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SDMS DocID 49003

PRELIMINARY FLOOD PLAIN ASSESSMENT INVESTIGATION

NEW BEDFORD HARBOR

NEW BEDFORD, MASSACHUSETTS

Superfund Records Center
SITE: New Bedford
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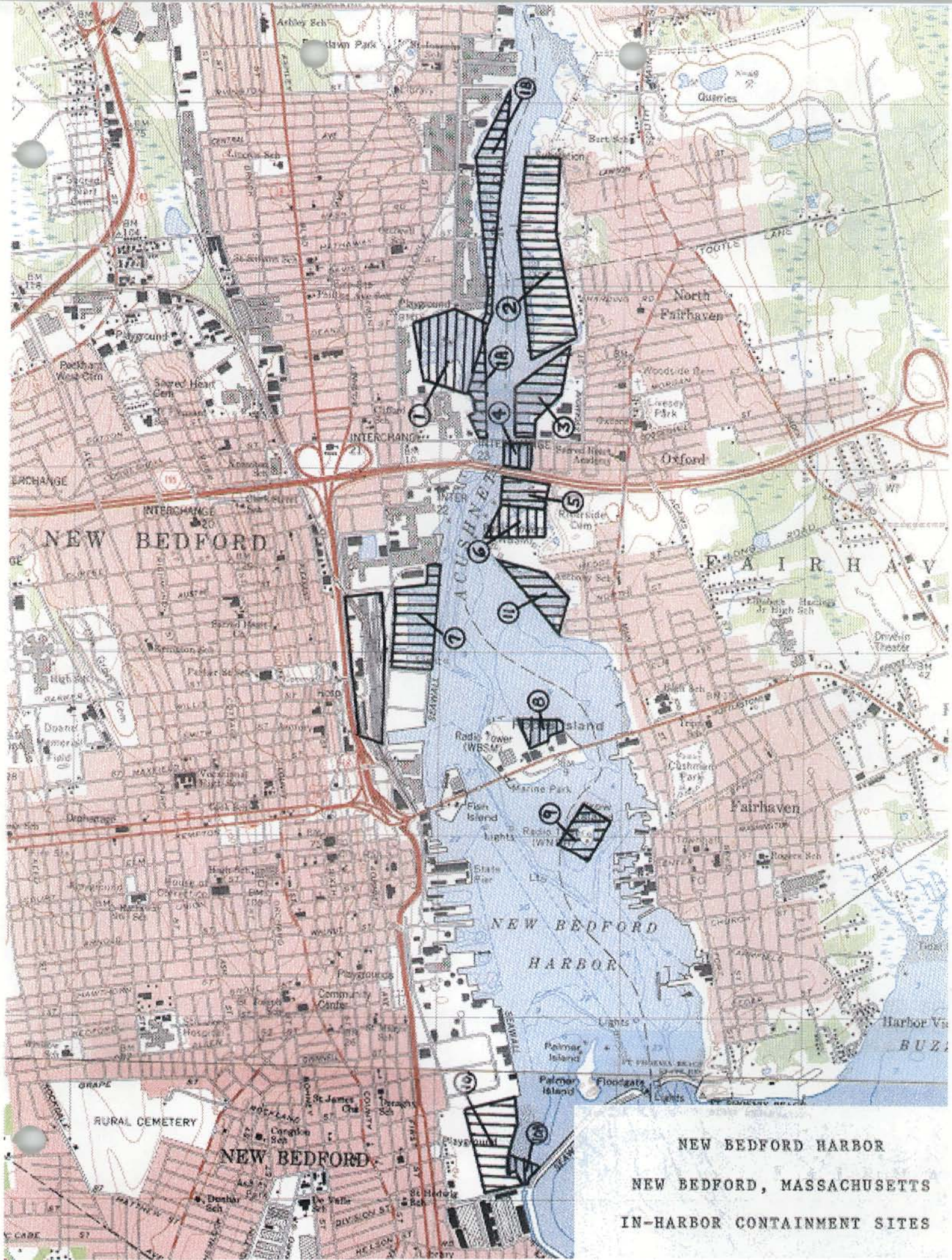
OTHER: 49003

This summarizes the results of the preliminary hydrology study of the various in-harbor containment areas and their effect on flooding within the New Bedford Harbor area. The 15 containment areas identified in the April 1986 evaluation by NUS entitled, "Investigation and Ranking of Potential In-Harbor Disposal Sites," are delineated on the attached map.

The hydrology study concluded that any loss of harbor volume, either by filling or diking, below elevation 2.0 feet NGVD would have no impact on the design storage capacity of the New Bedford Hurricane Barrier. Similarly, it is concluded that any loss of volume above elevation 6.0 feet NGVD would have no impact on design storage capacity. It is, therefore, loss of storage in the 2.0 to 6.0-foot elevation range that will have an effect on project flood storage capability. For every 400 acre-feet of volume lost between these elevations, there will be a resulting rise in project design flood level of about 0.2 feet. The attached table summarizes the total volume in acre-feet of each site and the resultant increase in flooding during design flow conditions.

The other option evaluated consists of channelizing the Acushnet River through an 80-foot wide trapezoidal channel from Coggeshall Street Bridge to the head of the harbor. Construction of this option would increase flood stages upstream of the Coggeshall Street Bridge by about 2.0 feet.



NEW BEDFORD HARBOR

NEW BEDFORD, MASSACHUSETTS

IN-HARBOR CONTAINMENT SITES

New Bedford Harbor
New Bedford, Massachusetts
In-Harbor Containment Sites

Volume Between +2' & +6' NGVD

Site Number	Surface Area (acres)	Dike Volume (ac-ft)	Total Volume (ac-ft)	Flooding Increase (feet)	Flooding Increase (inches)
1	29	26.3	142.3	0.07	0.85
1A	7	36.5	64.5	0.03	0.39
1B	18	72.4	144.4	0.07	0.87
2	43	45.3	217.3	0.11	1.30
3	17	24.2	92.2	0.05	0.55
4	5	10.9	30.9	0.02	0.19
5	7	14.0	42.0	0.02	0.25
6	11	17.4	61.4	0.03	0.37
7	23	27.8	119.8	0.06	0.72
8	7	12.4	40.4	0.02	0.24
9	11	20.3	64.3	0.03	0.39
10	25	26.8	126.8	0.06	0.76
10A	3	18.4	30.4	0.02	0.18
11	11	22.0	66.0	0.03	0.40

HYDROLOGY OF FLOODS

NEW BEDFORD HARBOR

MASSACHUSETTS

BY

HYDROLOGIC ENGINEERING SECTION
WATER CONTROL BRANCH
ENGINEERING DIVISION

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

SEPTEMBER 1987

HYDROLOGY OF FLOODS
NEW BEDFORD HARBOR
MASSACHUSETTS

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HYDROLOGY OF FLOODS

NEW BEDFORD HARBOR

MASSACHUSETTS

1. PURPOSE

This report presents basic hydrologic information and discussion as an aid to the planning and design of pollution control and abatement measures for the upper New Bedford Harbor, in the area generally upstream of Coggeshall Street bridge. Included are sections on site description, climatology, stream flow, tidal regime and analysis of floods. This initial assessment of preproject hydrologic conditions will be followed by assessments of the hydrologic impacts and alternatives of finally selected plans of action.

2. DESCRIPTION

a. New Bedford Tidal Estuary

New Bedford Harbor, located between the city of New Bedford on the west and Fairhaven, Massachusetts, on the east, is the tidal estuary of the Acushnet River and discharges to Buzzards Bay. The harbor has a maximum width of about 0.7 mile and an overall length of about 4.3 miles extending from just south of Palmer Island, upstream about 2.5 miles to the limits of navigation at Coggeshall Street bridge and then continues another 1.9 miles to the northerly limit of tide water. The outer limit of the Harbor is generally defined by a tidal barrier (see Paragraph 6) completed by the Corps of Engineers in 1966. Total surface area of the harbor, behind the barrier, is just over 1,000 acres at zero mean sea level, with about one fifth of the area located upstream of the Coggeshall Street bridge.

b. Acushnet River Watershed

The watershed of the Acushnet River, shown on Plate 1, is approximately 11 miles long and three miles wide. The drainage area above the main barrier is 29.4 square miles. The river originates in the town of Freetown, Massachusetts, and flows in a general southerly direction for about 12 miles to New Bedford Harbor. It has a total fall of about 50 feet of which seven feet are in the upper four miles and the remaining drop is in the middle four miles. The lower four miles are within New Bedford Harbor.

The headwater tributaries, Squam Brook and Keene River, originate on slopes that rise to about 160 feet above mean sea level. These two streams flow in a southeasterly direction for about two miles, then join to form the Acushnet River. This junction is at New Bedford Reservoir. New Bedford Reservoir controls 6.8 square miles of drainage area and has a water surface area of 600 acres at full pool. The top of dam is approximately five feet above the

spillway crest elevation. The surcharge storage at three feet above spillway crest is estimated to be 2,800 acre-feet, equivalent to 7.7 inches of runoff. Flood outflows from New Bedford Reservoir are greatly reduced by this large amount of surcharge storage.

Between New Bedford Reservoir and Saw Mill Dam, at the northern end of New Bedford Harbor, the Acushnet River meanders in a general southwesterly direction through large flat swamplands. A small dam has been built just upstream of Hamlin Road for irrigation purposes. The storage at this dam is very small and would have no appreciable effect on moderate or major floods. The storage at Saw Mill Dam also is small and would not have any appreciable effect on floods. The drainage area of the Acushnet River at Saw Mill dam is 18.4 square miles.

Between Saw Mill Dam and the main barrier, there are very few open channel streams entering the Acushnet River. In contrast to the area above Saw Mill Dam, which is sparsely settled, the area below Saw Mill Dam is highly urbanized and industrialized. This area is almost entirely drained by storm sewers. This urban area comprises a net drainage area of about 11 square miles.

3. CLIMATOLOGY

a. General

New Bedford, a humid region with an average annual precipitation of about 50 inches, has a variable climate characterized by frequent but generally short periods of heavy precipitation. Mean annual temperature is about 50 degrees Fahrenheit, varying from the low 70's in July to near 30 degrees Fahrenheit in January. Extremes in temperature range from highs in excess of 100 degrees to lows near minus 12 degrees Fahrenheit.

b. Storms

The Acushnet River Basin experiences three general types of storms: continental, coastal, and those associated with thunderstorms. Continental storms originate over the United States and southwestern Canada, and move in a general easterly and northeasterly direction. These storms may be rapidly-moving intense cyclones or may be of the stationary type. These are not limited to any season or month but follow one another at more or less regular intervals with varying intensities throughout the year. Of the coastal storms, tropical hurricanes constitute a very important potential for flood producing precipitation from July to October. Coastal storms of an extra-tropical nature differ from hurricanes, principally, in that they originate off the Carolina coastline. These storms occur most frequently during the autumn, winter and spring months. These coastal storms frequently produce severe weather in the form of high winds, tides and intense rainfall. Thunderstorms may be of local origin or of the frontal type associated with summer months.

c. Storm Rainfall

Heavy precipitation, often of torrential proportions, usually accompanies hurricanes and sub-hurricane coastal storms. A tabulation of historic hurricane rainfalls along the North Atlantic coastal region, developed in connection with the design of the New Bedford Barrier in 1961, is shown in Table 1. Included in the table are maximum 6-hour and one-day rainfalls at New Bedford, Massachusetts, and Providence, Rhode Island. Four notable sub-tropical coastal storms, experienced this century, occurred in November 1944, November 1953, November 1963 and January 1978. Storm rainfalls associated with these events ranged from 1.5 to 3 inches. Rainfall frequencies for durations of 1 to 24 hours, taken from U.S. Weather Bureau Technical Paper #40, are listed in Table 2.

TABLE 1

RAINFALL ASSOCIATED WITH HURRICANES
FOR NORTH ATLANTIC COASTLINE

DATE	YEAR	STORM CENTER	PRECIPITATION IN INCHES					
			10 SQ. MI.		NEW BEDFORD		PROVIDENCE	
			Max. 6-hr.	Max. 24-hr.	Max. 6-hr.	1-day	Max. 6-hr.	1-day
Oct 22-26	1923	Setauket, N.Y.		± 7	0.8*	1.0	0.6*	0.76
Aug 26	1924	Kingston, R.I.		± 7	4.2*	5.65	2.9*	3.76
Sep 16-17	1932	Westerly, R.I.	7.0	12.2	1.8*	2.42	4.1	6.17
Aug 20-24	1933	Peekamoose, N.J.	6.8	11.2	0.5*	0.6	0.6*	0.73
Sep 16-18	1933	Provincetown, MA		± 10	2.5*	3.35	3.0*	3.99
Sep 18-19	1936	Provincetown, MA		± 7	2.4*	3.16	2.2*	2.85
Sep 17-22	1938	Buck, CT	6.4	11.3	0.8*	1.04	0.8*	1.04
Aug 19	1939	Manakawkin, N.J.	9.7	17.8 (18 hrs)	0.8*	0.94	0.3*	0.43
Sep 31-Oct 1	1940	Ewan, N.J.	20.1	22.7 (12 hrs)	none	none	none	none
Sep 12-15	1944	New Brunswick, N.J.	6.2	7.0	1.78	1.93	4.69	5.43
Sep 7-12	1954	Long Island, N.Y.		± 9	2.39	3.35	2.74	4.37
Sep 25-Oct 1	1954	Eagles Mere, PA		± 6	none	none	none	none
Aug 11-15	1955	Slide Mt., N.Y.	5.6	10.8	2.42	3.47	1.59	2.25
Aug 17-20	1955	Westfield, MA	7.8	15.2	2.16	2.70	2.90	3.28
Sep 20	1955				0.25	0.25	0.47	0.47
Aug 29	1958	"Daisy"			0.61	0.85	0.30	0.34
Jul 29-31	1960	"Brenda"			0.25*	0.31	0.6*	0.72

* Estimated

TABLE 2

RAINFALL FREQUENCY - DURATION
NEW BEDFORD, MASSACHUSETTS

(USWB TP - 40)

Frequency In Years	1 hour	6 hours	12 hours	24 hours
2	1.2 in.	2.4 in.	2.8 in.	3.3 in.
5	1.6 in.	2.9 in.	3.5 in.	4.2 in.
10	2.0 in.	3.4 in.	4.1 in.	4.9 in.
25	2.2 in.	4.0 in.	4.7 in.	5.8 in.
50	2.5 in.	4.5 in.	5.2 in.	6.2 in.
100	3.0 in.	5.0 in.	6.0 in.	7.0 in.
SPF	3.5 in.	9.1 in.	10.5 in.	11.8 in.

4. TIDAL REGIME

a. General

Tides in New Bedford Harbor are semidiurnal, with two high and two low waters occurring each lunar day. The mean range of tide is 3.7 feet as measured between a mean low water of 1.3 feet below National Geodetic Vertical Datum of 1929 (NGVD) and a mean high water of 2.4 feet above NGVD. Spring tides have a mean range of 4.6 feet and a maximum range of approximately 6.7 feet. A maximum spring tide will reach elevation 4.2 feet above NGVD. Time interval for a complete tidal cycle averages about 12 hours and 25 minutes. Tidal data for New Bedford Harbor are summarized in Table 3.

TABLE 3

ASTRONOMIC TIDES
NEW BEDFORD, MASSACHUSETTS

	FEET
Mean Tide Range	3.7
Mean High Water (above NGVD)	2.4
Mean Low Water (below NGVD)	1.3
Mean Spring Tide Range	4.6
Mean Spring High Water (above NGVD)	2.9
Maximum Spring High Water (above NGVD)	4.2
Minimum Spring Low Water (below NGVD)	2.5

b. Storm Tide Levels

A recording tide gage was maintained at the New Bedford-Fairhaven bridge by the city of New Bedford from 1922 to 1965, and since 1966, the Corps has operated a continuous recording tide gage at the hurricane barrier. Based on the above gaged data and historical records for hurricanes, Table 4 lists outer harbor tide levels at New Bedford in excess of 5.5 feet NGVD.

c. Tidal Frequency

A tide-stage-frequency relationship for New Bedford has been developed utilizing a composite of a Pearson Type III distribution function (with expected probability adjustment) for analysis of adjusted annual maximum stillwater tide levels and a graphical solution of Weibull plot positions for partial duration series data. Historic tidal flood data for Providence, Rhode Island, together with a stage correlation between Providence and New Bedford were utilized to adjust the Pearson Type III statistics and effectively extend the historic period of record at New Bedford. The resulting tide stage-frequency relationship for the outer harbor at New Bedford is shown on Plate 2.

TABLE 4

MAXIMUM TIDE ELEVATIONS
NEW BEDFORD, MASSACHUSETTS

Date	Stillwater Elevation (ft, NGVD)
21 Sep 1938 Hurricane	12.5
31 Aug 1954 Hurricane "Carol"	11.9
23 Sep 1815 Hurricane	11.5± (est)
14 Sep 1944 Hurricane	8.1
30 Nov 1944	6.8
12 Sep 1960 Hurricane "Donna"	6.3
9 Jan 1978	6.3
22-23 Jan 1987	6.3
7 Nov 1953	6.2
30 Nov 1963	6.1
30 Jul 1960 Tropical Storm "Brenda"	6.1
19 Feb 1960	6.1
10 Jun 1960	6.1
20 Nov 1972	6.1
29 Dec 1966	6.0
25 Nov 1983	5.9
29 Dec 1959	5.8
2 Dec 1974	5.7

5. STREAMFLOW

a. General

There are no streamflow gaging stations on the Acushnet River. Based on long-term gaging station records in the region, it is estimated that the average annual flow of the river at tide water (drainage area = 18.4 square miles) is about 30 cfs or about 1.7 cfs per square mile, equivalent to about 26 inches of runoff per year, or about 50 percent of average annual precipitation. Accordingly, average annual runoff to New Bedford Harbor above the barrier, with a total drainage area of 29.5 square miles would be about 50 cfs. In general, about 60 percent of average annual runoff in this region occurs during the late winter and spring months: February - May.

b. Peak Discharges

Peak freshwater inflows into New Bedford Harbor are comprised of inflows of the Acushnet River at Saw Mill dam (drainage area = 18.4 square miles) and local runoff from the surrounding New Bedford and Fairhaven urban areas. The Acushnet River has a flat hydrologically sluggish watershed with considerable wetland detention area. Peak discharge frequencies for this river were based on gaged flows on a similar nearby watershed; the Wading River near Norton, Massachusetts, located about 12 miles northwest of New Bedford, with a drainage area of 42.4 square miles. Peak discharge frequencies for the Acushnet, listed in Table 5, were computed as proportional to the Wading River data by ratio of drainage areas to the 0.7 power. The Standard Project Flood (SPF) for the river, at 1,350 cfs, was computed during barrier design by applying SPF rainfall to an adopted unit hydrograph.

Peak runoff from the remaining local area, totalling 11 square miles below Saw Mill dam, would be comprised of the sum of the runoff of numerous storm drained areas discharging to the harbor. Runoff volume to the harbor from the local area during barrier gate closure was assumed equal to the maximum 5- or 6-hour rainfall times percent runoff. Percent runoff was 90 percent for 50 percent of the area; 60 percent for 36 percent of the area; and 100 percent for the 14 percent bay area. It is possible, but not likely, that the peak discharge of the river, the peak runoff of the local area, and the storm tide would all occur coincidently. However, for barrier design, it was assumed that 100-year local rainfall and standard project river flood could occur at time of design storm tide. For purposes of comparison, 10 percent (10-year), 2 percent (50-year) and 1 percent (100-year) events were developed in current studies assuming: a 10 percent chance (10-year) riverflow and tide coincident with a 50 percent (2-year) local rainfall, a 2 percent (50-year) riverflow and tide with a 10 percent (10-year) local rainfall, and a 1 percent (100-year) riverflow and tide with a 2 percent (50-year) local rainfall. Results of the analysis are summarized in Table 6.

TABLE 6

NEW BEDFORD HARBOR
FLOOD FREQUENCY DATA

FREQUENCY IN YEARS	10	50	100	DESIGN
Ocean Stillwater Elev. (NGVD)	7.0	10.8	12.6	16.0
Gate Closure Elev.	3.5-4.5	3.0-4.0	2.5-3.5	2.0-3.0
River Inflow at Saw Mill Dam (18.4 sq. mi.) (cfs):	475	740	880	1350 (SPF)
(acre-feet):	395	590	700	1080
Local Inflow (11 sq. mi.) (acre-feet):	1050 (2-yr)	1490 (10-yr)	1970 (50-yr)	2190 (100-yr)
Wave Overtopping (acre-ft)	0	0	0	900
TOTAL INFLOW (acre-feet)	1450	2080	2670	4170
Interior Elev. (ft. NGVD)				
Range:	4.5-5.5	4.5-5.5	4.6-5.6	5.2-6.2
Adopted:	5.0	5.0	5.1	5.7

6. NEW BEDFORD BARRIER

a. Description

The barrier at the mouth of the Harbor, the principal feature of the overall New Bedford-Fairhaven Tidal Flood Protection Project, extends from Fort Phoenix at the southwestern tip of Fairhaven, westward across the entrance to New Bedford-Fairhaven Harbor, a distance of 4,600 feet. A dike then extends from the western end of the barrier another 4,500 feet southward along the East Rodney French Boulevard to high ground. The barrier has a top elevation of 20 feet National Geodetic Vertical Datum (NGVD) and the dike is at 22 feet NGVD. Both are constructed of earth and rock fill with armor stone protection. The barrier has a 150-foot wide navigation opening equipped with two sector gates, with sills at -39.0 feet NGVD and tops at +20.0 feet NGVD. The barrier also has two twin-barrel gated conduits to provide circulation of water in the southwestern corner of the harbor. Each conduit is 6 feet wide

by 9 feet high. The dike has 3 circular gated conduits: 48, 36 and 24 inches in diameter plus a street gate, sill elevation 7.5 feet NGVD, on Rodney French Boulevard East. A general plan of the tidal flood protection project is shown on Plate 3.

b. Operating Procedures

The Corps of Engineers is responsible for operation of the main barrier, whereas, the city of New Bedford is responsible for operating the connecting dike. Operation of the main barrier for the more frequent coastal storms is under the direction of Corps staff at the Cape Cod Canal office. For hurricanes, main barrier operation is under the direction of Corps staff at New England Division headquarters in Waltham, Massachusetts. For coastal storms the barrier is closed on rising storm tides at tide levels of 3.5 to 4.5 feet NGVD. The closure level depending on wind speed and direction. For hurricanes, the barrier is closed when the bay reaches about +2.0 feet NGVD on a rising tide with an occurring or expected hurricane surge. For further information and discussion on operating procedures at the New Bedford Barrier, reference is made to: Corps of Engineers, New Bedford-Fairhaven Hurricane Barrier Regulation Manual for Hurricanes and Coastal Storms, August 1983.

c. Design Flood Conditions

The hurricane barrier and dike are designed to protect against a standard project hurricane tide having a stillwater tide level of 16 feet NGVD with accompanying winds of 100 miles per hour from the south producing 8-foot waves. The design standard project hurricane was based on a transposed Cape Hatteras hurricane of September 1944. For design flood conditions, gate closure is required at tide level +2.0 feet NGVD to provide interior storage capacity for design interior runoff and wave overtopping. Design interior runoff was based on:

(1) Standard project flood runoff from the Acushnet River upstream of Saw Mill Dam (1,350 cfs).

(2) Runoff from 1 percent chance (100-year) rainfall over interior area downstream of Saw Mill dam.

(3) Maximum overtopping from design hurricane tide.

Total design storage inflow was approximately 3,700 acre-feet assuming a 5-hour gate closure period and about 4,200 acre-feet assuming a 6-hour closure period. Total inflow was about 20 percent overtopping, 25 percent Acushnet flow and 55 percent local urban runoff.

With gate closure at +2.0 feet NGVD and a design inflow of 3,700 acre-feet, the resulting interior storage level would be to 4.8 feet NGVD. The original design area - capacity curve for the interior bay area is shown on Plate 4. The elevation 4.8 feet NGVD is considered a minimum design level. With a

6-hour inflow of 4,200 acre-feet and gate closure at +2.0 or +3.0 , the resulting interior storage levels would be +5.2 feet NGVD and +6.2 feet NGVD, respectively. Start of flood damage is between 4.0 and 4.5 feet NGVD depending on wind speed and direction. Significant damage commences with levels above 5 feet NGVD.

7. ANALYSIS OF FLOODS

a. General

The factors that govern water levels in New Bedford Harbor are twofold: one set for conditions with barrier closed and a second for barrier open. For conditions of hurricanes and coastal storms, with gate closure, resulting interior levels are almost entirely a function of interior flood storage governed by: interior runoff, available harbor area, gate closure elevation and duration of closure. Whereas, during non-gate closure periods, harbor levels are a function of the open ocean tidal regime and the hydraulics of flow conveyance through the harbor.

b. Flood Flow Conveyance

Under open gate, normal spring tide conditions, approximately 5,000 acre-feet of tidal flow enters and exits the harbor every 6-hour tide period which represents an average flow through the open navigation gate of about 10,000 cfs, requiring an average velocity through the 150-foot wide by 39-foot deep opening of about 2 feet per second. Velocities at the center of the opening at mid-tide are in the order of 4 feet per second. This tidal interchange rate of 10,000 cfs is about 10 times greater than the peak standard project flow of the Acushnet River above Saw Mill dam. Under present conditions tidal flows and river flows are conveyed through the harbor, with its large cross sectional area, with low velocities - generally less than 1 feet per second - and with negligible hydraulic head loss. Hydraulic losses and velocities in the reach between the barrier and Coggeshall bridge are quite negligible. From Coggeshall to the head of the harbor, with a river flow of 1,350 cfs (SPF), computed velocities and rise in water surface, under existing conditions, vary from about 2.5 feet per second and 3.5 feet with an ocean tide of -2.0 feet NGVD to 0.5 feet per second and 0.1 feet with an ocean tide of +2.0 feet NGVD.

By comparison, if the Acushnet River were to be channelized in an 80-foot wide trapezoidal channel with 2 horizontal on 1 vertical side slopes, from Coggeshall Street bridge, to the head of the harbor, the computed velocity and rise in water surface for a flow of 1,350 cfs would be 3.5 to 4 feet per second and about 5.5 feet with an ocean tide of -2.0 feet NGVD and about 3.0 feet per second and 2.0 feet with an ocean tide of +2.0 feet NGVD.

c. Flood Storage

Under conditions of gate closure, during hurricanes and coastal storms, harbor storage capacity, rather than conveyance, is vital for the safe storage of interior river and local urban runoff, and any barrier wave overtopping. Because the lowest gate closure tide level is about +2.0, any loss of harbor volume, either by filling or diking, below elevation +2.0 would have no impact on design storage capacity. Similarly, since upper limit storage capacity is about elevation 6.0 feet NGVD, it can generally be concluded that any loss of volume above elevation 6.0 feet NGVD would have no impact on design storage capacity. It is, therefore, loss of storage in the +2.0 to +6.0-foot elevation range that will have an effect on project flood storage capability. The present harbor area, at elevation +2.0 feet NGVD, is believed about 1,200 acres. Therefore, for every 100 acres of harbor area lost above +2.0 feet NGVD but below +6.0, either by diking or filling, there will be a resulting rise in project design flood level of about 0.2 feet.

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New England Division, Corps of Engineers, New Bedford-Fairhaven Hurricane Barrier, Design Memo. No. 1, Hydrology and Hydraulics, June 1961.

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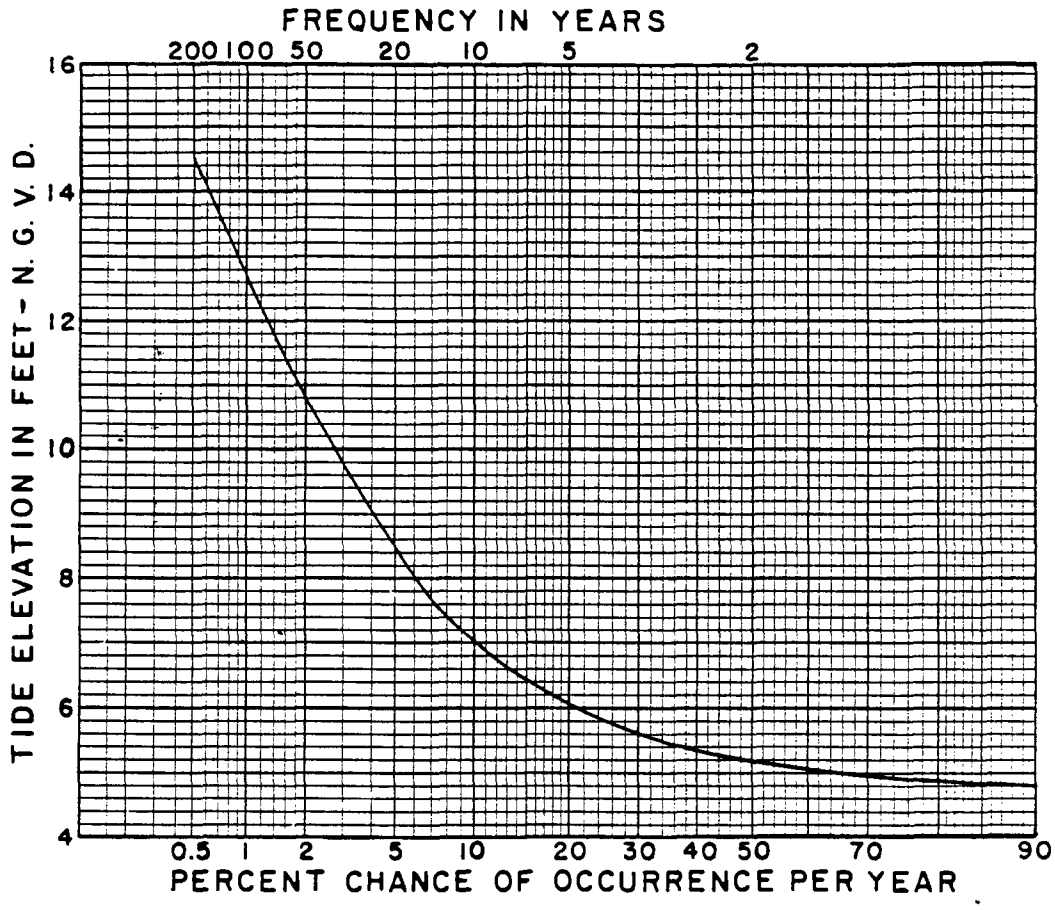
HURRICANE PROTECTION

NEW BEDFORD-FAIRHAVEN BARRIER

BASIN MAP

NEW BEDFORD HARBOR MASS.

PLATE 1



NOTES

1) Tidal Frequency Curve Prepared by Hydraulics and Water Quality Section.

2) Refer to Table 4 for Tabulation of Storm Tide Elevations Above 5.5 Ft.

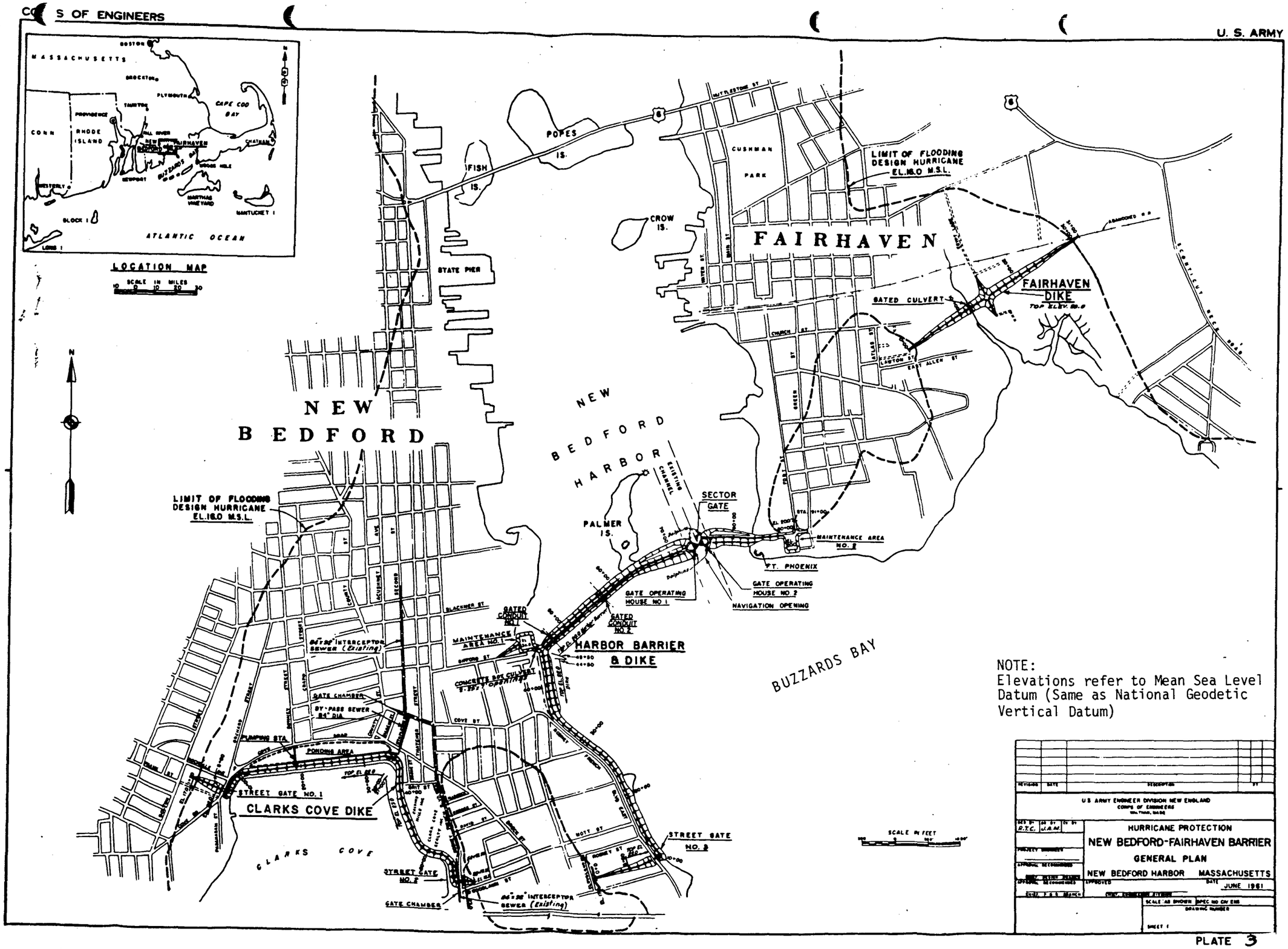
HURRICANE PROTECTION
NEW BEDFORD-FAIRHAVEN BARRIER

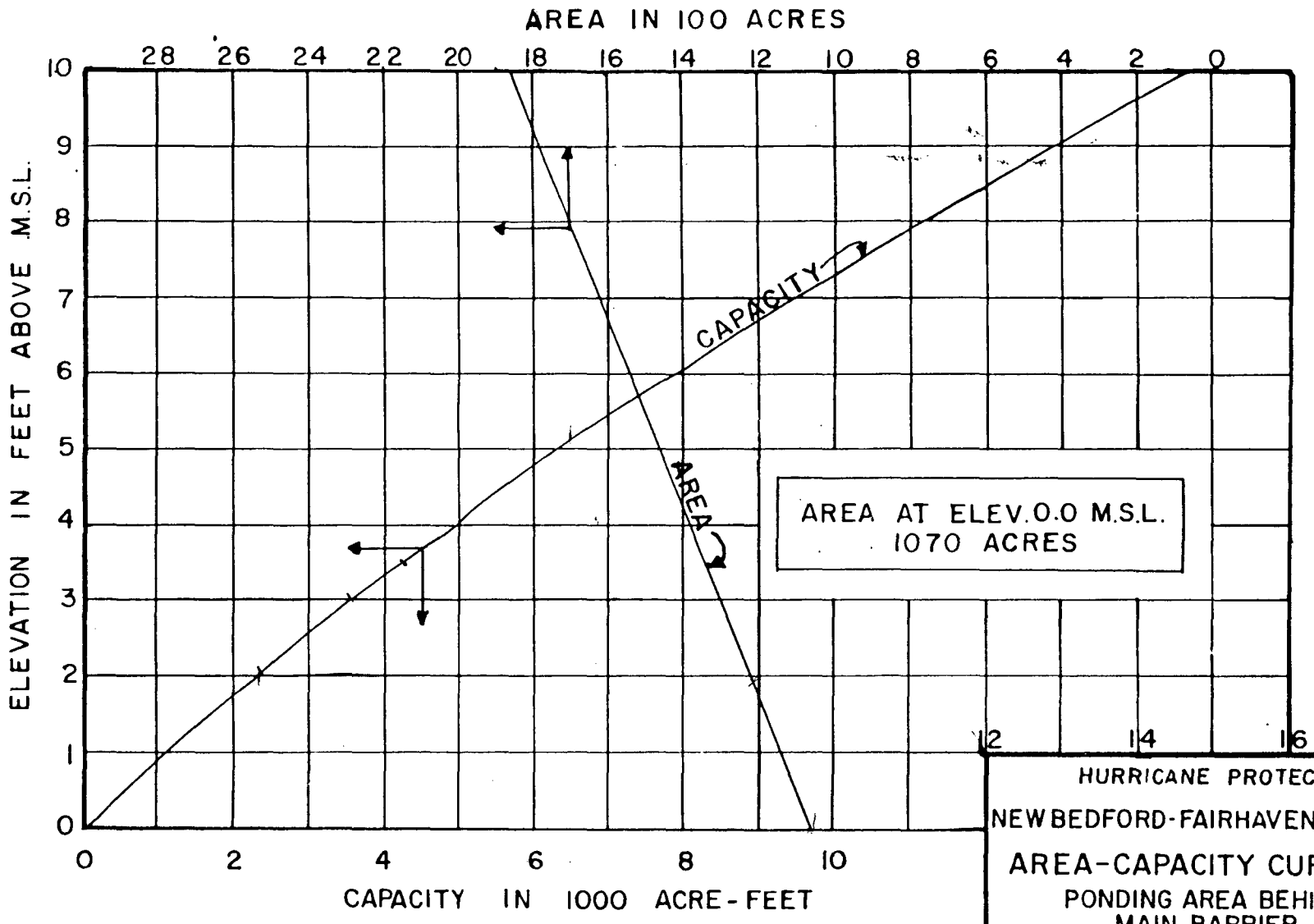
FREQUENCY OF TIDAL FLOODING

NEW BEDFORD HARBOR, MASS.

JUNE 1983

PLATE 2


LOCATION MAP
SCALE IN MILES
MASSACHUSETTS
BOSTON
BROCKTON
PLYMOUTH
TAUNTON
CAPE COD BAY
CONN
RHODE ISLAND
PROVIDENCE
FALL RIVER
NEW BEDFORD
FAIRHAVEN
CHATHAM
WOODS HOLE
BUZZARDS BAY
NEWPORT
WESTERLY
MARTHAS VINEYARD
NANTUCKET I
BLOCK I
ATLANTIC OCEAN
LONG I
N
NEW BEDFORD
FAIRHAVEN
STATE PIER
FISH IS.
POPES IS.
CROW IS.
CUSHMAN PARK
HUTTLESTONE ST
LIMIT OF FLOODING DESIGN HURRICANE EL.18.0 M.S.L.
GATED CULVERT
FAIRHAVEN DIKE
TOP ELEV. 18.0
ABANDONED R.R.
CONNECTICUT RIVER
NEW BEDFORD HARBOR
EXISTING CHANNEL
SECTOR GATE
PALMER IS.
MAINTENANCE AREA NO. 2
FT. PHOENIX
GATE OPERATING HOUSE NO. 2
NAVIGATION OPENING
GATE OPERATING HOUSE NO. 1
GATED CONDUIT NO. 1
GATED CONDUIT NO. 2
MAINTENANCE AREA NO. 1
HARBOR BARRIER & DIKE
BUZZARDS BAY
LIMIT OF FLOODING DESIGN HURRICANE EL.18.0 M.S.L.
84"x58" INTERCEPTOR SEWER (Existing)
CONCRETE BOX CULVERT
GATE CHAMBER
BY-PASS SEWER 84" DIA
PUMPING STA.
PONDING AREA
STREET GATE NO. 1
CLARKS COVE DIKE
CLARKS COVE
STREET GATE NO. 2
GATE CHAMBER
84"x58" INTERCEPTOR SEWER (Existing)
STREET GATE NO. 3
SCALE IN FEET
NOTE:
Elevations refer to Mean Sea Level Datum (Same as National Geodetic Vertical Datum)
U.S. ARMY ENGINEER DIVISION NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.
DRN BY R.T.C.
CK BY J.A.M.
HURRICANE PROTECTION
NEW BEDFORD-FAIRHAVEN BARRIER
GENERAL PLAN
NEW BEDFORD HARBOR MASSACHUSETTS
DATE JUNE 1961
SCALE AS SHOWN
SPEC NO CIV ENG
DRAWING NUMBER
SHEET 1



HURRICANE PROTECTION

NEW BEDFORD-FAIRHAVEN BARRIER

AREA-CAPACITY CURVES

PONDING AREA BEHIND MAIN BARRIER

NEW ENGLAND DIV. WALTHAM, MASS