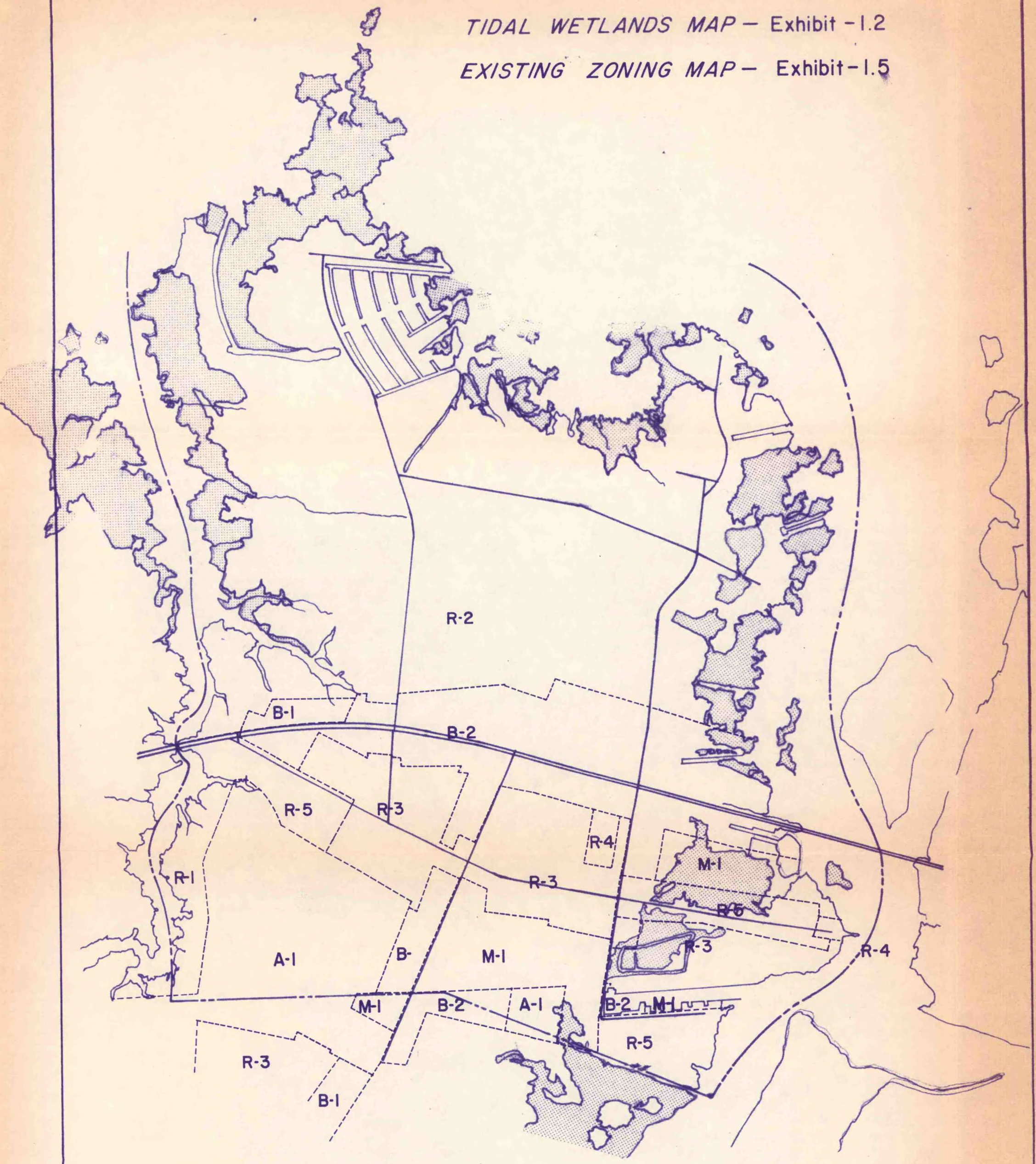
INDICATES ZONE C ; areas of minimal flooding

INDICATES TIDAL MARSH

EXISTING ZONING TIDAL WETLANDS

TIDAL WETLANDS MAP – Exhibit - 1.2

EXISTING ZONING MAP – Exhibit - 1.5



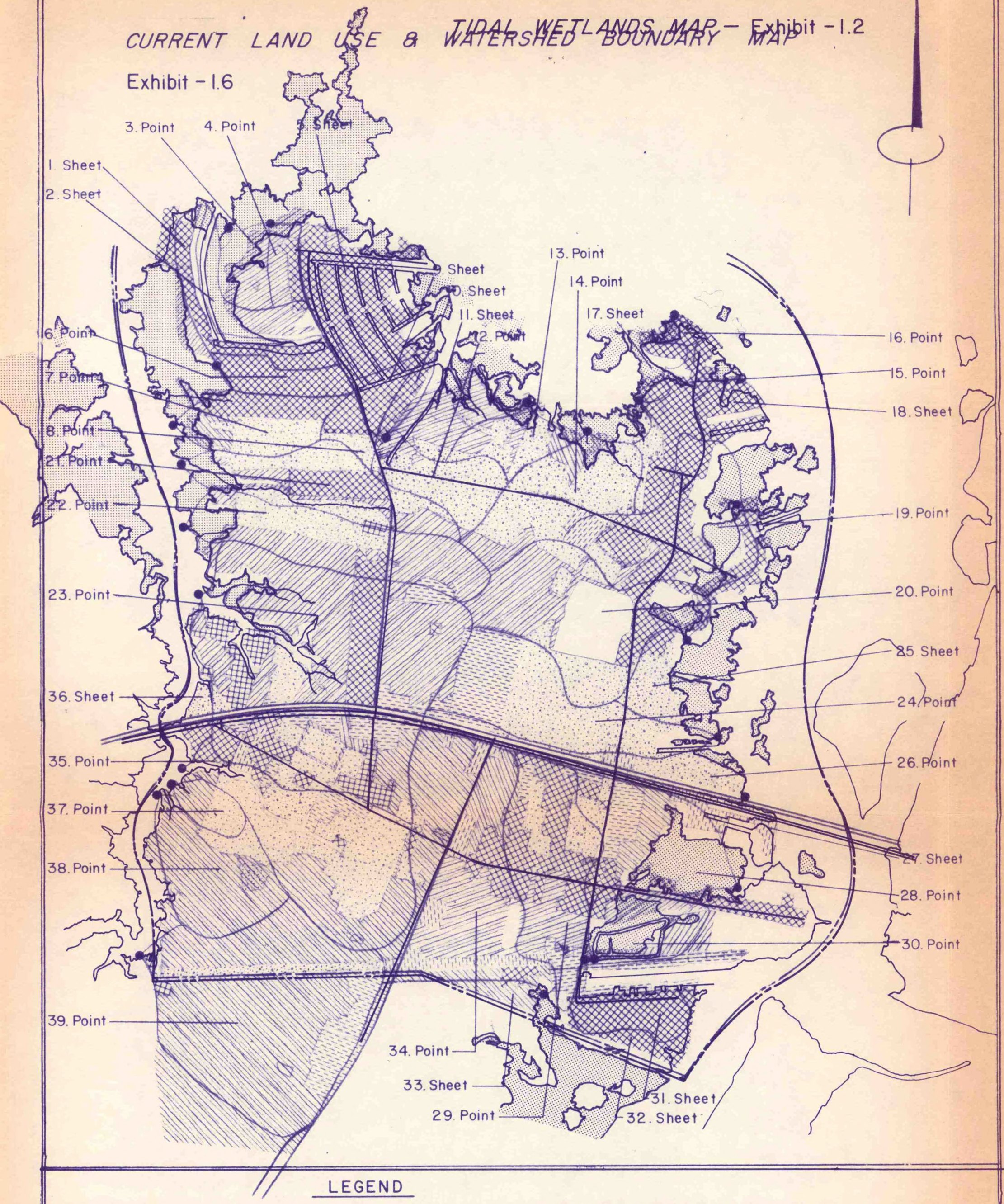
INDICATES TIDAL MARSH

TIDAL WETLANDS 1.2

CURRENT LAND USE & WATERSHED BOUNDARY MAP

Exhibit - 1.6

TIDAL WETLANDS MAP - Exhibit - 1.2



LEGEND

- INDICATES LANDS EXHIBITING COMMERCIAL LAND CHARACTERISTICS.
- INDICATES LANDS IN RESIDENTIAL USEAGE
- INDICATES CULTIVATED OR OPEN LANDS
- INDICATES WOODED LANDS
- **INDICATES TIDAL MARSH**
- INDICATES POINT OF DISCHARGE OR OF MAJOR CONSTRICTION
- 29. Point (LABELING SAMPLE)
  - TYPE OF DISCHARGE
  - WATERSHED NAME

S.C.S. SOIL MAP — Exhibit - I.7

MAP DESIGNATION	SOIL CLASSIFICATION	HYDROLOGIC SOIL GROUP
Tm	Tidal Marsh	-
WdA	Woodstown Sandy Loam, 0 to 2% slopes	C
Ma	Made land (characteristics too variable to classify)	Avg.C
Fa	Fallsington Sandy Loam	D
WdB	Woodstown Sandy Loam, 2 to 5% slopes	C
Fg	Fallsington Loam	D
SaB2	Sassafras Sandy Loam, 2 to 5% slopes	B
CbB	Coastal Beaches, 0 to 5% slopes	A
SaA	Sassafras Sandy Loam, 0 to 2% slopes	B
Pm	Pocomoke Loam	D
MpA	Mattapex Loam, 0 to 2% slopes	C
MdB	Matapeake Fine Sandy Loam, 2 to 5% slopes	B
MoA	Mattapex Fine Sandy Loam, 0 to 2% slopes	C
Ot	Othello Silt Loam	D
LmB	Lakeland Loamy Sand, clayey substratum,	A
LkD	Lakeland Loamy Sand, 5 to 15% slopes	A
FmB	Fort Mott Loamy Sand, 2 to 5% slopes	B
Gb	Gravel and Borrow Pits	-
MtA	Mattapex Silt Loam, 0 to 2% slopes	C

HYDROLOGIC SOIL GROUPS

INTRODUCTION

Each soil is placed into one of four groups according to the rate of surface infiltration of water, when the entire soil is thoroughly wetted. Infiltration under thoroughly wetted conditions is correlated positively with internal transmission of water, and thus negatively with runoff potential. Infiltration and transmission of water is not the same as permeability. For instance, a rapidly permeable soil, such as Plummer, will have a very slow infiltration and transmission rate when thoroughly wetted because of a stagnant water table. Descriptions of the different hydrologic soil groups are as follows:

Group A — Soils having high infiltration rates even when thoroughly wetted, consisting chiefly of deep, well to excessively drained sands and/or gravels. These soils have a high rate of water transmission and would result in a low runoff potential.

Group B — Soils having moderate infiltration rates when thoroughly wetted, consisting chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission and a moderate runoff potential.

Group C — Soils having a slow infiltration rate when thoroughly wetted, consisting chiefly of (1) soils with a layer that impedes the downward movement of water, or (2) soils with moderately fine texture and a slow infiltration rate. These soils have a slow rate of water transmission and a high runoff potential.

Group D — Soils having very slow infiltration rates when thoroughly wetted, consisting chiefly of (1) clay soils with a high swelling potential; (2) soils with a high permanent water table; (3) soils with claypan or clay layer near the surface; and (4) shallow soils over nearly impervious materials. These soils have a very slow rate of water transmission and a very high runoff potential.

II. WATER COURSES AND SURROUNDING LANDS

The West Ocean City Drainage Survey Area is bounded by major water courses on three sides, as can be noted on the Base Map **EXHIBIT 1.1.** to the West by Herring Creek; to the North by Turville Creek; and both the Sinepuxent and Isle of Wight Bays to the East. All of these waterways are subject to the ebb and flow of the Atlantic Ocean through the Ocean City Inlet, also shown on the Base Map. It must be noted that, constriction of these waters at any point may cause increased flooding during a major storm event, the severity of which would be upwardly proportional to the scope of the constriction. Also surface runoff from the surrounding lands into these waterways will add to their volume and so compound the problems of West Ocean City. A similar drainage study of these outside areas would indeed be beneficial to the county. Reference to (1) "Flood Insurance Study, Worc. Co. MD (unincorporated areas)" published by the U.S. Department of Housing and Urban Development, Federal Insurance Administration in August of 1978; and (2) "Potential Impacts of Sea Level Rise on the Beach at Ocean City, Maryland" published by the U.S. Environmental Protection Agency in October, 1985, for additional information.

III. INDIVIDUALIZING THE WATERSHEDS

The methodology used in determining the watersheds was in two parts:

A. Existing Maps

Using aerial infared photographs dated 3/28/82 a Base map was developed showing drainage courses and restrictions throughout the study area. Then USDA SCS Soil maps dated 1966 were incorporated to draw contours using general knowledge of the relative elevations of various soil types. These contours define the boundaries of the watersheds. Finally, U.S. Department of the Interior Wetland Maps were used to further define wetlands through the area. These maps were dated 1983.

B. Field Inspection

Development has altered the face of the study area since the above referenced maps were last updated creating areas without adequate data or coverage using the existing mapping method. Therefore, a joint effort was made by the Soil Conservation Service, Worcester District Office and Bay Country Consultants to conduct a topographic survey. By surveying major cross sections throughout the study area, sufficient data was accumulated to verify watershed delineation as well as defining the outlets of each. Specific data and photographs were taken in the field and will be presented in this report under the heading of the corresponding watershed label (see Section VIII).

IV. TR-55 CALCULATIONS & SUMMARIES OF EXISTING CONDITIONS

In June of 1986 the United States Department of Agriculture Soil Conservation Service issued the second edition of "Urban Hydrology for Small Watersheds" Technical Release 55. This release presents the currently accepted procedures for calculating storm runoff volume, time of concentration and time of travel, and peak rate of discharge. This method was used with the variables accumulated as described in Section III to generate with computers the following calculations. For the purposes of this study, the West Ocean City Drainage Survey Area has been divided into 39 major watersheds. **EXHIBIT 1.6** maps and labels these watersheds as well as delineates current land usage.

(See Appendix A to review TR-55 Pre-Development Calculation Sheets)

V. REVIEW OF GOVERNMENTAL POLICIES

Federal Level

In order to ascertain federal policy concerning the development of West Ocean City, interviews were made either in person or via telephone conversations with persons representing each of the following governmental agencies:

1. United States Department of the Interior
2. United States Department of Commerce

   National Marine Fisheries

   a. Merchant Marine and Fisheries - Full Committee

   b. Fisheries and Wildlife - Sub Committee

   c. Fish and Wildlife Service

   d. National Wetlands Protection Division

   e. Habitat Conservation Branch
3. United States Department of the Army:

   Army Corps of Engineers
4. Soil Conservation Service

Through these interviews, it was determined that the Army Corps of Engineers is the primary regulatory agency involved with the development by permit or protection of wetlands and waters of the United States by authority of the Clean Water Act. A quote from the Federal Register/Vol. 51, No. 219/November 13, 1986 reads as follows:

"Part 320 - General Regulatory Policies

.....Authority: 33 U.S.C. 401 et seq.: 33 U.S.C. 1344: 33 U.S.C. 1413.

Purpose and scope.

.....The Corps has authorized its district engineers to issue formal determinations concerning the applicability of the Clean Water Act or the Rivers and Harbors Act of 1899 to activities or tracts of land and the applicability of general permits or statutory exemptions to proposed activities. A determination pursuant to this authorization shall constitute a Corps final agency action..."

Authorities to issue permits.

Section 404 of the Clean Water Act (33 U.S.C. 1344)

Section 9 of the Rivers and Harbors Act...(33 U.S.C. 401)

Section 10 of the Rivers and Harbors Act...(33 U.S.C. 403)

Section 11 of the Rivers and Harbors Act...(33 U.S.C. 404)

Section 13 of the Rivers and Harbors Act...(33 U.S.C. 1344)"

Related Laws.

Section 401 of the Clean Water Act...(33 U.S.C. 1341)

Section 307 (C) of the Coastal Zone Management Act of 1972, as amended...(16 U.S.C. 1456 (C)

Section 302 of the Marine Protection, Research and Sanctuaries Act of 1972, as amended...(16 U.S.C. 1432)

The National Environmental Policy Act of 1969...(42 U.S.C. 4321-4347)

The Fish and Wildlife Act of 1956...(16 U.S.C. 742a, et seq.)

The Migratory Marine Game-Fish Act...(16 U.S.C. 760c - 760q)

The Fish and Wildlife Coordination Act...(16 U.S.C. 661 - 666c)

The Federal Power Act of 1920...(16 U.S.C. 791a et seq.)

The National Historic Preservation Act of 1966...(16 U.S.C. 470)

The Interstate Land Sales Full Disclosure Act...(15 U.S. C. 1701 et seq.)

The Endangered Species Act...(16 U.S.C. 1531 et seq.)

Section 7 (a) of the Wild and Scenic Rivers Act...(16 U.S.C. 1278 et seq.)

Section 402 of the Clean Water Act...(33 U.S.C. 1342)

The Federal Register/Vol. 46, No. 15/January 23, 1981 reviews the final policy set forth by the Department of the Interior Fish and Wildlife Service under the heading of U.S. Fish and Wildlife Service Mitigation Policy.

A quote from the general policy reads:

"...in the interest of serving the public, it is the policy of the U.S. Fish and Wildlife Service to seek to mitigate losses of fish, wildlife, their habitats, and uses thereof from land and water developments."

Authority for this policy comes mainly from the following four sources:

Fish and Wildlife Act of 1956...(16 U.S,.C. 742(a) - 754)

Fish and Wildlife Coordination Act...(16 U.S.C. 661 - 667(e)

Watershed Protection and Flood Prevention Act

...(16 U.S.C. 1001 -1009)

National Environmental Policy Act of 1969...(42 U.S.C. 4321 - 4347)

Federal activities occurring in Maryland's Coastal Zone, including the issuance of U.S. Army Corps of Engineers permits, must be determined to be consistent with the Coastal Zone Management Program. Although made by the State, this determination is incorporated in the COE permit review process.

The Corps of engineers interprets the Clean Water Act as describing Interior Wetlands as well as Tidal Wetlands as being necessary and valuable waters of the United States. To alter these wetlands without all required permits is illegal and must either be completely restored or go through a mitigation process.

A telephone conversation with Rod Schwarm of the Corps of Engineers on July 27th 1987 confirmed their position that Interior Wetlands as described in Section 2 of this report are also protected by the Clean Water Act.

As an example of this policy reference can be made to an Interior Wetland Unit located to the East of Keyser Point Road which is currently under scrutiny for three reasons:

1) It was witnessed and documented as being an Interior Wetlands Unit, by the Corps of Engineers, the Department of Natural Resources, Maryland Department of the Environment and the Soil Conservation Service in June of 1987.
2) On July 4th, 1987 a large part of it was destroyed by clearing and filling activities by a developer local to Worcester County without any of the required permits.
3) The Corps of Engineers is exercising their authority to force the developer to return the land in question, as closely as possible, to its original state.

STATE LEVEL

The State of Maryland Department of Natural Resources is a regulatory agency whose authority comes from the annotated code of Maryland; natural resources; Title 9. Subtitle 102 of Title 9 is a declaration of public policy.

An excerpt follows: "In many areas of the state much of the wetlands have been lost or despoiled by unregulated dredging, dumping, filling, and like activities, and the remaining wetlands are in jeopardy of being lost or despoiled by these and other activities. The loss or despoliation will affect adversely, if not eliminate entirely, the value of the wetlands as a source of nutrient to finfish, crustacea, and shellfish of significant economic value; the loss or despoliation will destroy the wetlands as a habitat for plants and animals of significant economic value and eliminate or substantially reduce marine commerce, recreation, and aesthetic enjoyment; in most cases, the loss or despoliation will affect the natural ability of tidal wetlands to reduce flood damage and affect adversely the public health and welfare; the loss or despoliation will reduce substantially the capacity of wetlands to absorb silt and result in increased silting of channel and harbor areas to the detriment of free navigation. It is therefore, the public policy of the state, taking into account varying ecological, economic, developmental, recreational, and aesthetic values, to preserve the wetlands and prevent their despoliation and destruction. (Annotated Code 1957, Art. 66C, & 718; 1973, 1st Sp. Sess., Ch. 4 & 1.)"

On July 1, 1987, Governor William Donald Schaefer created a new department to be called the Maryland Department of the Environment. **EXHIBIT 5.1** explains the Governor's new department and its responsibilities.

The authority for their regulatory function comes from Section 401 of the federal Clean Water Act, and from the Health-Environmental law of Maryland.

Prior to any developmental activities in state wetlands (i.e.: dredging, filling, building, watercourse change, etc.) a Water Quality Certification must be obtained from this office. (An application form for this is attached as **EXHIBIT 5.2.**) A Water Quality Certification shows compliance with the state's water quality standards which are codified in COMAR 10.50.01, Water Quality and Water Pollution Control Regulations.

The Office of Environmental Protection, prior to being segregated from the Maryland Department of Health and Mental Hygiene and placed in the new Maryland Department of the Environment, attached a "Consent Order" as a provision to the Federal and State Construction Grant Funding of the West Ocean City Sewerage Project. In a court action of 1987, Judge Eschenburg eliminated this attachment.

There is currently an appeal pending in the state court system designed to reinact this Consent Order. It is referenced here, should the Eschenburg decision be overturned.

Basically this document limits sewer service to the following criteria:

1) Only lots within the boundaries established as of March 1982 are eligible.

2) Undeveloped lots in the 100 year flood plain as published by Federal Emergency Management Agency (FEMA) are only eligible for service if they were platted prior to June 1, 1977; and planned to have a sewage flow of less than 280 gallons per day.

3) No structures being in a wetland as defined by the U.S. Fish and Wildlife Service are eligible for service.

There are other criteria and provisions of this document. The Maryland Department of the Environment holds this document for public review.

State of Maryland

DEPARTMENT OF THE ENVIRONMENT
201 WEST PRESTON STREET • BALTIMORE, MARYLAND 21201
AREA CODE 301 • 225-5747

William Donald Schaefer
Governor

Secretary

On July 1, 1987, the Maryland Department of the Environment will become the State's primary environmental protection agency. A bill signed into law by Governor William Donald Schaefer created the new Department by removing the Office of Environmental Programs (OEP) from the Department of Health and Mental Hygiene and combining it with certain programs from the Department of Natural Resources (DNR).

All existing programs in OEP's Air, Waste, and Water administrations will become part of the new Department, as will the three support groups--Administrative Services, Planning and Analysis, and the Science and Health Advisory Group. The Division of Radiation Control and the Noise Control Section, now in OEP's Community Health Program, will also join the Governor's newly-created operation. All other Community Health programs, including Food and Milk Control and Community Services, will remain in the Department of Health and Mental Hygiene.

Additionally, three key programs formerly in DNR will also become part of the new Department: the Oil Control Division, plus the Erosion and Sediment Control and Stormwater Management Programs.

For now, all programs in the Department of Environment will remain in their current locations. The Air (including Noise Control), Waste, and Water programs will be headquartered on the second floor of the O'Conor Building at 201 West Preston Street. Radiation Control will continue to be housed in the Hecht Company Towers at 118 North Howard Street, as will Water Management's Municipal and Construction Grants and Permits Program. Oil Control, Erosion and Sediment Control, and Stormwater Management will remain in the Tawes State Office Building in Annapolis.

In order to better serve you, a new Department receptionist (301-225-1250) will field calls from those of you unsure about whom to call. And, as always, the Public Affairs Office (301-225-5747) is ready to provide you with the right name and number when you need it.

We look forward to strengthening the excellent relationships we have today, and working together tomorrow to make Maryland's Environment a source of pride for all its citizens!

Exhibit 5.1

MARYLAND DEPARTMENT OF
HEALTH AND MENTAL HYGIENE

MARYLAND DEPARTMENT OF NATURAL RESOURCES
WATER RESOURCES ADMINISTRATION

STATE OF MARYLAND
WATER QUALITY CERTIFICATION AND WETLANDS ALTERATION APPLICATION

(301) 225-6293 (301) 269-3871

Under Section 401 of the Clean Water Act, the State of Maryland is required to issue a Water Quality Certification attendant to any federal permit for an activity which may result in a discharge to navigable waters or wetlands. This Water Quality Certification from the State certifies that the activity complies with State water quality standards or limitations. The information requested on this form is needed to initiate an evaluation of the water quality impact of the proposed activity.

The Wetlands Law (Section 9 of the Natural Resources Article of the **Annotated Code of Maryland**) requires property owners to obtain permission from the State of Maryland either through a Wetlands License issued by the State Board of Public Works and/or a Wetlands Permit or approval granted by the Department of Natural Resources before altering tidal wetlands.

One set of original drawings or good reproducible copies on 8½ x 11 inch paper which show the location and character of the proposed activity must be attached to this application and forwarded to **BOTH** the Department of Natural Resources, Water Resources Administration and Department of Health and Mental Hygiene, Office of Environmental Programs at the addresses indicated on the other side of this form. Submission of your application and drawings to both agencies should result in shorter processing times.

Any application that is not completed in full will be returned.

1. Certification No.
   Wetlands No.

   (For Agency Use Only)

2. NAME, ADDRESS OF APPLICANT

   Telephone Nos.

   A/C ( ) _____ (Residence)
   A/C ( ) _____ (Office)

3. NAME, ADDRESS, TITLE, AUTHORIZED AGENT

   Telephone Nos.
   A/C.( ) _____ (Residence)
   A/C.( ) _____ (Office)

Statement of Authorization: I hereby designate and authorize _____ to act in my behalf as my agent in the processing of this permit application and to furnish, upon request supplemental information in support of the application.

SIGNATURE OF APPLICANT DATE

Exhibit 5.2 A

4. DETAILED DESCRIPTION OF PROPOSED ACTIVITY

a. ACTIVITY - Structures to be erected, dredging, filling and dredged material disposal plans, etc.

b. PURPOSE AND INTENDED USE (private, public, commercial, other)

c. DISCHARGE OF DREDGED OR FILL MATERIAL - Date of expected discharge, filling or activity in wetlands: Type, composition and quantity of discharge or fill material:

If applicable, describe any equipment or facilities to treat this discharge, the degree of treatment to be attained and methods of monitoring the discharge: (If additional space is needed attach sheet with information)

5. NAMES AND ADDRESSES of Immediately Adjoining Property Owners, Leasees, etc. whose property also abuts the waterway.

6. WATERBODY & LOCATION ON WATERBODY WHERE ACTIVITY EXISTS OR IS PROPOSED: Indicate how to reach the site. (Street, road, route, etc.)

7. LOCAL GOVERNING JURISDICTION IN WHICH SITE IS LOCATED: (county or municipality)

8. SIGNATURE OF APPLICANT/PROPERTY OWNER DATE

9. SIGNATURE OF AGENT DATE

Application is hereby made for a Water Quality Certification and a Wetlands License/Permit to authorize the activities described herein. I certify that I am familiar with the information contained in this application, and that to the best of my knowledge and belief such information is true, complete and accurate. I further certify that I possess the authority to undertake the proposed activities or I am acting as the duly authorized agent of the applicant.

Send completed application and drawing to **BOTH:**

The Department of Health and Mental Hygiene
Office of Environmental Programs
Divison of Standards and Certification
201 West Preston St., P.O. Box 13387
Baltimore, Maryland 21201

The Department of Natural Resources
Water Resources Administration
Wetlands Division
Tawes State Office Building
Annapolis, Maryland 21401

COUNTY LEVEL

The Worcester County Commissioners have adopted a Comprehensive Land Use Plan associated with their goals for development. Recommendations of this plan place the bulk of future development into the West Ocean City area. Attached is **EXHIBIT 5.3** which is a map copied from the comprehensive plan titled "Worcester County Land Use Plan, Map 2.1". This map exhibits graphically the proposed pattern of development for the county. The official Land Use Map as well as a copy of the full comprehensive plan may be reviewed at the Worcester County Office of Planning and Permits.

On June 11, 1987 the Worcester District Soil Conservation Board of Supervisors unanimously approved a policy procedure requiring a fill permit or a release from the Corps of Engineers when an Interior Wetland is in danger of being destroyed. **EXHIBIT 5.4**, attached for reference, is a copy of the minutes of that meeting. **EXHIBIT 5.5** is a copy of the letter from the SCS Worcester County District Conservationist to the Corps of Engineers which further explains the intent of this policy.

Both the Worcester County Storm Water Management Ordinance and the Sediment and Erosion Control Ordinance also play a role in the development of West Ocean City, both in site specific and overall in an accumulated form.

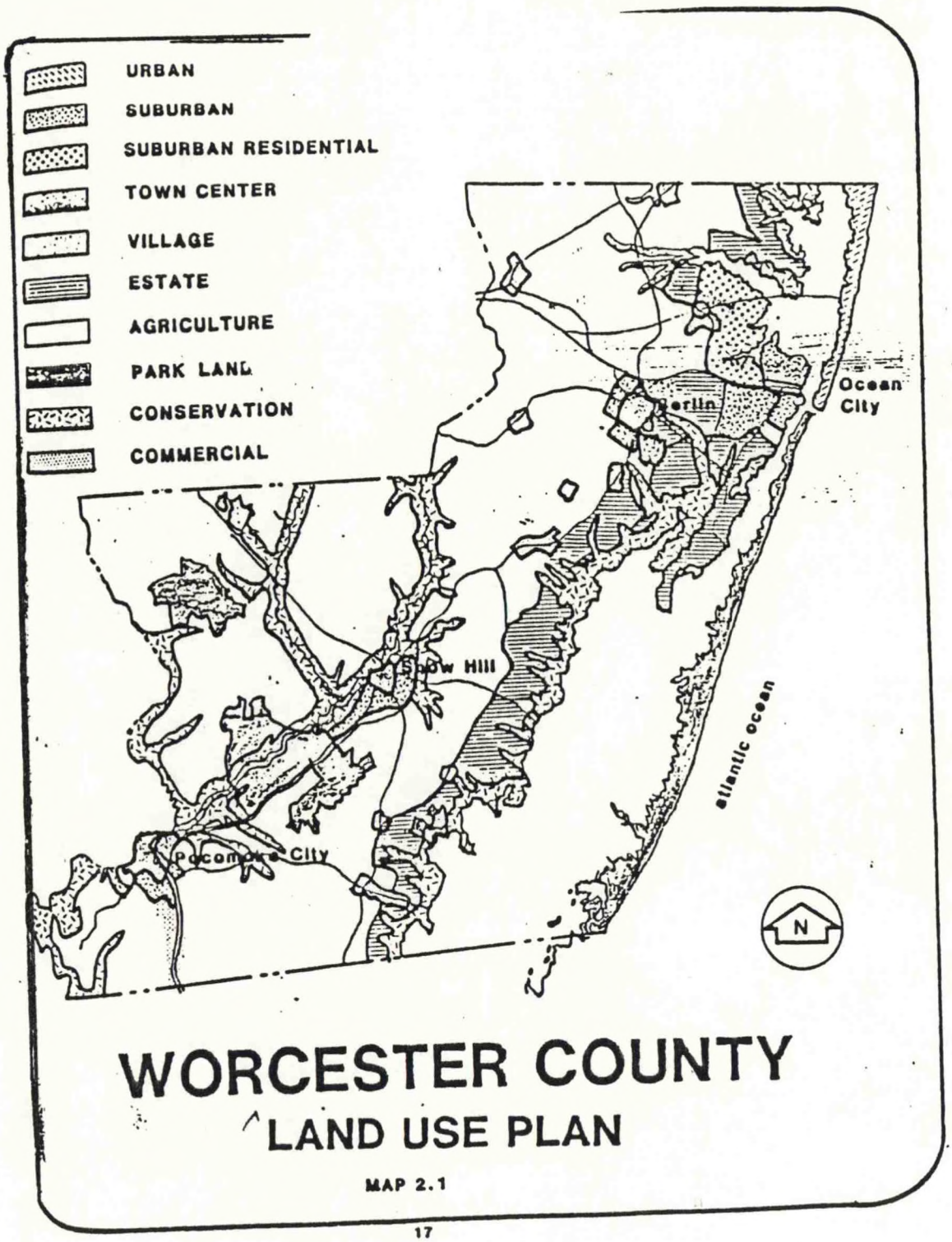

URBAN
SUBURBAN
SUBURBAN RESIDENTIAL
TOWN CENTER
VILLAGE
ESTATE
AGRICULTURE
PARK LAND
CONSERVATION
COMMERCIAL
Berlin
Ocean City
Snow Hill
Pocomoke City
Atlantic Ocean
N
WORCESTER COUNTY
LAND USE PLAN
MAP 2.1

Exhibit 5.3

Chip Derrickson

Worcester Soil Conservation District

P.O. BOX 97 SNOW HILL, MARYLAND 21863 PHONE (301) 632-1993

June 12, 1987

The regular meeting of the Worcester Soil Conservation District Board of Supervisors was held on the evening of June 11, 1987, at the District office. The meeting was called to order at 8:10 PM. Those in attendance were as follows:

Gerald F. Holloway, Chairman
Richard Jones, Vice-Chairman
W. Dan Redden, Treasurer
Clinton J. Hudson, Supervisor
Elwood Waters, Supervisor
Gerald Redden, Associate Supervisor
William C. Fritz, Sediment/SWM Specialist
Bruce E. Nichols, District Conservationist
Sabine P. Little, District Manager
John Hochmuth, County Extension Agent

The minutes of the last meeting and the May, 1987, financial statements were approved by motion from Richard Jones, seconded by Clinton Hudson. Two cooperator agreements were approved and signed. They are as follows:

Holly Farms Poultry Industries, Inc. (2)

Bill presented the Sediment/SWM activity sheet. He also discussed training David Montgomery in the Sediment, Erosion Control/ Storm Water Management approval process, and problems with the Homestretch Motel, which have been resolved for the most part.

Bruce presented the SCS report and discussed the following:

1. A proposed 700,000 capacity broiler facility in Girdletree, which will need 1800 A to spread waste - or 1300 A with a waste treatment lagoon;

2. The West Ocean City study - and the related problem of how the wetlands should be treated. It was proposed that Worcester SCD should require persons filling in upland wetlands to display either a fill permit or a release from the Corp. of Engineers before we will review for Sediment/SWM applications. The motion, made by Dan Redden and seconded by Richard Jones, was passed unanimously by the rest of the Board;

3. Farm Game Committee seed packets for wildlife plantings;

Exhibit 5.4

United States Department of Agriculture
Soil Conservation Service
301 Bank St., Snow Hill, MD 21863

June 15, 1987

Thomas J. Filip III, Asst. Chief
U.S. Army Corps of Engineers
Regulatory Functions Br.
Baltimore District
P.O. Box 1715
Baltimore, MD 21203

Following our meeting of June 11, 1987, I presented my interpretation of the Corps' position on interior wetlands to the Worcester Board of Supervisors. The position I presented was that in the case of any interior wetland unit, there must be a Corps determination as to first size of the wetland and then importance of the impact of the proposed activity. The importance of the impact of the proposed activity could be determined through various means including the Water Quality Certification Program of the Maryland Department of Health and Mental Hygiene for wetland units less than 10 acres in size.

If the wetland unit is greater than 10 acres or contiguous to or associated with other wetlands, it will have to go through the full Corps permit process including advertisement hearings and permit allocation or denial based on the findings.

If the wetland is less than 10 acres and isolated or not associated in a system, it can be reviewed through the Maryland Water Quality Certification Program. It may be granted a certification/permit based on their findings or it may be denied.

The Corps hopes that the increased coordination between the State's programs and the Federal programs will result in faster and better service to the public.

During our meeting, we all identified one problem with assuring the developers are aware of the required permit process to protect the wetland and maintain a healthy environment. The Corps nor the Water Quality Certification Program has a direct pre-construction contact that could allow information transfer to the contractors and developers. The Worcester Soil Conservation District, on the other hand, has a direct contact with each developer prior to obtaining a grading or building permit in review of the Stormwater and Sediment Control plan. It was thought that the District would be able to require a letter of approval, Water Quality Certificate or Corps permit prior to acceptance of the Stormwater Management or Sediment Control Plan in cases where wetlands were involved.

I presented this possibility to the Worcester Board of Supervisors and they supported requiring proper documentation of actions involving permitting in

Exhibit 5.5

interior wetlands just as they do in tidal influenced areas. The Board directed Bill Fritz, our Sediment and Stormwater Control Specialist, to institute this process.

Therefore, in cases with known interior wetlands, Bill Fritz will require documentation of actions involving the permit process prior to acceptance of a Stormwater and Sediment Control plan. This plan will have to reflect the determination of the Corps and the Water Quality Certification Program.

Tom, we discussed a letter from you, the Corps, stating the need or possible support of such an action. I would appreciate such a letter for our files. The Worcester District supports the Corps in their endeavor to protect wetlands and feels the Corps can lend a hand in documenting need.

Thanks for your assistance.

Bruce E. Nichols
District Conservationist

cc: Jo Ann Watson
Wm. Fritz ✓

Exhibit 5.5

VI. PROJECTED 100% DEVELOPMENT MODEL

EXHIBIT 6.1 is a map which overlays the Base Map and is titled "Projected land Use and Watershed Boundary Map."

It was developed by taking the existing watershed boundary map and adding to it:

First --- expected zoning changes and second --- eliminating all wooded and agricultural or open areas in order to fill every possible lot with the urbanized development as permitted by the aforementioned zoning classifications.

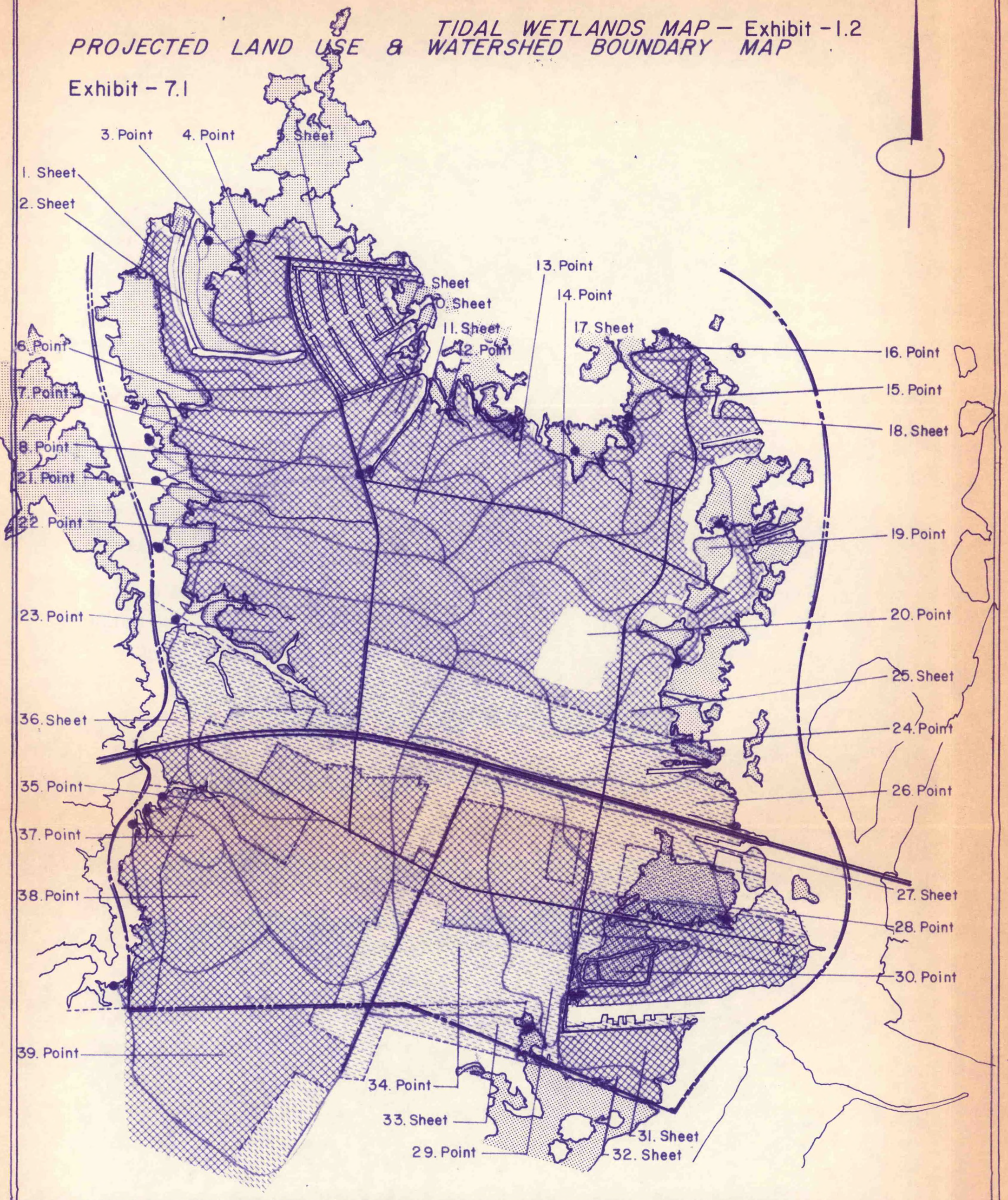
This may not prove to be the final land use outcome in West Ocean City, however it develops a model with a greater probability for intensive problems with storm water control and flood management.

Review of this map shows that most tidal marshes are shown. Interior Wetlands are not simply because the scale of the map (1"=1320') and the average size of the wetland units when coupled with the other necessary elements of the map make it very difficult to depict clearly the models intent. However, because of the required permit review process to fill and build in these wetland units, they are dealt with in this report as are tidal marshes and are not considered to be developable lands. (Refer again to **EXHIBIT 1.3** for the location and relative size of theses wetland units.)

TIDAL WETLANDS MAP – Exhibit – 1.2

PROJECTED LAND USE & WATERSHED BOUNDARY MAP

Exhibit – 7.1



LEGEND

- INDICATES LANDS EXHIBITING COMMERCIAL LAND CHARACTERISTICS.
- INDICATES RESIDENTIAL USEAGE
- INDICATES TIDAL MARSH
- INDICATES TIDAL MARSH
- INDICATES POINT OF DISCHARGE OR OF MAJOR CONSTRICTION
- 29. Point (LABELING SAMPLE)
  - TYPE OF DISCHARGE
  - WATERSHED NAME

VII. TR-55 CALCULATIONS & SUMMARIES OF POST-DEVELOPMENT CONDITIONS

These Calculations are very similar to those in Section 4, however the variables have been altered to represent the 100% development model (**EXHIBIT 7.1**). For the purpose of this model, the watershed boundaries are not anticipated to change significantly and it is therefore, possible to use much of the same characteristics of the individual watersheds as before.

(See Appendix A to review TR-55 Post-Development Calculation Sheets)

VIII. CORRELATION OF PRE AND POST-DEVELOPMENT CALCULATIONS

In order to further understand the individualized watersheds the preceding TR-55 calculations have been correlated in order to emphasize the effect on flooding potential of ongoing development in West Ocean City. The "specific data" referred to in Section III under...C. Field Inspection is also presented here under the subsection of the corresponding watershed.

WATERSHED NUMBER 1

		CURRENT	PROJECTED
Drainage Area		23.6 Acres	23.6 Acres
Runoff Curve Number		81	83
Time of Concentration		1.79 Hrs.	2.16 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	4.25	4.46
	50 Year Storm	5.08	5.31
	100 Year Storm	5.84	6.07

FIELD NOTES:

The Discharge is sheet runoff to a tidal lagoon. It currently exhibits light single family development. Land Elevations are extremely low.

WATERSHED NUMBER 2

		CURRENT	PROJECTED
Drainage Area		10.4 Acres	10.4 Acres
Runoff Curve Number		67	79
Time of Concentration		4.19 Hrs	2.19 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	2.84	4.04
	50 Year Storm	3.55	4.86
	100 Year Storm	4.20	5.60

FIELD NOTES:

The discharge is sheet runoff to a tidal lagoon. Current land useage is mostly tidal marsh though there is some developable lands, now wooded, which are zoned residential. Land elevations are extremely low.

WATERSHED NUMBER 3

		CURRENT	PROJECTED
Drainage Area		18 Acres	18 Acres
Runoff Curve Number		77	83
Time of Concentration		3.14 Hrs.	1.52 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	3.83	4.46
	50 Year Storm	4.64	5.31
	100 Year Storm	5.37	6.07

FIELD NOTES:

Currently completly undeveloped though there are some developable lands which are now wooded and zoned residential. Land elevations are extremely low.

WATERSHED NUMBER 4

		CURRENT	PROJECTED
Drainage Area		18 Acres	18 Acres
Runoff Curve Number		80	84
Time of Concentration		4.68 Hrs.	1.78 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	4.14	4.57
	50 Year Storm	4.97	5.43
	100 Year Storm	5.72	6.19

FIELD NOTES:

Some, very light, residential development, but mostly wooded. Runoff falls on a tidal marsh. Land elevations are extremely low.

WATERSHED NUMBER 5

		CURRENT	PROJECTED
Drainage Area		70 Acres	70 Acres
Runoff Curve Number		80	83
Time of Concentration		1.43 Hrs.	1.43 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	4.14	4.46
	50 Year Storm	4.97	5.31
	100 Year Storm	5.72	6.07

FIELD NOTES:

80% developed with single-family residential at present. Storm water discharge is sheet runoff to a tidal lagoon system. Land elevations are generally extremely low.

WATERSHED NUMBER 6

		CURRENT	PROJECTED
Drainage Area		22 Acres	22 Acres
Runoff Curve Number		76	81
Time of Concentration		2.25 Hrs.	2.21 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	3.73	4.25
	50 Year Storm	4.53	5.08
	100 Year Storm	5.25	5.84

FIELD NOTES:

Area known as "Cape Isle of Wight" uses a single 24"by 30' corrugated metal pipe as discharge onto tidal marsh. Land elevations are extremely low. Marsh grass is the predominant ground cover through most of this area, yet it is recorded as being buildable lots. Zoned residential, current development 25%.

WATERSHED NUMBER 7

		CURRENT	PROJECTED
Drainage Area		42 Acres	42 Acres
Runoff Curve Number		82	83
Time of Concentration		1.62 Hrs.	2.18 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	4.36	4.46
	50 Year Storm	5.20	5.31
	100 Year Storm	5.95	6.07

FIELD NOTES:

Storm water discharges to Herring Creek after filtering through a fringe marsh. Current land useage is partially residential and partially agricultural with a small remainder wooded.

WATERSHED NUMBER 8

		CURRENT	PROJECTED
Drainage Area		18 Acres	18 Acres
Runoff Curve Number		78	79
Time of Concentration		0.85 Hrs.	1.78 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	3.93	4.04
	50 Year Storm	4.75	4.86
	100 Year Storm	5.48	5.60

FIELD NOTES:

Storm water discharges into a tidal lagoon. It is zoned residential. There is some small acreage of agricultural land remaining there.

WATERSHED NUMBER 9

		CURRENT	PROJECTED
Drainage Area		14 Acres	14 Acres
Runoff Curve Number		80	81
Time of Concentration		3.02 Hrs.	2.30 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	4.14	4.25
	50 Year Storm	4.97	5.08
	100 Year Storm	5.72	5.84

FIELD NOTES:

80% developed single-family with storm water discharge being sheet run-off to a tidal lagoon.

WATERSHED NUMBER 10

		CURRENT	PROJECTED
Drainage Area		10 Acres	10 Acres
Runoff Curve Number		78	81
Time of Concentration		1.56 Hrs.	1.98 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	3.93	4.25
	50 Year Storm	4.75	5.08
	100 Year Storm	5.48	5.84

FIELD NOTES:

80% developed single-family with storm water discharge being sheet run-off to a tidal lagoon.

WATERSHED NUMBER 11

		CURRENT	PROJECTED
Drainage Area		29 Acres	29 Acres
Runoff Curve Number		74	90
Time of Concentration		2.37 Hrs.	1.58 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	3.52	5.24
	50 Year Storm	4.30	6.12
	100 Year Storm	5.02	6.90

FIELD NOTES:

Currently undeveloped and mostly wooded. Storm water discharge consists of sheet runoff to a tidal lagoon and a tidal marsh. Zoned residential.

WATERSHED NUMBER 12

		CURRENT	PROJECTED
Drainage Area		38 Acres	38 Acres
Runoff Curve Number		84	90
Time of Concentration		2.10 Hrs.	2.14 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	4.57	5.24
	50 Year Storm	5.43	6.12
	100 Year Storm	6.19	6.90

FIELD NOTES:

Mostly agricultural useage with some wooded acreage. Point of discharge is into a tidal lagoon. Marks on ground for aerial survey (often used to create plans for development) were witnessed in the field.

WATERSHED NUMBER 13

		CURRENT	PROJECTED
Drainage Area		22 Acres	22 Acres
Runoff Curve Number		81	90
Time of Concentration		0.90 Hrs.	1.52 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	4.25	5.24
	50 Year Storm	5.08	6.12
	100 Year Storm	5.84	6.90

FIELD NOTES:

Current land usage evenly mixed with agricultural and wooded. Storm water discharge is the head of a tidal gut.

WATERSHED NUMBER 14

		CURRENT	PROJECTED
Drainage Area		67 Acres	67 Acres
Runoff Curve Number		84	88
Time of Concentration		1.08 Hrs.	2.36 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	4.57	5.01
	50 Year Storm	5.43	5.89
	100 Year Storm	6.19	6.67

FIELD NOTES:

Current land usage is mostly agriculture with some wood and open, grassed areas. Approximately 50% of this watershead is not expected to change it's land use for quite a while as it is property of either an estate or a county school. It's point of discharge is a tidal gut which joins the Isle of Wight Bay.

WATERSHED NUMBER 15

		CURRENT	PROJECTED
Drainage Area		31.2 Acres	31.2 Acres
Runoff Curve Number		81	81
Time of Concentration		0.75 Hrs.	1.62 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	4.25	4.25
	50 Year Storm	5.08	5.08
	100 Year Storm	5.84	5.84

FIELD NOTES:

Zoned residential and 85% developed with single family homes. Storm water discharge is into a tidal gut by way of a series of road ditches. Driveway culverts are full of sediment and require maintenance.

WATERSHED NUMBER 16

		CURRENT	PROJECTED
Drainage Area		6 Acres	6 Acres
Runoff Curve Number		79	79
Time of Concentration		1.09 Hrs.	1.27 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	4.04	4.04
	50 Year Storm	4.86	4.86
	100 Year Storm	5.60	5.60

FIELD NOTES:

Fully developed residential neighborhood with large properties. Land is high (as relative to surrounding lands) and sloped for reasonably quick drainage. Point of discharge is a finger gut from the Isle of Wight Bay.

WATERSHED NUMBER 17

		CURRENT	PROJECTED
Drainage Area		10 Acres	10 Acres
Runoff Curve Number		81	81
Time of Concentration		2.16 Hrs.	1.84 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	4.25	4.25
	50 Year Storm	5.08	5.08
	100 Year Storm	5.84	5.84

FIELD NOTES:

95% developed single family residential. Storm water runs off in sheet form directly onto a tidal marsh.

WATERSHED NUMBER 18

		CURRENT	PROJECTED
Drainage Area		27 Acres	27 Acres
Runoff Curve Number		80	83
Time of Concentration		1.49 Hrs.	1.49 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	4.14	4.46
	50 Year Storm	4.97	5.31
	100 Year Storm	5.72	6.07

FIELD NOTES:

Mostly developed with single family dwellings. Storm water discharge is sheet or shallow concentrated form to a tidal lagoon and surrounding marsh.

WATERSHED NUMBER 19

		CURRENT	PROJECTED
Drainage Area		62 Acres	70 Acres
Runoff Curve Number		81	84
Time of Concentration		2.82 Hrs	2.84 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	4.25	4.57
	50 Year Storm	5.08	5.43
	100 Year Storm	5.84	6.19

FIELD NOTES:

80%-85% developed with single family dwellings. This is a area of strong concern because even though existing development is at reasonably high elevations, all drain to a "Pocket-Marsh" which is tidally influenced in the middle of the development. It's outlet, however, is restricted by a small (24"-30") corrugated metal pipe which is situated under an existing house. This pipe is currently collapsed. There is a history of complaints in this area.

WATERSHED NUMBER 20

		CURRENT	PROJECTED
Drainage Area		101 Acres	101 Acres
Runoff Curve Number		84	91
Time of Concentration		2.85 Hrs.	2.17 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	4.57	5.35
	50 Year Storm	5.43	6.23
	100 Year Storm	6.19	7.02

FIELD NOTES:

Partially developed with single family residential. This area also has a long history of complaints. Centered in the watershed is an abandoned borrow pit, approximately 24 acres in size, known as Elliot's Pond. This outlets through a metering pipe to a long system of (apparently) inadequate ditches and closed or constricted culverts to a point of discharge at a tidal gut.

WATERSHED NUMBER 21

		CURRENT	PROJECTED
Drainage Area		63 Acres	63 Acres
Runoff Curve Number		83	89
Time of Concentration		2.91 Hrs.	2.09 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	4.46	5.12
	50 Year Storm	5.31	6.00
	100 Year Storm	6.07	6.78

FIELD NOTES:

Some residential development, but mostly agricultural land usage. Drains to a long ditch which is partially influenced by normal tidal ebb and flow.

WATERSHED NUMBER 22

		CURRENT	PROJECTED
Drainage Area		75 Acres	75 Acres
Runoff Curve Number		79	91
Time of Concentration		4.51 Hrs.	3.29 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	4.04	5.35
	50 Year Storm	4.86	6.23
	100 Year Storm	5.60	7.02

FIELD NOTES:

Current land usage is about evenly split between wooded and idle lands (which are staked as individual lots) with some single family. Storm water discharge is to a tidal gut from Herring Creek.

WATERSHED NUMBER 23

		CURRENT	PROJECTED
Drainage Area		264 Acres	264 Acres
Runoff Curve Number		78	92
Time of Concentration		2.25 Hrs.	2.05 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	3.93	5.46
	50 Year Storm	4.75	6.35
	100 Year Storm	5.48	7.14

FIELD NOTES:

Very large watershed currently under urbanizing pressures. Mixed land usage. Northwest quadrant has little difficulty draining now, but east of Keyser Point Road and south of Route 50 both depend on non-maintained and inadequate ditches to reach the point discharge at a tidal creek. Also the area of destroyed interior wetland (see Section 6).

WATERSHED NUMBER 24

		CURRENT	PROJECTED
Drainage Area		88 Acres	88 Acres
Runoff Curve Number		88	94
Time of Concentration		1.45 Hrs.	1.00 Hr.
RUNOFF SHOWN IN INCHES	25 Year Storm	5.01	5.69
	50 Year Storm	5.89	6.59
	100 Year Storm	6.67	7.38

FIELD NOTES:

Area of strong concern due to inadequate drainage ditches (which outlet into the Isle of Wight Bay) and rapid commercial development.

WATERSHED NUMBER 25

		CURRENT	PROJECTED
Drainage Area		20 Acres	20 Acres
Runoff Curve Number		73	91
Time of Concentration		.081 Hrs.	1.81 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	3.42	5.35
	50 Year Storm	4.20	6.23
	100 Year Storm	4.90	7.02

FIELD NOTES:

Storm water drainage is a sheet action to a tidal marsh. Land usage is mostly "idle".

WATERSHED NUMBER 26

		CURRENT	PROJECTED
Drainage Area		47 Acres	47 Acres
Runoff Curve Number		88	95
Time of Concentration		1.79 Hrs.	1.18 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	5.01	5.81
	50 Year Storm	5.89	6.70
	100 Year Storm	6.67	7.50

FIELD NOTES:

Follows Route 50 and is expected to be commercially developed in the near future. Point of discharge is the Isle of Wight Bay north of Route 50.

WATERSHED NUMBER 27

		CURRENT	PROJECTED
Drainage Area		60 Acres	60 Acres
Runoff Curve Number		66	94
Time of Concentration		1.89 Hrs.	0.32 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	2.74	5.69
	50 Year Storm	3.44	6.59
	100 Year Storm	4.09	7.38

FIELD NOTES:

Sheet discharge into the Isle of Wight Bay. Limited commercial development with scattered residential. Expecting higher density commercial development and multi-family development.

WATERSHED NUMBER 28

		CURRENT	PROJECTED
Drainage Area		42 Acres	42 Acres
Runoff Curve Number		82	93
Time of Concentration		1.88 Hrs.	0.32 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	4.36	5.58
	50 Year Storm	5.20	6.47
	100 Year Storm	5.95	7.26

FIELD NOTES:

Limited development includes high density mobile home park. Ongoing urbanization has altered or destroyed current drainage route which ends on a tidal marsh.

WATERSHED NUMBER 29

		CURRENT	PROJECTED
Drainage Area		80 Acres	80 Acres
Runoff Curve Number		78	87
Time of Concentration		1.15 Hrs.	2.42 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	3.93	4.90
	50 Year Storm	4.75	5.77
	100 Year Storm	5.48	6.55

FIELD NOTES:

Partially residentially developed with a smattering of commercial. Point of discharge is to the West Ocean City Harbor (in conjunction with Watershed 30). Expect increased commercial and multi-family densities.

WATERSHED NUMBER 30

		CURRENT	PROJECTED
Drainage Area		48 Acres	48 Acres
Runoff Curve Number		77	90
Time of Concentration		2.00 Hrs.	1.65 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	3.83	5.24
	50 Year Storm	4.64	6.12
	100 Year Storm	5.37	6.90

FIELD NOTES:

Mostly undeveloped with a large dredge-spoil site at it's center. This is mostly surrounded by tidally influenced marsh, but further information is required from the Corps of Engineers as to its present and future legal status. It's point of drainage is at West Ocean City Harbor.

WATERSHED NUMBER 31

		CURRENT	PROJECTED
Drainage Area		36 Acres	36 Acres
Runoff Curve Number		88	93
Time of Concentration		0.11 Hrs.	0.11 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	5.01	5.58
	50 Year Storm	5.89	6.47
	100 Year Storm	6.67	7.26

FIELD NOTES:

Heavy commercial densities at the fringe of West Ocean City Harbor. The remainder is 95% developed as single-family or multi-family residential. Expect rebuilding to begin soon as mostly multi-family-multi-story dwellings. Storm water discharge is sheet flow to the harbor.

WATERSHED NUMBER 32

		CURRENT	PROJECTED
Drainage Area		16 Acres	16 Acres
Runoff Curve Number		79	83
Time of Concentration		1.98 Hrs.	1.98 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	4.04	4.46
	50 Year Storm	4.86	5.31
	100 Year Storm	5.60	6.07

FIELD NOTES:

Some existing single-family with remainder currently being developed the same.

Storm water discharge is sheet flow to a tidal gut joining the Sinepuxent Bay.

WATERSHED NUMBER 33

		CURRENT	PROJECTED
Drainage Area		8 Acres	8 Acres
Runoff Curve Number		73	94
Time of Concentration		1.19 Hrs.	0.41 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	3.42	5.69
	50 Year Storm	4.20	6.59
	100 Year Storm	4.90	7.38

FIELD NOTES:

Currently wooded, this area expects high density commercial development.

The storm water discharges in sheet runoff to a tidal marsh.

WATERSHED NUMBER 34

		CURRENT	PROJECTED
Drainage Area		142 Acres	142 Acres
Runoff Curve Number		81	91
Time of Concentration		3.12 Hrs.	2.00 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	4.25	5.35
	50 Year Storm	5.08	6.23
	100 Year Storm	5.84	7.02

FIELD NOTES:

Currently land usage is mixed with commercial, residential and agricultural but is primarily wooded. This watershed is split by State Route 611 and drains by way of the state roads ditch along Route 611 and Sunset Boulevard to discharge onto a tidal marsh. This is an area of concern because even though this drainage pattern has been newly established by the state, it is apparent that the design was based only on the state's property and not the entire watershed. Also evident is the fact that future development of the watershed, which is expected to be a demanding area, did not enter into the design creteria.

WATERSHED NUMBER 35

		CURRENT	PROJECTED
Drainage Area		112 Acres	112 Acres
Runoff Curve Number		77	89
Time of Concentration		1.34 Hrs.	0.97 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	3.83	5.12
	50 Year Storm	4.64	6.00
	100 Year Storm	5.37	6.78

FIELD NOTES:

The primary land usage at present is agricultural, however zoning permits high-density multi-family development. This area is expected to grow quickly. It's point of discharge is a tidal gut which joins Herring Creek.

WATERSHED NUMBER 36

		CURRENT	PROJECTED
Drainage Area		10 Acres	10 Acres
Runoff Curve Number		81	92
Time of Concentration		0.37 Hrs.	0.16 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	4.25	5.46
	50 Year Storm	5.08	6.35
	100 Year Storm	5.84	7.14

FIELD NOTES:

Partially developed with single-family homes, half of this watershed is in an agricultural state. This is expected to change to commercial with the residential area increasing in density. The storm water discharges in sheet form to Herring Creek.

WATERSHED NUMBER 37

		CURRENT	PROJECTED
Drainage Area		24 Acres	24 Acres
Runoff Curve Number		79	88
Time of Concentration		0.87 Hrs.	1.70 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	4.04	5.01
	50 Year Storm	4.86	5.89
	100 Year Storm	5.60	6.67

FIELD NOTES:

Current land usage is agricultural and wooded. It is expected to become high-density residential. It's point of discharge is Herring Creek.

WATERSHED NUMBER 38

		CURRENT	PROJECTED
Drainage Area		64 Acres	64 Acres
Runoff Curve Number		74	90
Time of Concentration		1.97 Hrs.	2.01 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	3.52	5.24
	50 Year Storm	4.30	6.12
	100 Year Storm	5.02	6.90

FIELD NOTES:

Current land usage is primarily wooded. Zoning permits high-density residential.

Point of discharge is Herring Creek.

WATERSHED NUMBER 39

		CURRENT	PROJECTED
Drainage Area		188 Acres	188 Acres
Runoff Curve Number		83	92
Time of Concentration		4.88 Hrs.	3.73 Hrs.
RUNOFF SHOWN IN INCHES	25 Year Storm	4.46	5.46
	50 Year Storm	5.31	6.35
	100 Year Storm	6.07	7.14

FIELD NOTES:

Primary land usage is currently wooded with some commercial. The woods are expected to be replaced with high-density multi-family dwellings.

IX. PRIORITIZATION OF WATERSHEDS

At present, no formula has been established to give priority to any one watershed. Some of these areas, though, present themselves as having extreme drainage problems. A short listing of those follows:

PRIORITY NO.	WATERSHED NO. & DESCRIPTION
1	#19 Developed residential district with a history of complaints. Collapsed outlet requires attention.
2	#20 Developed residential district with a history of complaints. Inadequate ditching needs to be updated. Flooding from Elliots Pond a major concern.
3	#24 Rapidly developing commercial area. Present drainage ditching is already overstressed.
4	#34 Largely a commercial area expecting rapid development. State plans on Route 611 are not sufficient for the entire watershed.
5	#39 Expect rapid multi-family development. This increased runoff will flood-out the lower end of watershed without attention.
6	#29 Mixed residential and commercial land usage, growing rapidly. Current drainage system is inadequate and too slow.

X. GENERAL DESCRIPTION OF ALTERNATIVE IMPROVEMENTS

The following are briefly stated possible improvements to the West Ocean City Drainage Systems currently existing. All of these plans meet the goals of this study as stated in the introduction. No one plan can be described as a "Best" plan for the entire study area. Chapter XI will list the plans in order of functionability for each individual watershed.

Conventional Ditching

The most widely used drainage method throughout the Coastal Plains has traditionally been to design conventional ditches. These are gravity induced ditches which incorporate gradients, or a slope, to direct storm-water towards a specific outlet. Environmental safeguards which are inherent to these ditches include, but are not limited to, one or more of the following systems: Sediment Basins, Drop Structures, Detention Ponds, Retention Ponds, Infiltration Basins, etc. Good engineering practice requires that minimum slopes should be greater than .2%. Recent surveys show that in many cases slopes have been cut at .1% and less. West Ocean City is simply too flat in most cases to allow more practical gradients. Therefore, to allow this type of ditching, it becomes necessary to provide destination points closer to project locations. Stormwater storage units need to be created. This would be accomplished by excavating ponds to a depth considerably lower than the surrounding lands. Conventional Ditching Systems could then be designed using these new outlets and reducing storm serge. An additional concern to this plan is to discharge the water before it overflows the planned limits of the stormwater storage units and creates the flooding we are trying to relieve. There remains the problem with ditching to natural outlet points. In many cases the only solution

may be to pump the water through a force main to the point of discharge.

Infiltration Basins

An alternative to constant pumping of runoff stormwater would be to attempt to percolate the contained water into the ground. This is not practical when the soils are already saturated. Therefore, the infiltration unit must be large enough to hold an immense volume of water and hold it until the soils are able to absorb it or outlet it. To create such a unit would mean taking a vast amount of property out of a potentially developable state. It would mean creating ponds or constructing gravel filled basins. In all of these instances pumping stations would be required as back-up or emergency systems. However, the more water that can be stored, the less that has to be pumped.

An advantage to this plan, from a purely environmental point of view, is that it would severely limit zoning densities through approximately fifty percent (50%) of the study area. **EXHIBIT 10-1** is a shaded soil survey map showing: 1) Heavily shaded areas representing soils which are generally suitable for infiltration practices; 2) Lightly shaded areas which represent Made Land (Ma) and are too variable to determine suitability without sight-specific evaluation; 3) Non-shaded areas which are representative of soils that are not suitable for planned infiltration basins.

Vegetated Aquatic Waterways

This might be described as a wide marsh level ditch with multiple (2 or more) outlets. A Vegetated Aquatic Waterway (V.A.W.) differs from "conventional ditching" in that:

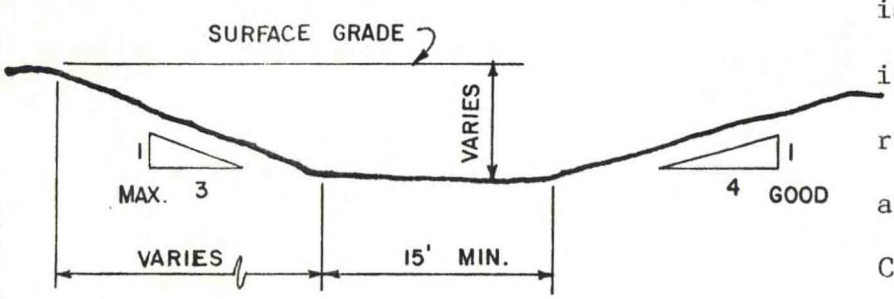
1) There is no gradient. The bottom should remain uniform in elevation.

2) The direction of flow is not mandated. The use of gradient in conventional ditching uses gravity to induce water to flow to a specific point of discharge. A V.A.W. may have more than one outlet and no gradient. These combined facts induce the water to flow in the direction of least resistance. With multiple outlets, stormwater could travel in either direction, and be discharged as quickly as the tidal outlets will accept them.

The greatest economic advantage to using these Vegetated Aquatic Wateways is the fact that it provides an outlet. This allows conventional ditching through interior developable lands to intercept the outlet elevation with a more functional gradient than was possible before.

V.A.W.'s have a drawback in that they must be very wide in order to convey the volumes of water which would be transmitted to them during any storm event.

The bottom of these V.A.W.'s must be at least 15 feet wide at its midpoint and wider as necessary to facilitate stormwater intercepted in route to the outlet.

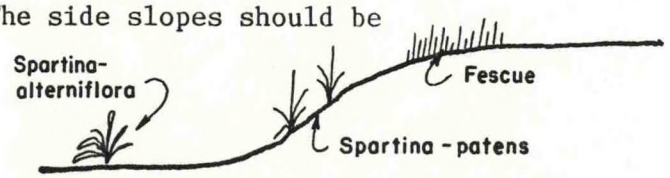


A second required feature that makes V.A.W.'s so wide is long sloping banks. This is necessary for two reasons. First is maintenance.

Conventional ditches of these depths often have

very steep side slopes which may not be naturally stabilized. With the longer slopes various types of grasses may be grown to hold the soils in place. Periodic mowing will then maintain the banks and the waterway properly. Reason #2 is safety. A conventional ditch of this depth would be a serious hazard to people and animals.

These Vegetated Aquatic Waterways should be excavated to a depth which would promote the growth of Spartina-alterniflora on the bottom where salt water influence is sufficient. The side slopes should be planted with Spartina-patens within its compatible range of elevation. Where removed from the intrusion of salt water, smartweeds and other fresh water species should be introduced in order to stabilize the waterway. **EXHIBIT 10.2** maps the suggested system.



Harbor Dredge - Spoil Site

Directly North of the West Ocean City Harbor and East of Harbor Road there exists a site which was once used as a containment facility for dredge-spoil taken from the harbor by the Corps of Engineers and Worcester County in years past. This project has been completed and all leasing rights have ceased. The sight remains privately owned.

Information obtained verbally from the Corps of Engineers indicates that the wetlands that are now established through and around this facility are under their jurisdiction and considered to be not developable.

This site could be capable of becoming a vast above grade stormwater storage facility. **EXHIBIT 10-3** shows an enlarged map of the site and a diagram of how it could be utilized. Basically the walls of this unit are well established and stable. Very few improvements would be required

to guarantee stability.

Improvements that are necessary to make this feasible, would be as follows:

1. A pumping station that would intake water from outside or perimeter stormwater collection sites, and discharge it into the above grade storage facility.

   These collection sites might be the detention ponds described in this chapter under Borrow Pits-General or any drainage ditch within reach which is unable to sufficiently convey stormwater to their points of discharge.

2. A large sluice or stage gate to regulate the discharge of the stored water into the harbor when the tidal waters recede sufficiently to accept this new influx of water. A slow release or drawdown of the stored waters is necessary to insure the stability of the side slopes.

3. Several emergency spillways to insure against overfilling the unit and protect surrounding properties.

The benefit that can be derived from this plan is that it could be used in times of strong tidal stress or storm surge. At these times, when natural drainage is impossible due to inundation by high water elevations, it may be possible to save property in this high density commercial district by pumping stormwater which is backed up into the above grade storage unit.

Borrow Pits-General

Abandoned borrow pits represent an opportunity to impound storm water runoff with a minimal expense to the county. **EXHIBIT 10-4** shows the

approximate location of all those borrow pits within the study area. In every case they are centered in areas which have displayed drainage problems.

It must be noted here that even though these pits are privately owned they are considered to be waters of the United States of America and are subject to the jurisdiction of the Army Corps of Engineers. This does not give the County license to alter them, but it could be possible to improve these wetlands to be more beneficial to the people of Worcester County and the State of Maryland.

All permits and approvals would have to be acquired prior to alteration of the site. Refer to Section V for a list of the authorities involved. The improvements here considered would be to:

1. Excavate these borrow pits approximately an additional 4.5 to 5.0 feet.
2. Design the surrounding drainage systems to discharge into the re-excavated borrow pit using conventional ditching wherever possible.
3. Design an outfall which will maintain a predetermined water elevation in the pond. In most cases it should be possible to accomplish this using a Vegetated Aquatic Waterway as the outlet system. However further information is required than is available at this time to supply all the variables needed to establish pond elevations in all cases. Though unlikely, it is possible that pumping stations may necessarily be incorporated to accomplish the goals in some of these projects.
4. Re-establish the ecosystem which is currently dependent upon these borrow pits. This is not a difficult undertaking and is

beneficial to the plan for several reasons. First in that it is a stated goal of the County Commissioners and this study to protect fish and wildlife and habitat to the fullest extent possible. And secondly with the fact that a well-ordered and self-sustaining ecosystem will be functionally stable and require less maintenance expenditures.

Even if pumping stations are required to make one of these systems work it might be considered to be dollars well spent by the county in that it vastly improves the drainage (and therefore the property values) of the watersheds directly involved.

Elliott's Pond

This is also an abandoned borrow pit and is subject to the jurisdiction of the Corps of Engineers. Yet its great size and its proximity to priority watersheds causes it to be discussed separately. This 22 acre site is commonly referenced as "Elliott's Pond" and recognized as supporting an attractive habitat for migratory waterfowl throughout the year. It is located North of Route 50 and borders Golf Course Road. This abandoned borrow pit represents the best possibility for a stormwater collection facility within the study area. Currently it acts as just such a facility collecting runoff from a 101 acre watershed and depositing it onto a tidal marsh which fringes the Isle of Wight Bay. However, by lowering its elevation and improving both the inlet and the outlet systems, its capacity could be expanded to satisfy the drainage requirements of an additional 502 acres of developable lands. **EXHIBIT 10-5** shows a map of Elliott's Pond as it currently exists, as well as, a map of possible improvements and the areas which would be directly affected.

This project best satisfies the goals of the study in that, firstly, it improves the drainage of seven major watersheds immensely and secondly does not destroy wildlife habitat, but enhances it and actually creates more.

Step #1 Data Collection

Complete an in-depth inventory of zoological and horticultural habitat in the pond. This is required so that we can reconstruct the existing ecosystem or a preferred one later..

Step #2 Excavation

The pond basin shall be cut to a depth 4.5 to 5.0 feet lower than it currently exists. Further excavation would be to improve the existing outlet by cutting it to an elevation suitable to Spartina alterniflora and widening it as much as possible. (See Vegetated Aquatic Wateway)

Step #3 Control Outlets

There are several methods of controlling the rate of outfall or discharge of water from the pond:

1) Metering Pipes - by choosing a culvert size an engineer chooses how much water is allowed to pass in a given amount of time.
2) A Weir System - with this design you do not control the volume of discharge, but the water level in the pond.

Both are reasonable options but a stage weir with an adjustable gate is the more practical choice for this project. It would make it possible to contain stormwater runoff for whatever time is necessary and then to meter its discharge so as not to over stress the outlet ditch. It also allows more time for the suspended sediment in the runoff to settle out of the water prior to discharge.

Step #4 Reclamation

This is possibly the most critical point of the project. Using notes from the habitat inventory (Step #1) rebuild the habitat which was modified with the excavation. This step is critical for two reasons:

1) A well ordered and balanced ecosystem, no matter what size, will basically maintain itself. The existing habitat has proven itself over the years as being self-sustaining and self-maintained.

2) The governing agencies, referred to in Section V, Review Of Governmental Policies, must approve the project before it can begin. It is unlikely that any of them would allow the destruction of any habitat within their jurisdiction without reasonable compensatory mitigation. Which basically means if you destroy a habitat you must replace it in kind with that of equal or greater value. To replace the habitat in kind would seem to satisfy the needs of all concerned.

Sheet Drainage Watersheds

Currently, there are 14 watersheds in our study area which do not display a point of discharge, but are labeled sheet drainage. This is not totally accurate. Technically each of these watersheds is actually comprised of several minute watersheds, each with a point of discharge. The size of these "sub-watersheds" however, are usually smaller than one-tenth of an acre. In each case if their point of discharge were blocked or interrupted the storm water runoff would simply find a second outlet without causing any real hazard or problems. Therefore, these "sub-watersheds" may be practically lumped together into a single larger

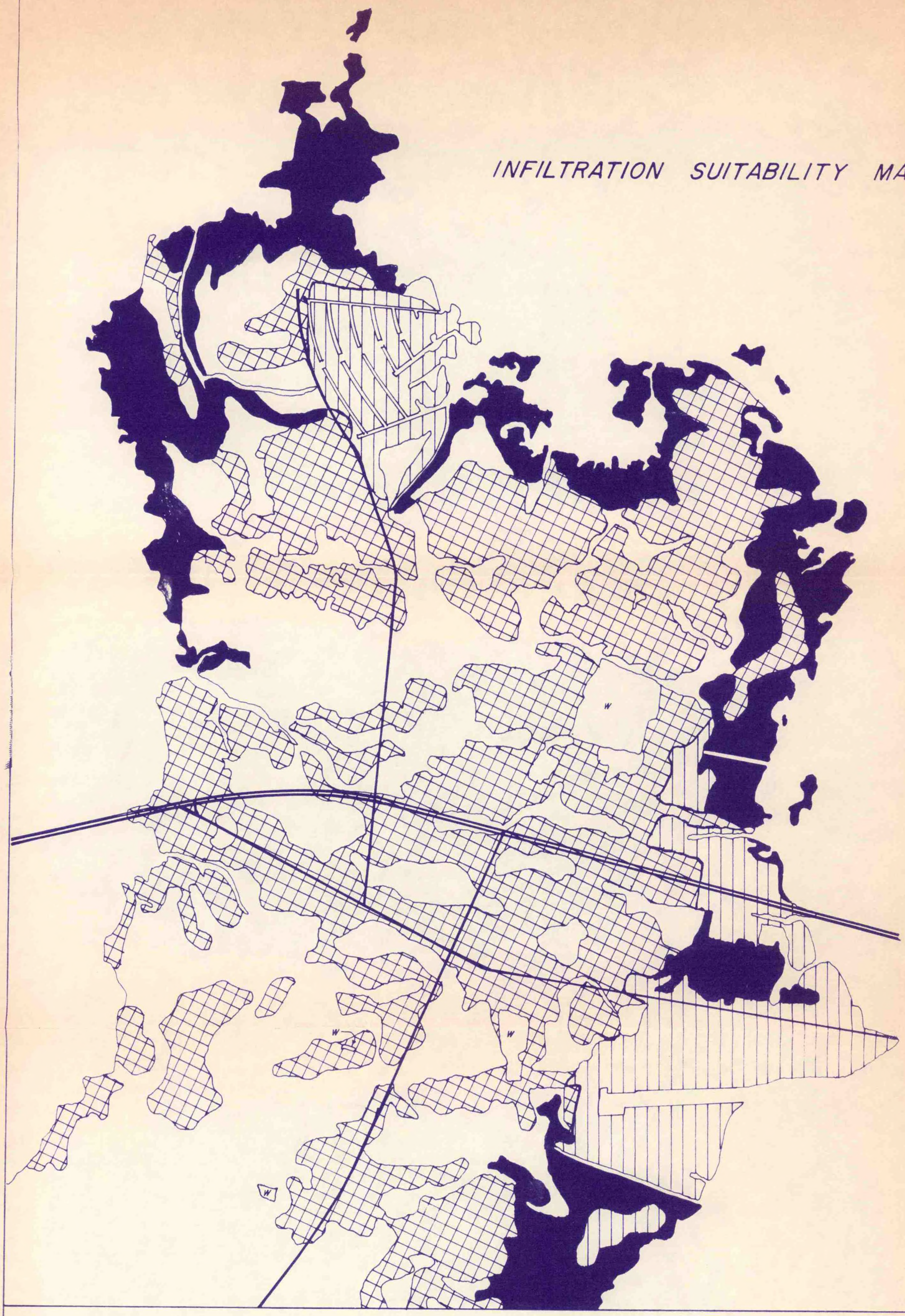
area and labeled a sheet drainage watershed. These watersheds are shown and labeled on **Exhibits 1.6** and **6.1**. They are watershed numbers 1, 2, 5, 9, 10, 11, 17, 18, 25, 27, 31, 32, 33, and 36.

For the reasons described above, there is very little that can be done to improve drainage in these areas. It may be that serious flooding will occur in these areas first, but the problem is not one of drainage. Vertical elevations of these lands are to low to inhibit inundation by surrounding waters swelled by storm tides. As far as normal drainage patterns are concerned, existing sediment and stormwater control methods and the current permitting process should be adequate to insure that no serious infractions to these drainage patterns occur.

Environmentally, however, there is a danger of seriously polluting tidal marshes and other aquatic habitat fringing these sheet discharge watersheds with new construction. The danger comes from chemicals and large quantities of foreign minerals associated with residential ground maintenance.

In consideration of this hazard, it would be prudent to require a minimum of a twenty-five (25) foot buffer zone between the improved property and the mean high water line. This will reduce undesireable sediments and nutrients in the runoff and help to maintain the water quality. Also, the scenic value of unspoiled environmental habitat can not be ignored.

INFILTRATION SUITABILITY MAP



LEGEND

- TIDAL MARSH - NOT DEVELOPABLE
- LANDS GENERALY SUITABLE FOR INFILTRATION PRACTICES
- MADE LAND (Ma) VARIABLE
- LANDS GENERALY NOT SUITABLE FOR INFILTRATION PRACTICES
- W — ABANDONED BORROW PIT

NOTE: THESE SOIL CLASSIFICATIONS ARE GENERAL ONLY. SITE SPECIFIC EVALUATIONS ARE REQUIRED FOR VERIFICATION AND DESIGN.

EXHIBIT 10.2

VEGETATED AQUATIC WATERWAY SYSTEM (VAW)

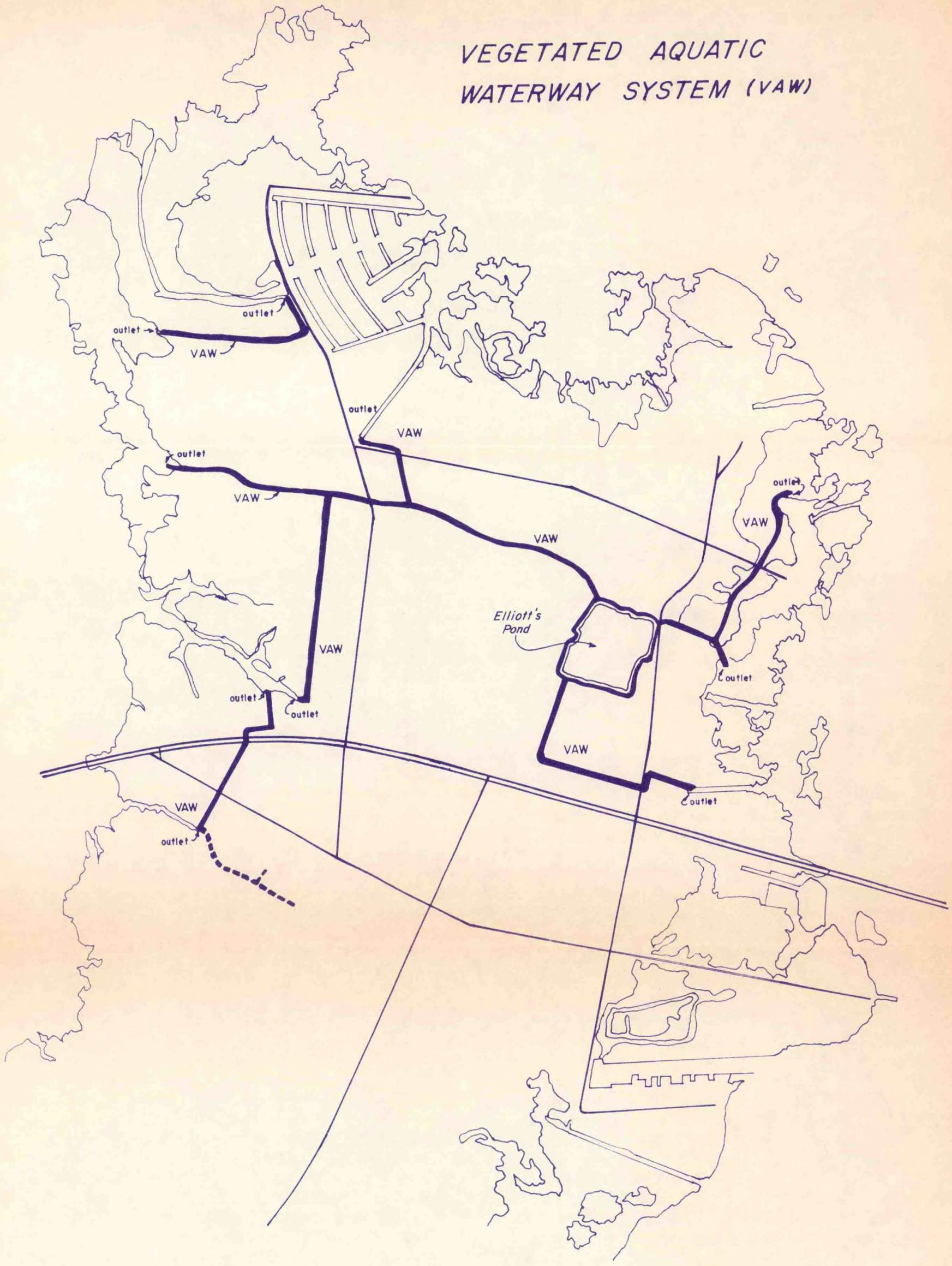
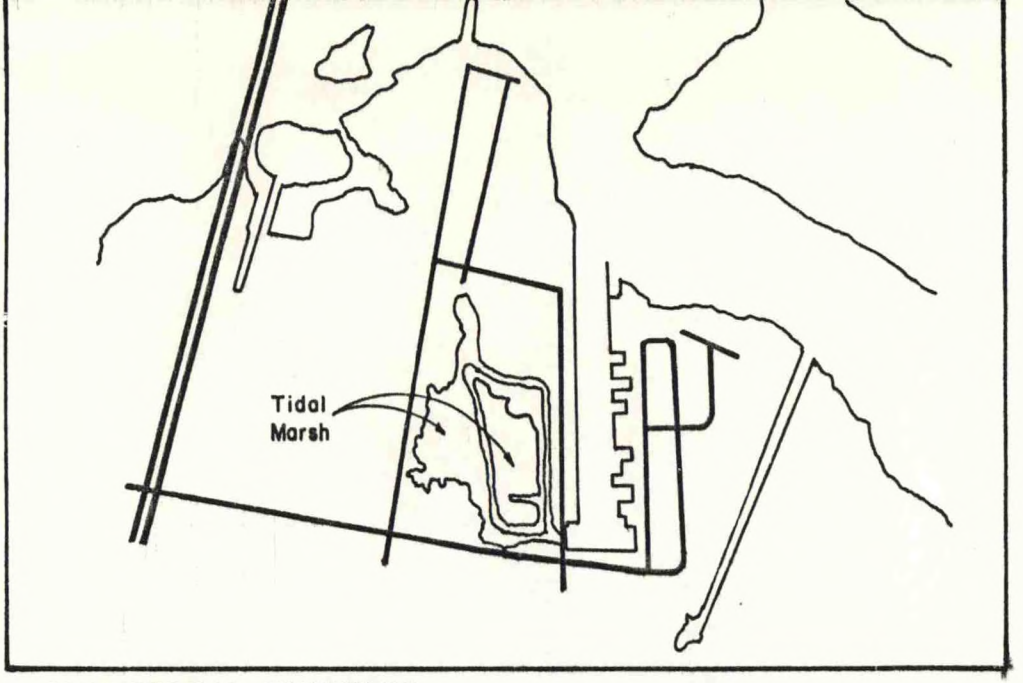
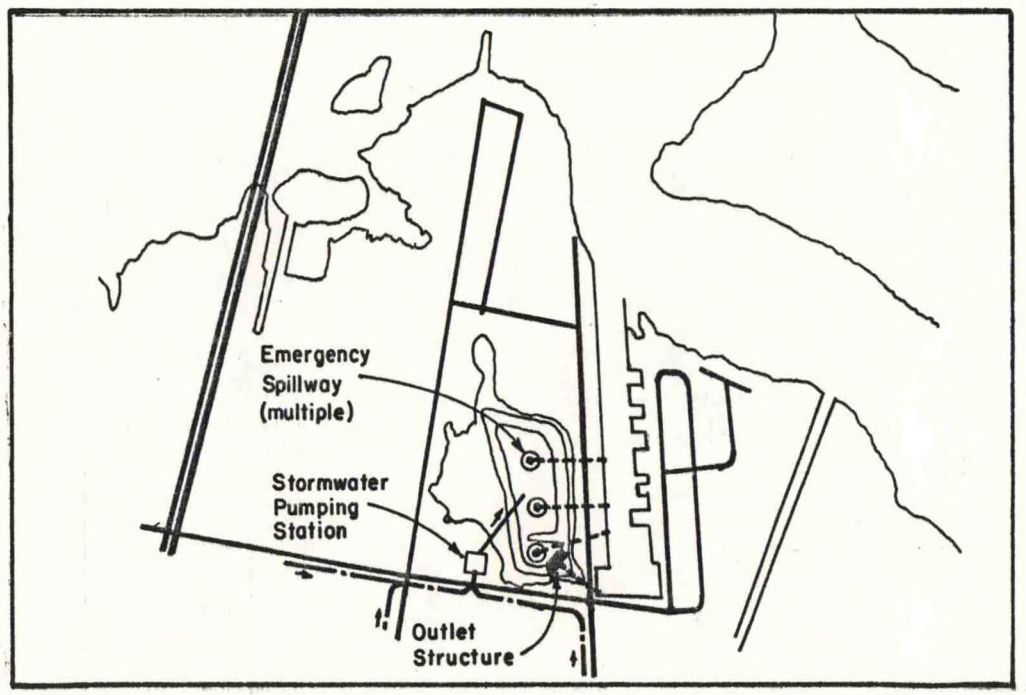


EXHIBIT 10.2



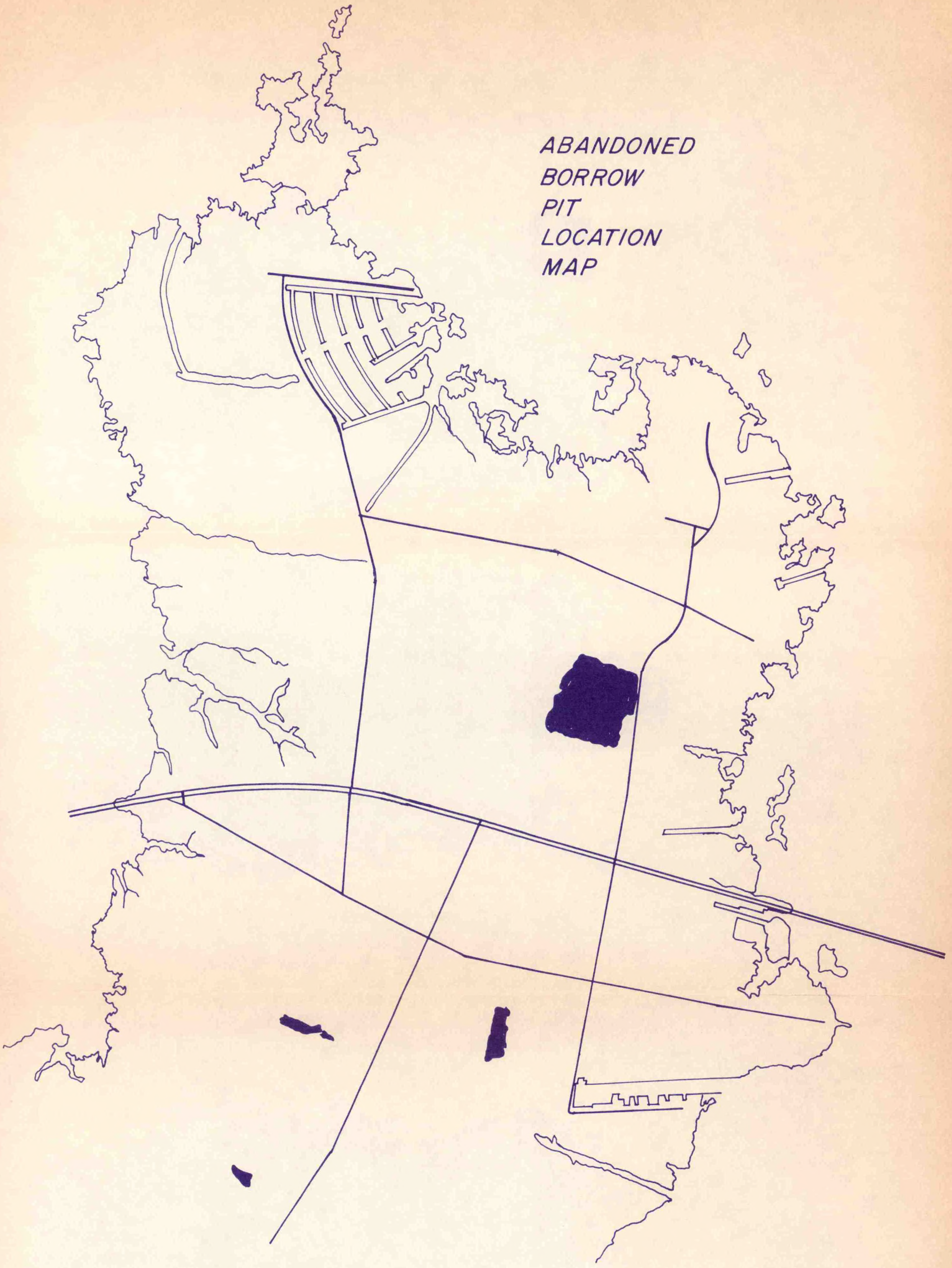
CURRENTLY EXISTING



PROPOSED IMPROVEMENTS

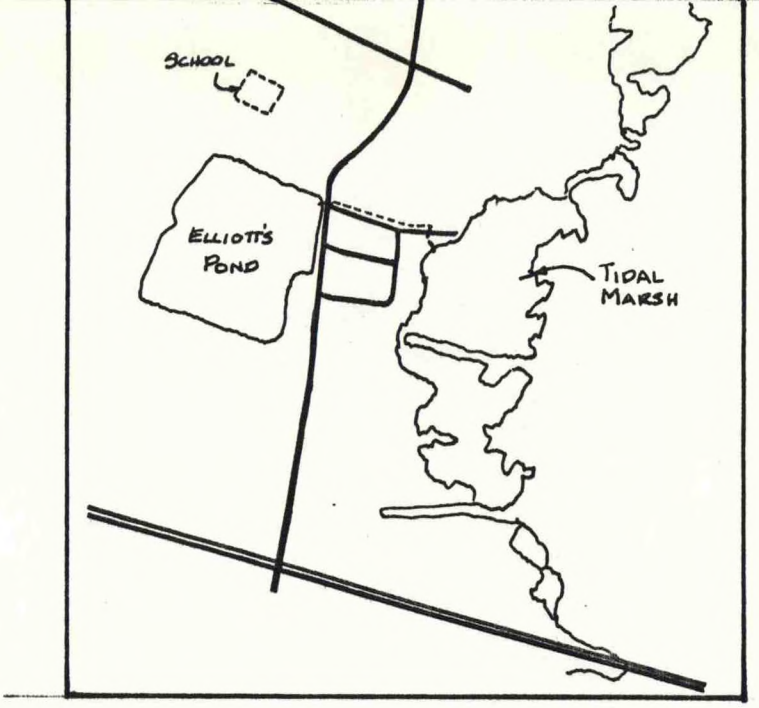
EXHIBIT 10.3

ABANDONED BORROW PIT LOCATION MAP

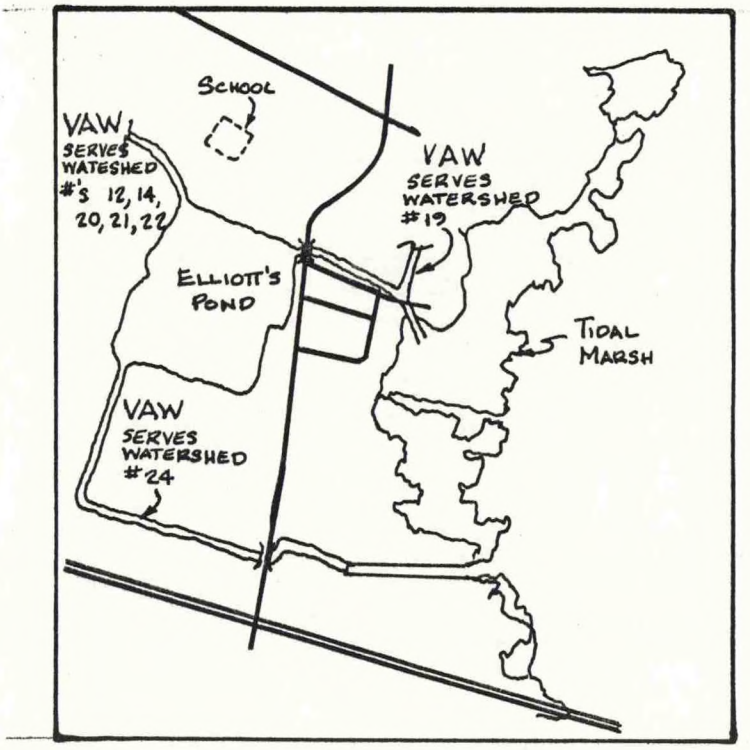


INDICATES ABANDONED BORROW PIT

EXHIBIT 10.4



EXISTING



PROPOSED

EXHIBIT 10.5

XI. INDIVIDUAL WATERSHEDS

This section of the report is dedicated to listing alternative plans for each individual watershed in order of functionability. A strong emphasis is placed on the development of Vegetated Aquatic Waterways and Abandoned Borrow Pits. This is due to the fact that with care in the acquisition of the required lands and in the design phases, these alternatives would provide the most environmentally beneficial and economically practical means of managing stormwater as is possible with current technology.

Each watershed is first described in terms of acreage and current zoning, the percentage of existing development, and the percentage of projected development. Projected development percentages do not reflect the area of land which would be required for stormwater management facilities as that would be determined by the alternative chosen.

Following the description will be the list of practical alternative plans. In some cases (such as watersheds 15 and 16) only one alternative has been listed. This is simply because no other plans show any practical application to that property as a whole. In all cases, however, efforts were made to list a minimum of two practical methods of stormwater management.

Watersheds which are not listed in this section are described as sheet discharge watersheds and have been dealt with prior to this in Section X (See Page 66).

WATERSHEDS 3 & 4

Total Acreage = 36 Acres Residential Zoning

Existing Development = 5%

Projected Development = 80% (20% Wetlands)

Practical Alternative Plans:

1. Conventional Ditching - Its close proximity to natural outlet points should make it possible for these watersheds to use conventional ditching by itself.
2. Vegetated Aquatic Waterway - This is the most practical alternative available for these watersheds, should efficient gradients not be possible with conventional ditching.

WATERSHED #6

Total Acreage = 22 Acres Residential Zoning

Existing Development = 25%

Projected Development = 100%

Practical Alternative Plans:

1. Vegetated Aquatic Waterway - Because of the extremely low elevations in this area this is the only practical plan to move stormwater out of the depressed watershed. Even this will only be effective during storm events of less significance than 25 years.

WATERSHED #7

Total Acreage = 42 Acres Residential Zoning

Existing Development = 30%

Projected Development = 95% (5% Wetlands)

Practical Alternative Plans:

1. Vegetated Aquatic Waterway - would take less square footage out of a productive state, and therefore be more cost effective than the second alternative. Conventional ditching could then be designed to functionally serve the watershed.
2. Storage ponds could be made to work but would necessarily confuse the layout of any development and road system. More square footage of road - more construction cost - less developable land.

WATERSHED #8

Total Acreage = 18 Acres Residential Zoning

Existing Development = 40%

Projected Development = 100%

Practical Alternative Plans:

1. Conventional Ditching - Using, as the outlet, the lagoon east of Keyser Point Road and just North of Golf Course Road it is possible to redesign conventional ditching through this area to become functional.

2. Vegetated Aquatic Waterway - The VAW System prescribed by this report and mapped on **Exhibit 10.2** runs through the center of this watershed. Though, this may not be as cost effective to this specific watershed, it is the most advantageous plan to other watersheds. Specifically, watersheds numbers 12, 13, 19, 20, 21, 22, and 24.

WATERSHED #12

Total Acreage = 38 Acres Residential Zoning

Existing Development = 0%

Projected Development = 100%

Practical Alternative Plans:

1. Vegetated Aquatic Waterway - Conventional ditching can not be expected to perform properly in this area without aide. The most practical plan available to bring the elevation of final outlet closer to the project location is the use of VAW's.

2. Central Storage Ponds - These are not as economical as the VAW but have proven to be effective in situations of these circumstances. A large multi-family development in this area might benefit from the effect of being clustered around a series of ponds, (as one example-only).

WATERSHED #13

Total Acreage = 22 Acres Residential Zoning

Existing Development = 0%

Projected Development = 100%

Practical Alternative Plans:

1. Central Storage Pond - This would be feasible here because of the proximity to a natural outlet point. Advantages here include:
   a) Adequate drainage for the watershed; and
   b) Improved water quality control due to the sedimentation process which would naturally occur in the pond.
2. Conventional Ditching - Could be designed for this area with functional gradients. The outlet for any such design, however, should not be discharged to the neighboring marsh, but to the Vegetated Aquatic Waterway located westerly along Golf Course Road. This offers some protection to water quality via the vegetative interaction with suspended sediment and nutrients prior to final discharge.

WATERSHED #14

Total Acreage = 67 Acres

Existing Development = ±20%

Projected Development = 70% (30% Estate Owned or County School)

Practical Alternative Plans:

1. Vegetated Aquatic Waterway - This is the most practical alternative for this watershed because of its relative efficiency in conveying stormwater runoff to the point of discharge. Much of this area is too distant from a natural outlet and at too shallow a slope to allow for functionability with conventional ditching, unless assisted by some means, such as a VAW.

2. Central Storage Ponds - Conventional ditching through this watershed might be aided by centering around sediment basins. The impracticalities involved here are, first, that they would necessarily take approximately 50% of developable land left through this area; and secondly, that pumping stations would be required to remove the stormwater runoff once collected.

WATERSHED #15

Total Property = 31.2 Acres Residential Zoning

Existing Development = ±85%

Projected Development = 100%

Practical Alternative Plans:

1. Conventional Ditching - This method is presently being utilized, however, inadequate gradients and lack of maintenance have reduced the efficiency of these ditches by as much as 80%. A rerouting of some of these ditches may improve the gradients. Presently, a roadside ditch follows pond road and drains from east to west, outletting on a tidal marsh. An improvement to this would be to break the slope midway down Pond Road. The slope would be to the west on the western half of the road, and towards Captains Hill Road on the eastern half. At the intersection of Captains Hill Road the ditch should turn south to meet and outlet at a tidal gut which ends at the road across from Anchor Court. A second rerouting which would improve drainage through the watershed would occur at Inlet Road. A roadside ditch flowing from south to north would outlet on the same tidal gut mentioned above. Throughout the watershed the driveway culverts are too small and clogged with sediment and debris. Many have less than 10% of the original capacity left. This must be corrected and a firm commitment made to proper and necessary maintenance.

WATERSHED #16

Total Acreage = 6 Acres Residential Zoning

Existing Development = 100%

Practical Alternative Plans:

1. Conventional Ditching - This area currently drains along the road and outlets to a finger gut which separates a tidal marsh from a bulkheaded property. Drainage here can be improved by increasing the depth and width of these ditches. Driveway culverts need to be increased as well.

WATERSHED #19

Total Property = 70 Acres Zoned Residential

Existing Development = ±85%

Projected Development = 100%

Practical Alternative Plans:

1. Vegetated Aquatic Waterway - This watershed is centered around a salt marsh. A channel runs naturally through this marsh and uses two separate outlets. Recently both outlets have been destroyed by development. First, to the north with the collapse of a culvert running under a house. This must be corrected either by replacing and enlarging the pipe, or by rerouting the natural channel around the blockage. The second blockage is to the south at the crossing of Riggin Ridge Road. This culvert, as well as, the one at the crossing of Center Drive should be replaced with double 30" diameter reinforced concrete pipes or suitable alternative product. An additional concern in this area is the presence of realtor signs on this marsh offering it for sale. Though it is saleable land it should not be misconstrued as being developable. This salt marsh should be recognized as a natural and necessary floodplain. Its development could only be harmful to all the properties located in this watershed.

WATERSHED #20

Total Acreage = 101 Acres Residential Zoning

Existing Development = 30%

Projected Development = 80% (20% - Abandoned Borrow Pit)

Practical Alternative Plans:

1. Central Storage Pond & Vegetated Aquatic Waterway - **EXHIBIT 10.2** shows a map of the proposed VAW System. Note that the abandoned borrow pit known as "Elliott's Pond" is central to this system. This is labeled as the most practical plan because it expands the drainage potential of West Ocean City dramatically, and does not require the expense of pumping the stormwater to a natural outlet.
2. Conventional Ditching - It may be possible to drain future development through this watershed with gravity induced ditching back to Elliott's Pond without the aide of a VAW. However, the gradients there would be in kind with those that are already proving ineffective throughout West Ocean City. Also, the outlet which currently exists for this stormwater collection site is not adequate now, and would have to be improved greatly to accept new development.

WATERSHED #21

Total Acreage = 63 Acres Residential Zoning

Existing Development = 18%

Projected Development = 95% (5% Wetlands)

Practical Alternative Plans:

1. Vegetated Aquatic Waterway - This watershed drains to a tidal gut which empties into Herring Creek. At one time the tidal action was active up to and possibly beyond Keyser Point Road. Years of sedimentation and partial filling have changed this gut into a ditch. By cleaning the gut and connecting it with the VAW System its efficiency and contribution to the West Ocean City Stormwater Management System would improve greatly. It could become the central drainage spur for Watersheds 7, 21, & 22.

2. Conventional Ditching - It would be possible to use conventional ditching through this watershed to outlet into this tidal gut. However, the stream bed has become narrow and clogged. Its slopes need to be recut and stabilized prior to accepting the dependency of new development.

3. Central Storage Pond - This may be necessary in the section of the watershed adjacent to Watershed #8, if conventional ditching (alternative #2) alone is the plan accepted by the commissioners.

WATERSHED #22

Total Acreage = 75 Acres Residential Zoning

Existing Development = 5%

Projected Development = 95% (5% Wetlands)

Practical Alternative Plans:

1. Vegetated Aquatic Waterway - See Watershed #21, Plan 1; See also **EXHIBIT 10.2.**
2. Central Storage Ponds - Some soils in this area are suitable for infiltration basins, but the majority of the area would have to be serviced by stormwater retention systems if this plan were followed.

WATERSHED #23

Total Acreage = 264 Acres - 30% Business Zoning

- 70% Residential Zoning

Existing Development = 35%

Projected Development = 85% (15% mixed wetlands & highways)

Practical Alternative Plans:

1. Vegetated Aquatic Waterway - This plan would most efficiently solve the drainage problem in this watershed. It is extremely large and requires a system which will convey water a great distance, with little slope.
2. Central Storage Ponds - These could be located throughout the area as the centers of small communities. Much of the soils are suitable for infiltration basins. However, in order to convey water out of the watershed, either ditching along the lines of VAW's or pumping stations will be necessary.

WATERSHED #24

Total Acreage = 88 Acres Business Zoning

Existing Development = 50%

Projected Development = 100%

Practical Alternative Plans:

1. Vegetated Aquatic Waterway - The County may take the option here of requiring that detention ponds be used as a sediment trap and filtration device, however, the most practical method of draining stormwater from this watershed is naturally through VAW's.
2. Central Storage Ponds - If VAW's are considered here to be undesirable for any reason, then it will become necessary to provide larger retention basins to collect the stormwater runoff and then remove it by way of pumping it to the isle of Wight Bay.
3. Infiltration Basins - These become a viable option here, but the design of these will demand that they cover a vast amount of square footage.

WATERSHED #26

Total Acreage = 47 Acres Business Zoning

Existing Development = 50% (30% U.S. Rte 50)

Projected Development = 100%

Practical Alternative Plans:

1. Conventional Ditching - It is sensible here to continue to use the stormwater collection and discharge system provided along U.S. Route 50. However, the need exists now and will continue to grow with future development, to provide better environmental safeguards. The most practical method would be to reserve and design a buffer zone around the final outlet.

WATERSHED #28

Total Acreage = 42 Acres Business and Industrial Zoning

Existing Development = 20%

Projected Development = 50% (50% Wetlands)

Practical Alternative Plans:

1. Central Storage Ponds - Some soils through this watershed are suitable for infiltration basins. Otherwise carefully placed and designed detention ponds seem to be the best option here.
2. Vegetated Aquatic Waterway - These could easily be designed and prove very effective if the land can be made available for it to be routed properly.

WATERSHED #29

Total Acreage = 80 Acres - 50% Residential Zoning

\- 20% Business Zoning

\- 30% Industrial Zoning

Existing Development = 40%

Projected Development = 100%

Practical Alternative Plans:

1. Infiltration Ponds - Many of the soils here are suitable for infiltration practices. Infiltration basins create parklike settings which scenically improve and environmentally enhance the per unit value of residential properties.

2. Stormwater Retention Ponds - These ponds would be effective here if an adequate outlet may be designed. A detailed topography will most likely show that elevations will not lend themselves through most of the area to discharging the ponds via conventional ditching. In such cases the incorporation of pumping stations will be required.

WATERSHED #30

Total Acreage = 48 Acres Residential Zoning

Existing Development = 15%

Projected Development = 50% (50% Wetlands)

Practical Alternative Plans:

1. Conventional Ditching - Because of the proximity of natural outlet locations, design of conventional ditching should be possible through the developable lands of this watershed at effective gradients.
2. See Harbor Dredge Spoil Site - Section X

WATERSHED #34

Total Acreage = 142 Acres - 35% Business Zoning

- 35% Residential Zoning

- 30% Industrial Zoning

Existing Development = 20%

Projected Development = 95% (5% Wetlands)

Practical Alternative Plans:

1. Conventional Ditching - Recently the State of Maryland has widened Route 611 through this watershed and improved the roadside ditches accordingly. The drainage pattern used was to carry the stormwater from Route 50 South to Sunset Avenue and then east along Sunset largely through a closed system to outlet onto a tidal marsh west of the West Ocean City Harbor. The states design, however, did not include the runoff from the remainder of the watershed. The most practical means of conveying this remaining stormwater to an outlet would be to transmit it through conventional ditching to the state system. Design of the state system would then have to be reviewed and further improved to accept the additional runoff. A cost sharing for this new construction between the county and state would be the most equitable solution to this dilemma.

2. Central Storage Ponds - Infiltration Basins would lend themselves well to most of the soils throughout this watershed, and therefore represent a viable second

option. It is important, however, to realize that these alternative plans require completely different drainage patterns. A determination of which alternative is the most feasible should be made as quickly as possible so as not to create conflicts with future development.

WATERSHED #35

Total Acreage = 112 Acres - 10% Business Zoning

- 40% Residential Zoning
- 50% Agricultural Zoning

(Expected to be rezoned residential)

Existing Development = 5%

Projected Development = 100%

Practical Alternative Plans:

1. Vegetated Aquatic Waterway - This "VAW" would differ slightly from that described in Section X in that it exhibits a spur which ends without an outlet. This spur would have a slight gradient (.1 to .05%) though it would not discharge 100% of the stormwater as effectively as the standard VAW's herein described, it would improve the discharge of stormwater greatly and allow conventional ditching through the remainder of the watershed.
2. Infiltration Basins - are a good option through most of this watershed, and could be used to supplement the VAW System.

WATERSHED #37

Total Acreage = 24 Acres - 50% Residential Zoning

- 50% Agricultural Zoning

(Expected to be rezoned residential)

Existing Development = 0%

Projected Development = 98% (2% Wetlands)

Practical Alternative Plans:

1. Infiltration Basins - Many of the soils here are suitable and this is the most environmentally sound plan for this area.
2. Conventional Ditching - Further topographical information is required to make a final determination, but it may be possible, though not desirable, to successfully serve this watershed using shallow gradients.

WATERSHED #38

Total Acreage = 64 Acres - 40% Residential Zoning

- 60% Agricultural Zoning

(Expected to be rezoned Residential)

Existing Development = 5%

Projected Development = 97% (3% Wetlands)

Practical Alternative Plans:

1. Central Storage Ponds - The best plan through this watershed may be to design a large infiltration basin on the most centrally located suitable soils and then connect it to detention ponds located radially around it. An overflow waterway to Herring Creek would be a good safeguard against central flooding of the watershed.
2. Central Storage Ponds - Should the infiltration pond mentioned above prove not feasible upon closer examination, a pumping station would become necessary to remove the water from what would now be called retention basins. (See Harbor Dredge Spoil Site, Section X.)

WATERSHED #39

Total Acreage = 188 Acres
- 12% Business Zoning
- 10% Industrial Zoning
- 28% Residential Zoning
- 50% Agricultural Zoning

(Expected to be rezoned Residential)

Existing Development = 15% (includes Private Road and Power R.O.W.)

Projected Development = 98% (2% Wetlands)

Practical Alternative Plans:

1. Central Storage Ponds - As mentioned under Watershed #38, stormwater detention ponds located radially around a large infiltration basin where suitable may be the most cost efficient system for this watershed.
2. Central Storage Ponds - Should infiltration practices prove not to be practical, pumping stations would become the most efficient method of discharge.

XII. CLOSING SUMMARY

In order to summarize, the initial goals listed in the introduction will be restated. A brief synopsis of how these goals were met will follow each one. The close of this report will then come with some conclusions as to the need for improved stormwater management programs and possible funding sources.

1) **Identify the current drainage problems and how they will be affected by 100% urbanized development of the area.**

This has been accomplished in two steps, first by presenting West Ocean City as it currently exists. Several Exhibits were used to map Tidal Wetlands, Interior Wetlands, Flood Boundaries, Existing Zoning, Current Land Use, and Soil Groups. **Exhibit 1.6**, which maps the Current Land Usage through the study area, also depicts the boundaries of 39 major watersheds, labels them, and identifies their discharge.

Through means such as topographical surveying, field inspection, and computer generated hydrological evaluations, this report has revealed the constricted or inadequate discharges and poor drainage patterns concurrent with the individual watersheds.

Review of this information highlights low land elevations and flat terrain as the two major difficulties in effectively discharging stormwater. Inefficient gradients, and constricting debries clogged culvert pipes are common throughout.

Second, for the purpose of determining the effect of urbanization

pressures, a model of the study area was designed to project 100% developoment. This was accomplished by modifying the Current Land Use Map (**Exhibit 1.6**) to depict a complete coverage of the developable lands. The type of land usages shown are the most environmentally stressfull allowed by current and projected zoning classifications. At the completion of this 100% Development Model a second series of technical hydrological evaluations was prepared.

These Post-Development data sheets in comparison with the existing, or Pre-Development evaluations generally show a dramatic rise in the volume of stormwater runoff which is directly proportional to the acreage of the watershed and both the density and intensity of the projected development. Refer to Section VIII to study correlation sheets between Pre- and Post-Development evaluations.

2) **List and discuss alternative systems to elimate, to the fullest extent possible, the hazards of flooding while allowing the fullest development possible.**

Section X deals with alternative improvements which might be used to modify current drainage patterns and increase the capabilities of West Ocean City to effectively discharge stormwater runoff. Methods discussed included:

Conventional Ditching, which uses a gradient, or slope, to induce water to flow toward a water quality control structure and then an outlet. This is effective only when engineered and constructed with consideration to the remainder of the entire watershed. It is not practical to construct a drainage system specific to a single

building lot when it will constrict the runoff flow from the remainder of the watershed upgrade. Yet, this situation has been documented throughout West Ocean City. Disadvantages associated with conventional ditching are

(A) There is generally not enough relief in the study area to allow effective engineering

(B) Maintenance, when scheduled properly, is expensive,

(C) Environmental safeguards such as sediment basins and filtration devices are often overlooked, though required by law.

Advantages are that

(A) They are effective on short runs when designed properly, and

(B) They are, at least initially, the least costly method of conveying stormwater.

Infiltration Basins, have been used successfully to percolate stormwater into the ground. This is an environmentally sound method of dealing with stormwater runoff. However, there are limiting factors which have to be contended with.

(A) The soils found in approximately 50% of the study area are not suitable for the practice of infiltration.

(B) Depending on the percocity rate of the soil and the volume of water being designed for, infiltration basins are often prohibitarily large.

(C) Design of these basins in a high development area must include an emergency drainage way for safety reasons. If this is not possible with a conventional ditch or a Vegetated

Aquatic Waterway, it may become necessary to install a pumping system.

Advantages to this method include

(A) The aforementioned environmental parameters

(B) The low maintenance costs (where pumps are not incorporated)

(C) The asesthetic value of open green space. A good application for infiltration basins would be in suitable soils within a Planned Unit Development (PUD) where 30% of the subdivision must be dedicated to green space.

Vegetated Aquatic Waterway is an innovative technique well suited to low-lying, flat terrain, as found in West Ocean City. These are wide, marsh level ditches with multiple outlets. They would be vegetated with aquatics which, through natural functions, would stabilize and substantially reduce the maintenance cost for the system. **Exhibit 10.2** shows the suggested coursing of this system.

Some of the drawbacks foreseen with V.A.W.'s are

(A) They are necessarily extremely wide

(B) The initial construction cost may prove to be fairly expensive.

Some of the merits associated include

(A) A dramatically more extensive and efficient drainage system,

(B) Low maintenance costs

(C) They are aesthetically more attractive than other forms of ditching

(D) They are safer than other forms of ditching due to gradual slopes

(E) They exhibit a positive suitability to the terrain of the area

(F) They are environmentally sound in that they create new habitat and improve water quality considerably through filtration

(G) Hidden costs associated with other forms of ditching such as sediment basins, drob structures, ect. are avoided with this method in most cases.

The Harbor Dredge-Spoil Site has potential for becoming an above-grade stormwater storage facility. This method of handling stormwater has functionability in a situation where inundation by high water levels renders natural drainage impossible. In these instances runoff collected at other locations would be pumped into this facility and stored there until it becomes possible to discharge through a slow release to surrounding waters. Negative factors associated with this plan are

(A) High initial construction cost

(B) High maintenance cost

(C) Limited practical usage.

Positive aspects of this project are that

(A) It offers a practical flood protection system which could save countless dollars of property damage

(B) It makes use of an otherwise unsightly unit of land

(C) Under county government supervision it could be given a second role as an educational park dedicated to natural habitat and wildlife study. This might be accomplished

by creating a fenced trail spiraling down into the site and exhibiting various habitat and wildlife common to this climate and elevation. The creation of such a park could be an additional drawing factor to a year round tourist trade and be beneficial to both the county and state in this manner. It may open doors to funding sources outside the County.

Abandoned Borrow Pits may be used as stormwater detention basins providing that all required permits from State and Federal Authorities are first obtained. Development around these ponds could direct its drainage to them where sediment suspended in the runoff would settle to the bottom. A metering system would establish the mean water elevation in the pond and regulate the discharge of stormwater to the final outlet. It might be recommended here to establish parks centered around these ponds to take full advantage of the aesthetic qualities inherent to them. Disadvantages to this system include

(A) The possible rerouting of some established drainage patterns,

(B) The possible need for pumping stations. Though this requirement is unlikely, it can not be ruled out without further topographical information.

Advantages are

(A) Increased drainage potential

(B) Aesthetically pleasing atmosphere

(C) Increased land values (due to A & B)

(D) Establishes an environmentally responsible system of dealing with Water Quality Control.

Elliott's Pond is also an abondoned Borrow Pit and may be considered as a potential stormwater detention basin. When used in conjunction with the Vegetated Aquatic Waterway System, however, its capabilities could be increased to directly affect seven major watersheds extending as far West as Herring Creek, and as far South as Route 50.

Disadvantages to this plan include only the cost of revegetating the pond. Advantages on the other hand encompass

(A) A vastly improved drainage system

(B) Improved land values

(C) Enhancing wildlife habitat

(D) Improved water quality control of stormwater discharge

(E) Maintaining an ecologically and aesthetically important county resource.

Buffer Strips are mentioned in section 10 under the subheading of Sheet Drainage Watersheds. Twenty-five foot buffer strips will not improve drainage patterns which are adequate. They will, though, improve the Water Quality immensely, and therefore, be in keeping with the intentions of federal and state level laws and regulations which deal with clean water.

Facts which may prove deterants to the implementation of buffer strips are

(A) The loss of developable lands

(B) The possible need to adjust zoning classifications or

stormwater management regulations to state clearly a requirement for these in specific areas. Merits of this plan include

(A) Improved water quality control

(B) A better stabilization of the high water line

(C) A more aesthetically pleasing shoreline.

3. **Develop plans to ensure that proper and necessary environmental safeguards are responsibly dealt with.**

All of the drainage alternatives herein listed, take into consideration and discuss environmental parameters. Where possible, unsightly stormwater management structures have been avoided. This report, however, does not constitute a final design and further research during the engineering phases may show the necessity for more stringent environmental protection measures.

Better Management of Stormwater facilities is necessary throughout the study area. This should occur by improving:

A. Planning and Design -

In reviewing plans for future development, it is important to consider the entire watershed as opposed to simply the site specific. This was, perhaps, the ultimate goal of the Worcester County Storm Water Management Ordinance and the Sediment and Erosion Control Ordinance, both regulations being important steps towards proper management. However, further work needs to be done in this area. The most prudent recommendation would be to design, not only for the specific site, but also for the volume of stormwater runoff from the remaining portion of the watershed. If the jurisdiction deems that it is unnecessary to construct the larger system at that time, the area required for it should be set aside as a perpetual easement. The monies required for construction, as determined proportionally for each watershed, should be placed in escrow by the developer and controlled by the jurisdiction. Another area of concern in the planning and design process is the necessity to plan for maintenance. Stormwater drainage systems, which serve more of the watershed than an individual site of proposed development, require periodic maintenance, which should be monitored and directed by the jurisdiction. This, of course, is not possible without access. To assure access to these systems, both for maintenance and system upgrading, either perpetual easements or fee simple ownership held by the Worcester County Commissioners is necessary. Either method would also insure against building in an area required for stormwater management facilities.

B. Post-Development Management -

As discussed earlier, monitoring and maintenance are priority concerns. Though the resident jurisdiction has the liability of these functions, because of the possible danger to life and property, the County holds an obligation to oversee them and step in if necessary. If it becomes required that the County use its manpower or monies on the behalf of a jurisdiction, those funds should be reimburseable, either through billing for work completed or taxing for services performed.

Another program which would ultimately be beneficial to the County and the State, is a Transfer of Development Rights Program. This may not be effective, if applied only to the 2,500 acre West Ocean City area, but County wide implementation of such a program holds merit. Reference is made to the "Agricultural and Rural Open Space Preservation Program" of Montgomery County, Maryland, which discusses this program in depth.

Priority watersheds (see Section IX, page 57) currently exhibit drainage problems which should not be ignored while developing alternative funding sources. As an example, Watershed #19 has been listed as watershed priority number 1. The problems listed are collapsed and constricted or blocked culverts. This has seriously impaired the watersheds ability to effectively discharge stormwater, and has become a severe hazard. Further research into the permits to construct a building over the outlet and the liabilities associated with them is required before a final determination is made as to who is responsible for correcting the problem. But while the decision is being made the hazard still exists and is worsening. Because of the severity of the constriction, plans need to be made as soon as possible to elevate the problem.

Funding programs go hand-in-hand with management. The Worcester County Commissioners may determine that it is necessary to implement these new stormwater management alternatives immediately and be reimbursed by the local jurisdictions over a period of time. A second option, in areas of less priority, might be to allow the various jurisdictions to implement plans for stormwater management systems, as approved by the County. As development increases through the watershed, the need for these systems grows. This would be advantageous to the public in that future developments would be responsible to pay their equitable share of the construction costs as determined by their contribution both of increased stormwater runoff and to the need for collection and control facilities.

Some examples of local jurisdictions and management systems would include:

1. Public Watershed Associations (PWA)
2. Public Drainage Associations (PDA)
3. Tax Ditches (other)
4. Complete County control

PWA's are recommended to handle their own interior stormwater system monitoring and maintenance. Though there should be some county supervision of this process, PWA's should not have to be directly managed by the commissioners.

The second step in complete management should be set up similarly to a Tax Ditch System, but in respect to VAW's. These Vegetated Aquatic Waterways function as a system and must be handled and maintained as a whole system rather than in a broken, disorderly, and slow method, as would be the case if controlled by the various watershed associations.

VAW's should remain completely under the control of the Worcester County Board of Commissioners. A user fee designed to pay for the monitoring, maintenance and administrative work should then be taxed to the various watershed associations on a basis of percentage of total volume of stormwater runoff deposited into the system.

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