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OFFICE OF STANDARDS DEVELOPMENT

REGULATORY GUIDE 1.59

DESIGN BASIS FLOODS FOR NUCLEAR POWER PLANTS

UNITED STATES
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ERRATA

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"Design Basis Floods for Nuclear Power Plants"

New information that affects the Probable Maximum Flood (PMF) isolines for the Upper Ohio River for drainage areas of 10,000 and 20,000 square miles has been identified. The changes to the isolines affect only a small area in the Upper Ohio River Basin and do not have any significant impact on the Design Basis Flood for existing plants.

As a result of the new information, revised Figures B.6 and B.7 transmitted herewith should be used in future PMF discharge determinations when the simplified methods presented in Appendix B to the Regulatory Guide are being used. In addition, appropriate changes have been made to the PMF data on pages 28 and 30 of Table B.1, which are also transmitted herewith.

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*Lines indicate substantive changes from previous issue.

A. INTRODUCTION

General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Licensing of Production and Utilization Facilities," requires, in part, that structures, systems, and components important to safety be designed to withstand the effects of natural phenomena such as floods, tsunami, and seiches without loss of capability to perform their safety functions. Criterion 2 also requires that design bases for these structures, systems, and components reflect (1) appropriate consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding region, with sufficient margin for the limited accuracy and quantity of the historical data and the period of time in which the data have been accumulated, (2) appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena, and (3) the importance of the safety functions to be performed.

Paragraph 100.10(c) of 10 CFR Part 100, "Reactor Site Criteria," requires that physical characteristics of the site, including seismology, meteorology, geology, and hydrology, be taken into account in determining the acceptability of a site for a nuclear power reactor.

Section IV(c) of Appendix A, "Seismic and Geologic Siting Criteria for Nuclear Power Plants," to 10 CFR Part 100 suggests investigations for a detailed study of seismically induced floods and water waves. The appendix also suggests [Section IV(c)(iii)] that the determination of design bases for seismically induced floods and water waves be based on the results of the required geologic and seismic investigations and that these design bases be taken into account in the design of the nuclear power plant.

This guide discusses the design basis floods that nuclear power plants should be designed to withstand without loss of capability for cold shutdown and maintenance thereof. The design requirements for flood protection are the subject of Regulatory Guide 1.102, "Flood Protection for Nuclear Power Plants."

The material previously contained in Appendix A, "Probable Maximum and Seismically Induced Floods on Streams," has been replaced by American National Standards Institute (ANSI) Standard N170-1976, "Standards for Determining Design Basis Flooding at Power Reactor Sites,"[1] which has been endorsed as acceptable by the NRC staff with the exception noted in Appendix A. In addition to information on stream flooding, ANSI N170-1976 contains methodology for estimating probable maximum surges and seiches at estuaries and coastal areas on oceans and large lakes. Appendix B gives timesaving alternative methods of estimating the probable maximum flood along streams, and Appendix C gives a simplified method of estimating probable maximum surges on the Atlantic and Gulf coasts. The Advisory Committee on Reactor Safeguards has been consulted concerning this guide and has concurred in the regulatory position.

[1]Copies of ANSI Standard N170-1976 may be purchased from the American Nuclear Society, 555 North Kensington Avenue, La Grange Park, IL 60525.

B. DISCUSSION

Nuclear power plants should be designed to prevent the loss of capability for cold shutdown and maintenance thereof resulting from the most severe flood conditions that can reasonably be predicted to occur at a site as a result of severe hydrometeorological conditions, seismic activity, or both.

The Corps of Engineers for many years has studied conditions and circumstances relating to floods and flood control. As a result of these studies, it has developed a definition for a Probable Maximum Flood (PMF)[2] and attendant analytical techniques for estimating, with an acceptable degree of conservatism, flood levels on streams resulting from hydrometeorological conditions. For estimating seismically induced flood levels, an acceptable degree of conservatism for evaluating the effects of the initiating event is provided by Appendix A to 10 CFR Part 100.

The conditions resulting from the worst site-related flood probable at the nuclear power plant (e.g., PMF, seismically induced flood, seiche, surge, severe local precipitation) with attendant wind-generated wave activity constitute the design basis flood conditions that safety-related structures, systems, and components identified in Regulatory Guide 1.29[3] should be

[2]Corps of Engineers' Probable Maximum Flood definition appears in many publications of that agency such as Engineering Circular EC 1110-2-27, Change 1, "Engineering and Design—Policies and Procedures Pertaining to Determination of Spillway Capacities and Freeboard Allowances for Dams," dated 19 Feb. 1968. The Probable Maximum Flood is also directly analogous to the Corps of Engineers' "Spillway Design Flood" as used for dams whose failures would result in a significant loss of life and property.

[3]Regulatory Guide 1.29, "Seismic Design Classification," identifies structures, systems, and components of light-water-cooled nuclear power plants that should be designed to withstand the effects of the Safe Shutdown Earthquake and remain functional. These structures, systems, and components are those necessary to ensure (1) the integrity of the reactor coolant pressure boundary, (2) the capability to shut down the reactor and maintain it in a safe shutdown condition, or (3) the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposures comparable to the guideline exposures of 10 CFR Part 100. These same structures, systems, and components should also be designed to withstand conditions resulting from the design basis flood and retain capability for cold shutdown and maintenance thereof of other types of nuclear power plants. It is expected that safety-related structures, systems, and components of other types of nuclear power plants will be identified in future regulatory guides. In the interim, Regulatory Guide 1.29 should be used as guidance when identifying safety-related structures, systems, and components of other types of nuclear power plants.

designed to withstand and retain capability for cold shutdown and maintenance therof.

For sites along streams, the PMF generally provides the design basis flood. For sites along lakes or seashores, a flood condition of comparable severity could be produced by the most severe combination of hydrometeorological parameters reasonably possible, such as may be produced by a Probable Maximum Hurricane[4] or by a Probable Maximum Seiche. On estuaries, a Probable Maximum River Flood, a Probable Maximum Surge, a Probable Maximum Seiche, or a reasonable combination of less severe phenomenologically caused flooding events should be considered in arriving at design basis flood conditions comparable in frequency of occurrence with a PMF on streams.

In addition to floods produced by severe hydrometeorological conditions, the most severe seismically induced floods reasonably possible should be considered for each site. Along streams and estuaries, seismically induced floods may be produced by dam failures or landslides. Along lakeshores, coastlines, and estuaries, seismically induced or tsunami-type flooding should be considered. Consideration of seismically induced floods should include the same range of seismic events as is postulated for the design of the nuclear plant. For instance, the analysis of floods caused by dam failures, landslides, or tsunami requires consideration of seismic events of the severity of the Safe Shutdown Earthquake occurring at the location that would produce the worst such flood at the nuclear power plant site. In the case of seismically induced floods along rivers, lakes, and estuaries that may be produced by events less severe than a Safe Shutdown Earthquake, consideration should be given to the coincident occurrence of floods due to severe hydrometeorological conditions, but only where the effects on the plant are worse than and the probability of such combined events may be greater than an individual occurrence of the most severe event of either type. Appendix A contains acceptable combinations of such events. For the specific case of seismically induced floods due to dam failures, an evaluation should be made of flood waves that may be caused by domino-type dam failures triggered by a seismically induced failure of a critically located dam and of flood waves that may be caused by multiple dam failures in a region where dams may be located close enough together that a single seismic event can cause multiple failures.

Each of the severe flood types discussed above should represent the upper limit of all potential phenomenologically caused flood combinations considered reasonably possible. Analytical techniques are available and should generally be used for prediction at individual sites. Those techniques applicable to PMF and seismically induced flood estimates on streams are presented in Appendices A and B of this guide. For sites on coasts, estuaries, and large lakes, techniques are presented in Appendices A and C of this guide.

Analyses of only the most severe flood conditions may not indicate potential threats to safety-related systems that might result from combinations of flood conditions thought to be less severe. Therefore, reasonable combinations of less-severe flood conditions should also be considered to the extent needed for a consistent level of conservatism. Such combinations should be evaluated in cases where the probability of their existing at the same time and having significant consequences is at least comparable to that associated with the most severe hydrometeorological or seismically induced flood. For example, a failure of relatively high levees adjacent to a plant could occur during floods less severe than the worst site-related flood, but would produce conditions more severe than would result during a greater flood (where a levee failure elsewhere would produce less severe conditions at the plant site).

Wind-generated wave activity may produce severe flood-induced static and dynamic conditions either independent of or coincident with severe hydrometeorological or seismic flood-producing mechanisms. For example, along a lake, reservoir, river, or seashore, reasonably severe wave action should be considered coincident with the probable maximum water level conditions.[5] The coincidence of wave activity with probable maximum water level conditions should take into account the fact that sufficient time can elapse between the occurrence of the assumed meteorological mechanism and the maximum water level to allow subsequent meteorological activity to produce substantial wind-generated waves coincident with the high water level. In addition, the most severe wave activity at the site that can be generated by distant hydrometeorological activity should be considered. For instance, coastal locations may be subjected to severe wave action caused by a distant storm that, although not as severe as a local storm (e.g., a Probable Maximum Hurricane), may produce more severe wave action because of a very long wave-generating fetch. The most severe wave activity at the site that may be generated by conditions at a distance from the site should be considered in such cases. In addition, assurance should be provided

[4]See References 2 and 5, Appendix C.

[5]Probable Maximum Water Level is defined by the Corps of Engineers as "the maximum still water level (i.e., exclusive of local coincident wave runup) which can be produced by the most severe combination of hydrometeorological and/or seismic parameters reasonably possible for a particular location. Such phenomena are hurricanes, moving squall lines, other cyclonic meteorological events, tsunami, etc., which, when combined with the physical response of a body of water and severe ambient hydrological conditions, would produce a still water level that has virtually no risk of being exceeded."

that safety systems necessary for cold shutdown and maintenance thereof are designed to withstand the static and dynamic effects resulting from frequent flood levels (i.e., the maximum operating level in reservoirs and the 10-year flood level in streams) coincident with the waves that would be produced by the Probable Maximum Gradient Wind[6] for the site (based on a study of historical regional meteorology).

C. REGULATORY POSITION

1. The conditions resulting from the worst site-related flood probable at a nuclear power plant (e.g., PMF, seismically induced flood, hurricane, seiche, surge, heavy local precipitation) with attendant wind-generated wave activity constitute the design basis flood conditions that safety-related structures, systems, and components identified in Regulatory Guide 1.29 (see footnote 3) must be designed to withstand and retain capability for cold shutdown and maintenance thereof.

a. The PMF on streams, as defined in Appendix A and based on the analytical techniques summarized in Appendices A and B of this guide, provides an acceptable level of conservatism for estimating flood levels caused by severe hydrometeorological conditions.

b. Along lakeshores, coastlines, and estuaries, estimates of flood levels resulting from severe surges, seiches, and wave action caused by hydrometeorological activity should be based on criteria comparable in conservatism to those used for Probable Maximum Floods. Criteria and analytical techniques providing this level of conservatism for the analysis of these events are summarized in Appendix A of this guide. Appendix C of this guide presents an acceptable method for estimating the still-water level of the Probable Maximum Surge from hurricanes at open-coast sites on the Atlantic Ocean and Gulf of Mexico.

c. Flood conditions that could be caused by dam failures from earthquakes should also be considered in establishing the design basis flood. Analytical techniques for evaluating the hydrologic effects of seismically induced dam failures discussed herein are presented in Appendix A of this guide. Techniques for evaluating the effects of tsunami will be presented in a future appendix.

d. Where upstream dams or other features that provide flood protection are present, in addition to the analyses of the most severe floods that may be induced by either hydrometeorological or seismic mechanisms, reasonable combinations of less-severe flood conditions and seismic events should also be considered to the extent needed for a consistent level of conservatism. The effect of such combinations on the flood conditions at the plant site should be evaluated in cases where the probability of such combinations occurring at the same time and having significant consequences is at least comparable to the probability associated with the most severe hydrometeorological or seismically induced flood. For relatively large streams, examples of acceptable combinations of runoff floods and seismic events that could affect the flood conditions at the plant are contained in Appendix A. Less-severe flood conditions, associated with the above seismic events, may be acceptable for small streams that exhibit relatively short periods of flooding.

e. The effects of coincident wind-generated wave activity to the water levels associated with the worst site-related flood possible (as determined from paragraphs a, b, c, or d above) should be added to generally define the upper limit of flood potential. Acceptable procedures are contained in Appendix A of this guide.

2. As an alternative to designing *hardened protection*[7] for all safety-related structures, systems, and components as specified in Regulatory Position 1 above, it is permissible not to provide hardened protection for some of these features if:

a. Sufficient warning time is shown to be available to shut the plant down and implement adequate emergency procedures;

b. All safety-related structures, systems, and components identified in Regulatory Guide 1.29 (see footnote 3) are designed to withstand the flood conditions resulting from a Standard Project event[8] with attendant wind-generated wave activity that may be produced by the worst winds of record and remain functional;

c. In addition to the analyses in paragraph 2.b above, reasonable combinations of less-severe flood conditions are also considered to the extent needed for a consistent level of conservatism; and

[6]Probable Maximum Gradient Wind is defined as a gradient wind of a designated duration, which there is virtually no risk of exceeding.

[7]*Hardened protection* means structural provisions incorporated in the plant design that will protect safety-related structures, systems, and components from the static and dynamic effects of floods. In addition, each component of the protection must be passive and in place, as it is to be used for flood protection, during normal plant operation. Examples of the types of flood protection to be provided for nuclear power plants are contained in Regulatory Guide 1.102.

[8]For sites along streams, this event is characterized by the Corps of Engineers' definition of a Standard Project Flood. Such floods have been found to produce flow rates generally 40 to 60 percent of the PMF. For sites along seashores, this event may be characterized by the Corps of Engineers' definition of a Standard Project Hurricane. For other sites, a comparable level of risk should be assumed.

d. In addition to paragraph 2.b above, at least those structures, systems, and components necessary for cold shutdown and maintenance thereof are designed with *hardened* protective features to remain functional while withstanding the entire range of flood conditions up to and including the worst site-related flood probable (e.g., PMF, seismically induced flood, hurricane, surge, seiche, heavy local precipitation) with coincident wind-generated wave action as discussed in Regulatory Position 1 above.

3. During the economic life of a nuclear power plant, unanticipated changes to the site environs which may adversely affect the flood-producing characteristics of the environs are possible. Examples include construction of a dam upstream or downstream of the plant or, comparably, construction of a highway or railroad bridge and embankment that obstructs the flood flow of a river and construction of a harbor or deepening of an existing harbor near a coastal or lake site plant.

Significantly adverse changes in the runoff or other flood-producing characteristics of the site environs, as they affect the design basis flood, should be identified and used as the basis to develop or modify emergency operating procedures, if necessary, to mitigate the effects of the increased flood.

4. Proper utilization of the data and procedures in Appendices B and C will result in PMF peak discharges and PMS peak stillwater levels which will in many cases be approved by the NRC staff with no further verification. The staff will continue to accept for review detailed PMF and PMS analyses that result in less conservative estimates than those obtained by use of Appendices B and C. In addition, previously reviewed and approved detailed PMF and PMS analyses will continue to be acceptable even though the data and procedures in Appendices B and C result in more conservative estimates.

D. IMPLEMENTATION

The purpose of this section is to provide information to license applicants and licensees regarding the NRC staff's plans for using this regulatory guide.

This guide reflects current NRC practice. Therefore, except in those cases in which the applicant or licensee proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the methods described herein are being and will continue to be used in the evaluation of submittals for construction permit applications until this guide is revised as a result of suggestions from the public or additional staff review.

APPENDIX A

PROBABLE MAXIMUM AND SEISMICALLY INDUCED FLOODS ON STREAMS AND COASTAL AREAS

The material previously contained in Appendix A has been replaced by American National Standards Institute (ANSI) Standard N170-1976, "Standards for Determining Design Basis Flooding at Power Reactor Sites," with the following exception:

Sections 5.5.4.2.3 and 5.5.5 of ANSI N170-1976 contain references to methods for evaluating the erosion failure of earthfill or rockfill dams and determining the resulting outflow hydrographs. The staff has found that some of these methods may not be conservative because they predict slower rates of erosion than have historically occurred. Modifications to the models may be made to increase their conservatism. Such modifications will be reviewed by the NRC staff on a case-by-case basis.

APPENDIX B

ALTERNATIVE METHODS OF ESTIMATING PROBABLE MAXIMUM FLOODS

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FIGURES

TABLE

B.1 INTRODUCTION

This appendix presents timesaving alternative methods of estimating the probable maximum flood (PMF) peak discharge for nuclear facilities on nontidal streams in the contiguous United States. Use of the methods herein will reduce both the time necessary for applicants to prepare license applications and the NRC staff's review effort.

The procedures are based on PMF values determined by the U.S. Army Corps of Engineers, by applicants for licenses that have been reviewed and accepted by the NRC staff, and by the staff and its consultants. The information in this appendix was developed from a study made by Nunn, Snyder, and Associates, through a contract with NRC (Ref. 1).

PMF peak discharge determinations for the entire contiguous United States are presented in Table B.1. Under some conditions, these may be used directly to evaluate the PMF at specific sites. In addition, maps showing enveloping isolines of PMF discharge for several index drainage areas are presented in Figures B.2 through B.7 for the contiguous United States east of the 103rd meridian, including instructions for and an example of their use (see Figure B.8). Because of the enveloping procedures used in preparing the maps, results from their use are highly conservative.

Limitations on the use of these generalized methods of estimating PMFs are identified in Section B.4. These limitations should be considered in detail in assessing the applicability of the methods at specific sites.

Applicants for licenses for nuclear facilities at sites on nontidal streams in the contiguous United States have the option of using these methods in lieu of the more precise but laborious methods of Appendix A. The results of application of the methods in this appendix will in many cases be accepted by the NRC staff with no further verification.

B.2 SCOPE

The data and procedures in this appendix apply only to nontidal streams in the contiguous United States. Two procedures are included for nontidal streams east of the 103rd meridian.

Future studies are planned to determine the applicability of similar generalized methods and to develop such methods, if feasible, for other areas. These studies, to be included in similar appendices, are anticipated for the main stems of large rivers and the United States west of the 103rd meridian, including Hawaii and Alaska.

B.3 PROBABLE MAXIMUM FLOOD PEAK DISCHARGE

The data presented in this section are as follows:

1. A tabulation of PMF peak discharge determinations at specific locations throughout the contiguous United States. These data are subdivided into water resources regions, delineated on Figure B.1, and are tabulated in Table B.1.

2. A set of six maps, Figures B.2 through B.7, covering index drainage areas of 100, 500, 1,000, 5,000, 10,000, and 20,000 square miles, containing isolines of equal PMF peak discharge for drainage areas of those sizes east of the 103rd meridian.

B.3.1 Use of PMF Discharge Determinations

The PMF peak discharge determinations listed in Table B.1 are those computed by the Corps of Engineers, by the NRC staff and their consultants, or computed by applicants and accepted by the staff.

For a nuclear facility located near or adjacent to one of the streams listed in the table and reasonably close to the location of the PMF determination, that PMF may be transposed, with proper adjustment, or routed to the nuclear facility site. Methods of transposition, adjustment, and routing are given in standard hydrology texts and are not repeated here.

B.3.2 Enveloping Isolines of PMF Peak Discharge

B.3.2.1 Preparation of Maps

For each of the water resources regions, each PMF determination in Table B.1 was plotted on logarithmic paper (cubic feet per second per square mile versus drainage area). It was found that there were insufficient data and too much scatter west of about the 103rd meridian, caused by variations in precipitation from orographic effects or by melting snowpack. Accordingly, the rest of the study was confined to the United States east of the 103rd meridian. For sites west of the 103rd meridian, the methods of the preceding section may be used.

Envelope curves were drawn for each region east of the 103rd meridian. It was found that the envelope curves generally paralleled the Creager curve (Ref. 2), defined as

$$Q=46.0\ CA^{(0.894A^{-0.048})-1}$$

where

Q is the discharge in cubic feet per second (cfs)
C is a constant, taken as 100 for this study
A is the drainage area in square miles.

Each PMF discharge determination of 50 square miles or more was adjusted to one or more of the six selected index drainage areas in accordance with the slope of the Creager curve. Such adjustments were made as follows:

PMF Within Drainage Area Range, sq. mi.	Adjusted to Index Drainage Area, sq. mi.
50 to 500	100
100 to 1,000	500
500 to 5,000	1,000
1,000 to 10,000	5,000
5,000 to 50,000	10,000
10,000 or greater	20,000

The PMF values so adjusted were plotted on maps of the United States east of the 103rd meridian, one map for each of the six index drainage areas. It was found that there were areas on each map with insufficient points to define isolines. To fill in such gaps, conservative computations of approximate PMF peak discharge were made for each two-degree latitude-longitude intersection on each map. This was done by using enveloped relations between drainage area and PMF peak discharge (in cfs per inch of runoff), and applying appropriate probable maximum precipitation (PMP) at each two-degree latitude-longitude intersection. PMP values, obtained from References 3 and 4, were assumed to be for a 48-hour storm to which losses of 0.05 inch per hour were applied. These approximate PMF values were also plotted on the maps for each index drainage area and the enveloping isolines were drawn as shown on Figures B.2 through B.7.

B.3.2.2 Use of Maps

The maps may be used to determine PMF peak discharge at a given site with a known drainage area as follows:

1. Locate the site on the 100-square-mile map, Figure B.2.

2. Read and record the 100-square-mile PMF peak discharge by straight-line interpolation between the isolines.

3. Repeat Steps 1 and 2 for 500, 1,000, 5,000, 10,000, and 20,000 square miles from Figures B.3 through B.7.

4. Plot the six PMF peak discharges so obtained on logarithmic paper against drainage area, as shown on Figure B.8.

5. Draw a smooth curve through the points. Reasonable extrapolations above and below the defined curve may be made.

6. Read the PMF peak discharge at the site from the curve at the appropriate drainage area.

B.3.3 Probable Maximum Water Level

When the PMF peak discharge has been obtained as outlined in the foregoing sections, the PMF stillwater level should be determined. The methods given in Appendix A are acceptable for this purpose.

B.3.4 Wind-Wave Effects

Wind-wave effects should be superimposed on the PMF stillwater level. Criteria and acceptable methods are given in Appendix A.

B.4 LIMITATIONS

1. The NRC staff will continue to accept for review detailed PMF analyses that result in less conservative estimates. In addition, previously reviewed and approved detailed PMF analyses at specific sites will continue to be acceptable even though the data and procedures in this appendix result in more conservative estimates.

2. The PMF estimates obtained as outlined in Sections B.3.1 and B.3.2 are peak discharges that should be converted to water level to which appropriate wind-wave effects should be added.

3. If there are one or more reservoirs in the drainage area upstream of the site, seismic and hydrologic dam failure[1] flood analyses should be made to determine whether such a flood will produce the design basis water level. Criteria and acceptable methods are included in Appendix A.

4. Because of the enveloping procedures used, PMF peak discharges estimated as outlined in Section B.3.2 have a high degree of conservatism. If the PMF so estimated casts doubt on the suitability of a site, or if protection from a flood of that magnitude would not be physically or economically feasible, consideration should be given to performing a detailed PMF analysis, as outlined in Appendix A. It is likely that such an analysis will result in appreciably lower PMF levels.

[1]In this context, "hydrologic dam failure" means a failure caused by a flood from the drainage area upstream of the dam.

REFERENCES

1. Nunn, Snyder, and Associates, "Probable Maximum Flood and Hurricane Surge Estimates," unpublished report to NRC, June 13, 1975 (available in the public document room).

2. W.P. Creager, J.D. Justin, and J. Hinds, "Engineering for Dams," J. Wiley and Sons, Inc., New York, 1945.

3. U.S. Weather Bureau (now U.S. Weather Service, NOAA), "Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian," Hydrometeorological Report No. 33, 1956.[1]

4. U.S. Department of Commerce, NOAA, "All-Season Probable Maximum Precipitation—United States East of the 105th Meridian, for Areas from 1,000 to 20,000 Square Miles and Durations from 6 to 72 Hours," draft report, July 1972.[1]

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[1]Note: References 3 and 4 are being updated and combined into a single report by NOAA. This report is expected to be published in the near future as Hydrometeorological Report No. 51 with the title "Probable Maximum Precipitation Estimates, United States East of the 105th Meridian."

FIGURE B.1 WATER RESOURCES REGIONS

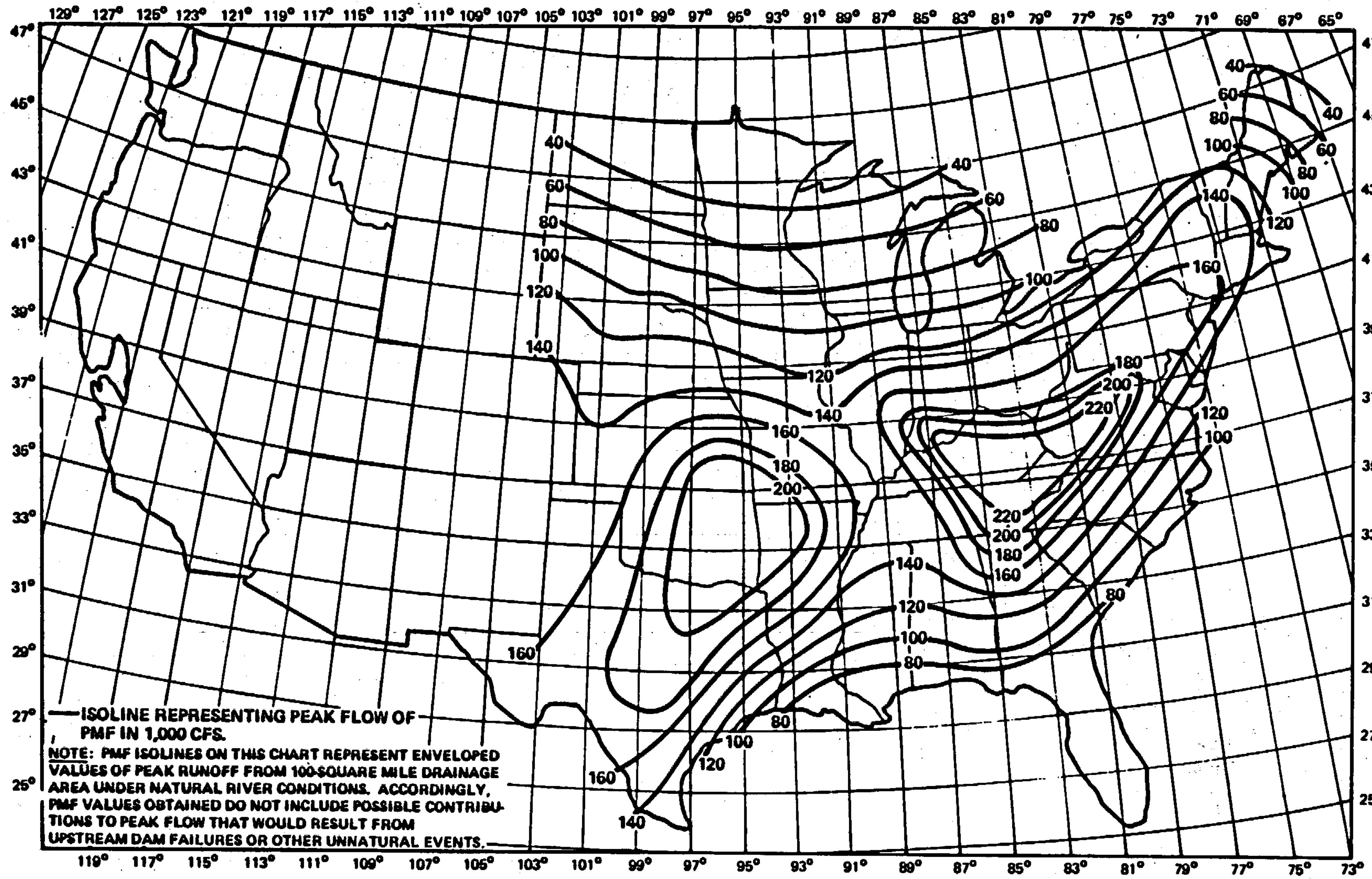

FIGURE B.2 PROBABLE MAXIMUM FLOOD (ENVELOPING PMF ISOLINES) FOR 100 SQUARE MILES

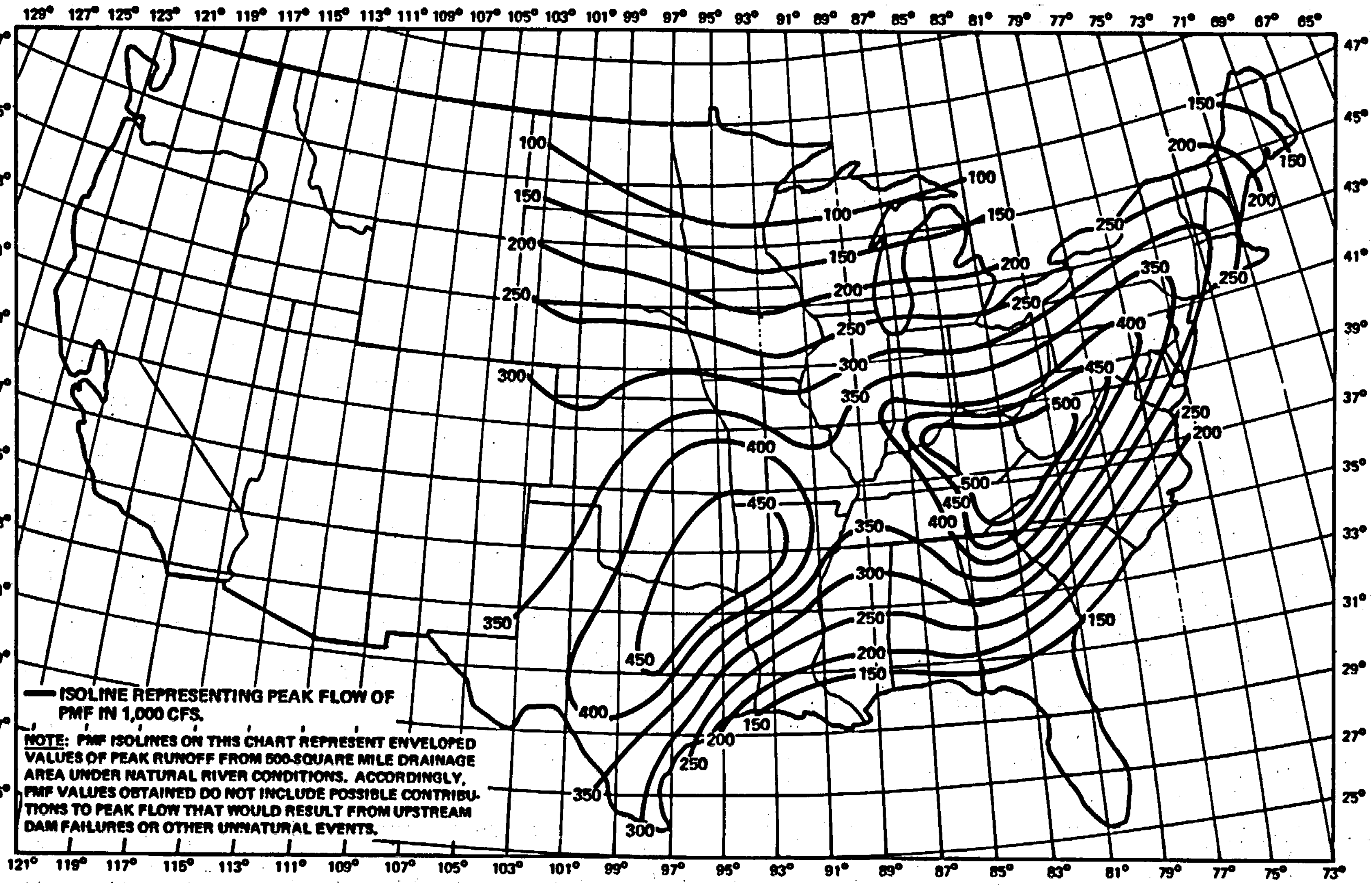

FIGURE B.3 PROBABLE MAXIMUM FLOOD (ENVELOPING PMF ISOLINES) FOR 500 SQUARE MILES

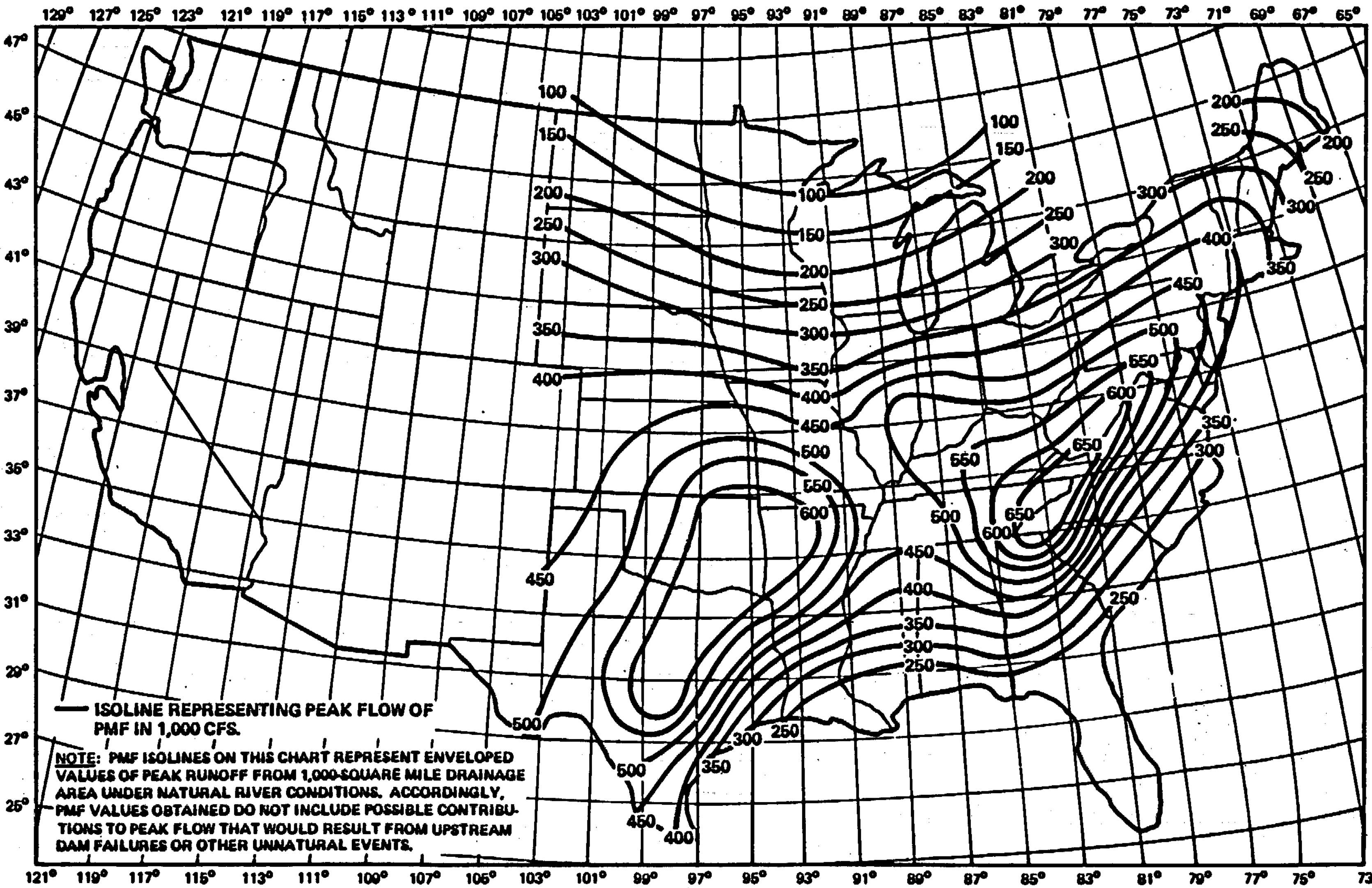

FIGURE B.4 PROBABLE MAXIMUM FLOOD (ENVELOPING PMF ISOLINES) FOR 1,000 SQUARE MILES

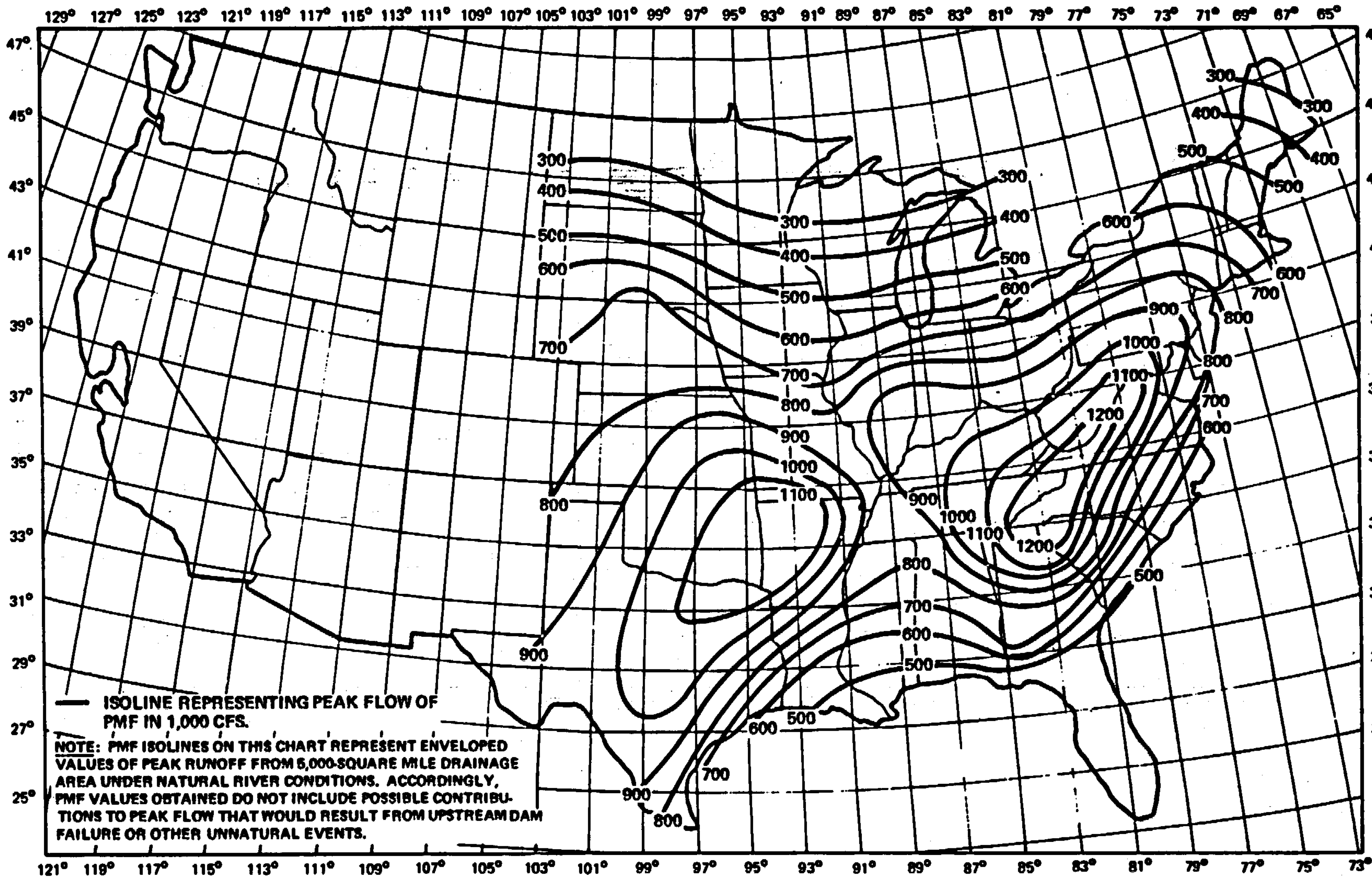

FIGURE B.5 PROBABLE MAXIMUM FLOOD (ENVELOPING PMF ISOLINES) FOR 5,000 SQUARE MILES

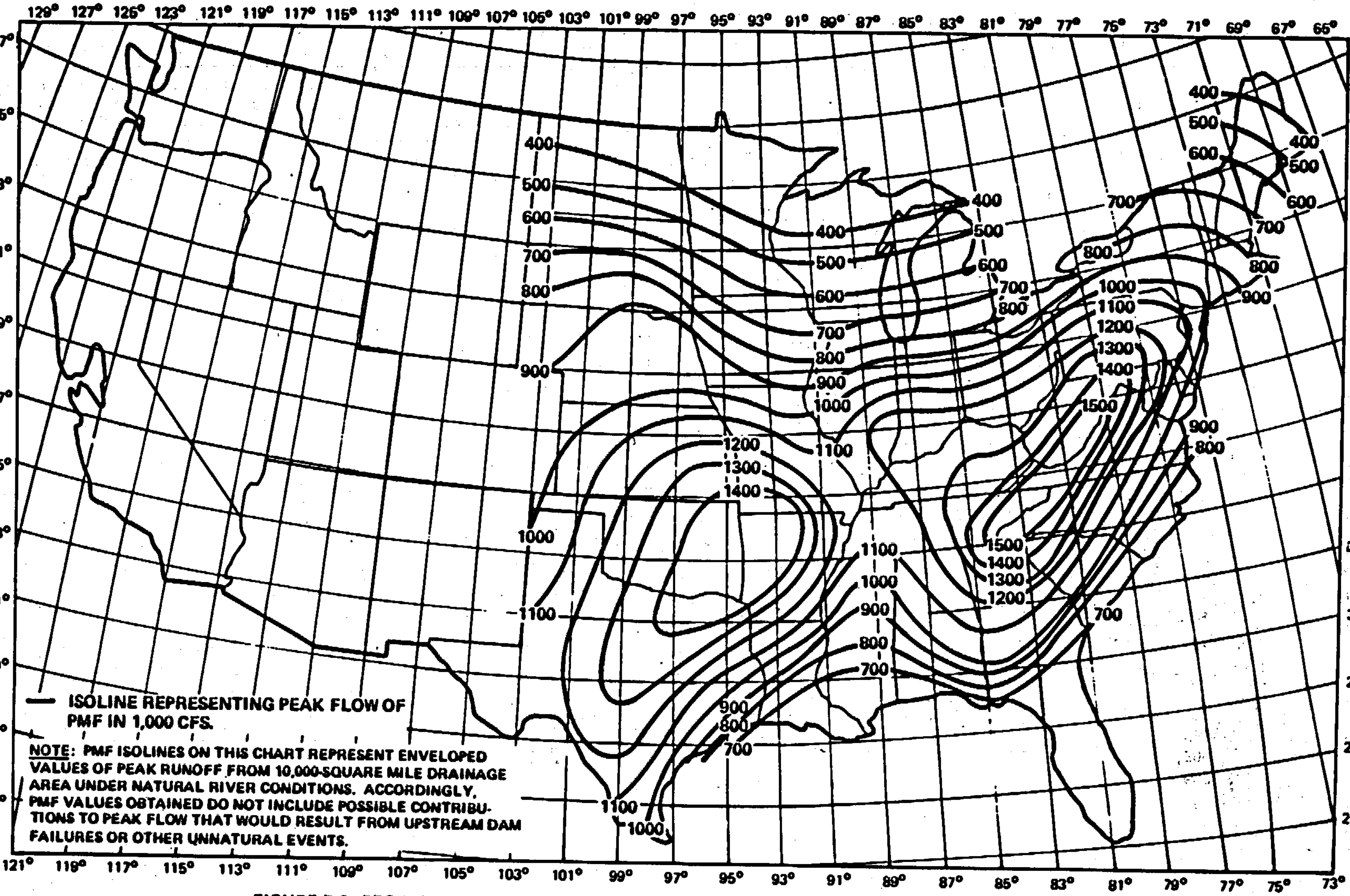

FIGURE B.6 PROBABLE MAXIMUM FLOOD (ENVELOPING PMF ISOLINES) FOR 10,000 SQUARE MILES

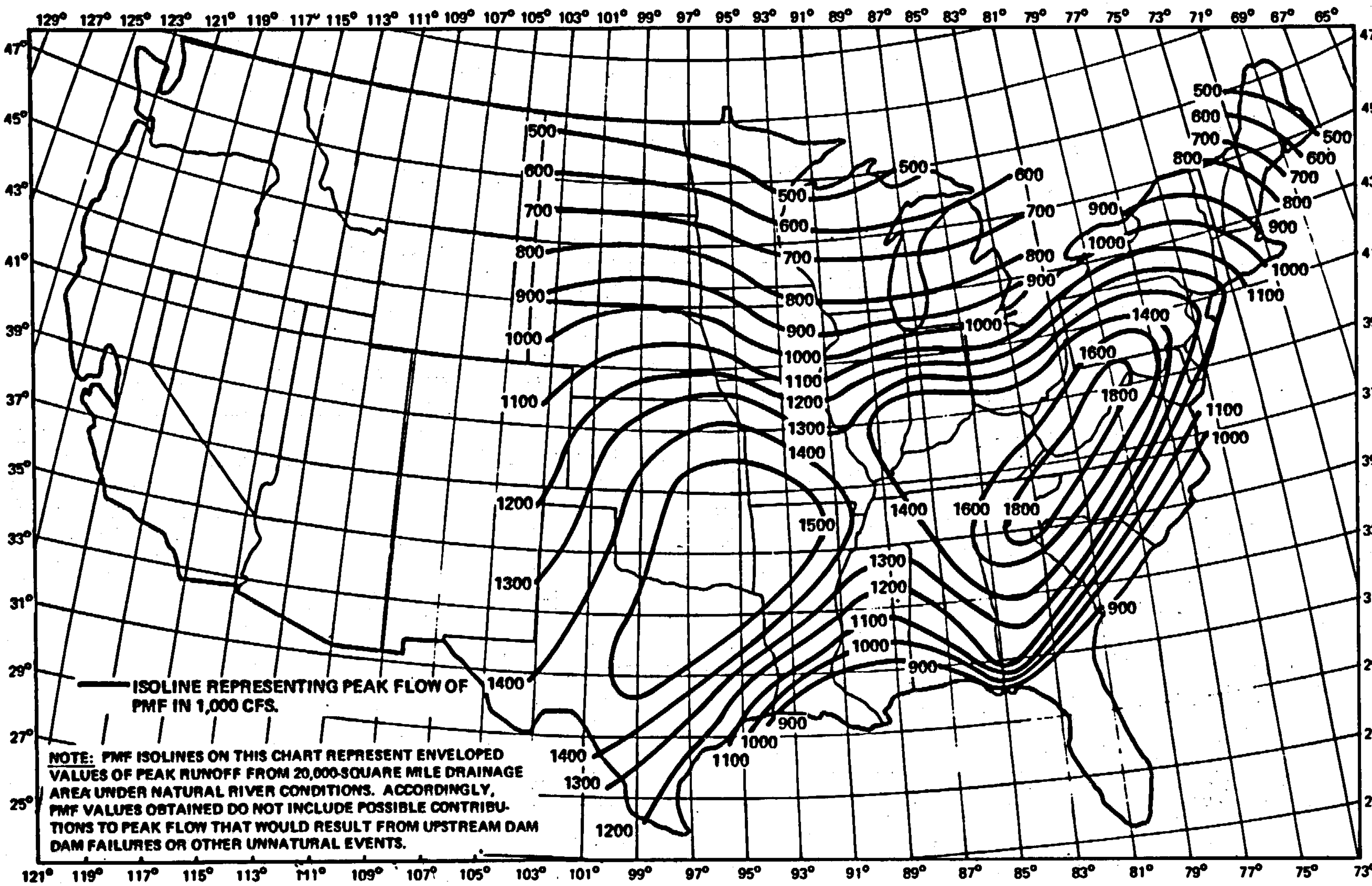

FIGURE B.7 PROBABLE MAXIMUM FLOOD (ENVELOPING PMF ISOLINES) FOR 20,000 SQUARE MILES

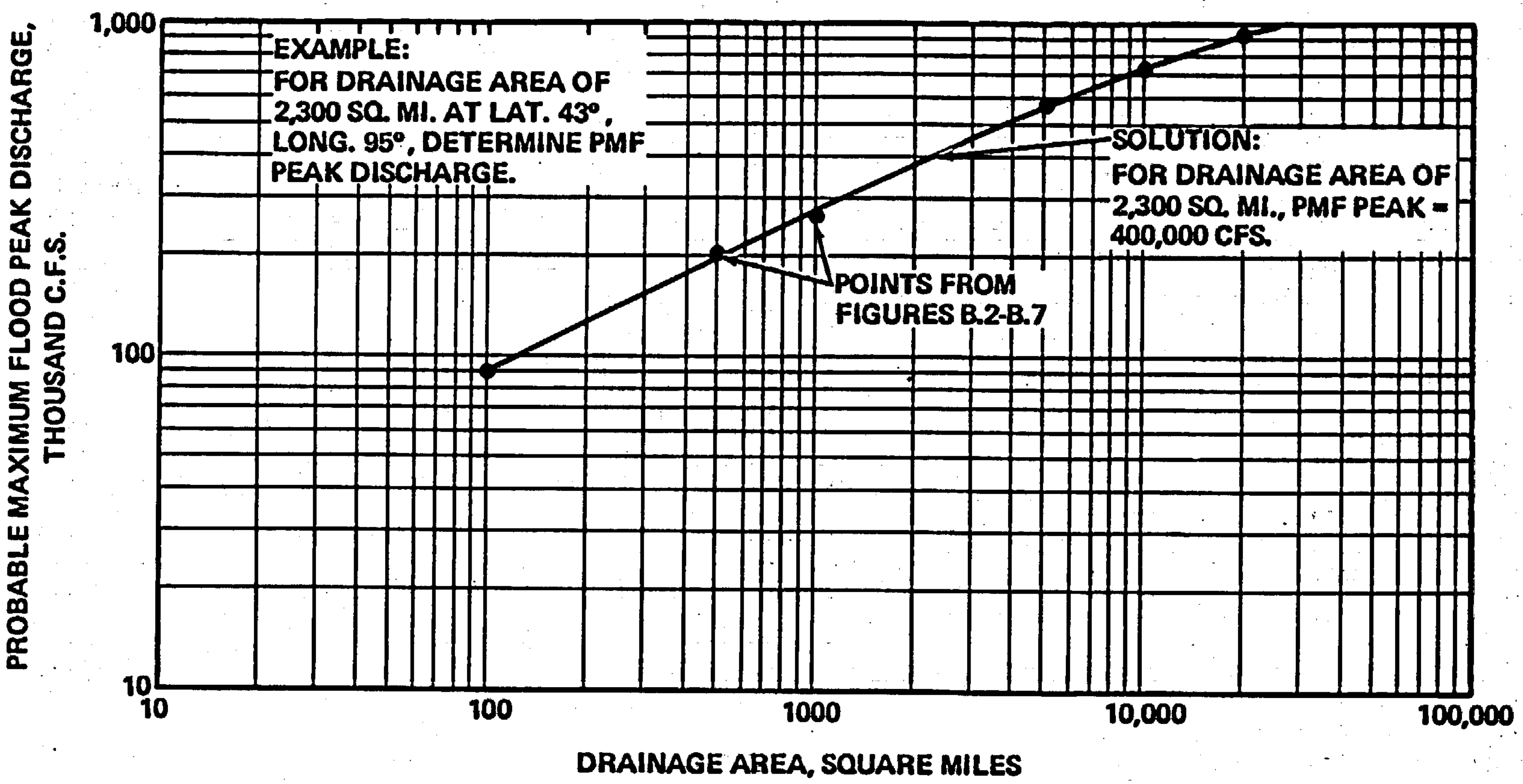

FIGURE B.8 EXAMPLE OF USE OF ENVELOPING ISOLINES

TABLE B.1

PROBABLE MAXIMUM FLOOD DATA (Page 1 of 17)

Project	State	River Basin	Stream	Drainage Area (sq.mi.)	Basin Average (in inches) Prec.	Basin Average (in inches) Runoff	PMF Peak Discharge (cfs)
North Atlantic Region (Northeast Atlantic Sub-region)							
Ball Mountain	Vt.	Connecticut	West River	172	20.6	18.1	190,000
Barre Falls	Mass.	Connecticut	Ware River	55	20.1	18.9	61,000
Beaver Brook	N. H.	Connecticut	Beaver Brook	6.0	21.3	19.7	10,400
Birch Hill	Mass.	Connecticut	Millers River	175	18.3	17.1	88.500
Black Rock	Conn.	Housatonic	Branch Brook	20	22.2	20.6	35,000
Blackwater	N. H.	Merrimack	Blackwater River	128	18.3	16.4	95,000
Buffumville	Mass.	Thames	Little River	26	26.6	25.3	36,500
Colebrook	Conn.	Connecticut	Farmington River	118	22.7	21.1	165,000
Conant Brook	Mass.	Connecticut	Conant Brook	7.8	24.4	23.2	11,900
East Barre	Vt.	Winooski	Jail Branch	39	21.5	18.6	52,500
East Branch	Conn.	Housatonic	Naugatuck River	9.2	24.0	22.8	15,500
East Brimfield	Mass.	Thames	Quinebaug River	68	24.2	22.9	73,900
Edward McDowell	N. H.	Merrimack	Nubanusit River	44	19.5	18.3	43,000
Everett	N. H.	Merrimack	Piscataquog River	64	20.7	18.2	68,000
Franklin Falls	N.H.	Merrimack	Pemigewasset River	1,000	15.8	13.3	300,000
Hall Meadow	Conn.	Connecticut	Hall Meadow Brook	17	24.0	22.8	26,600
Hancock	Conn.	Housatonic	Hancock Brook	12	24.0	22.8	20,700
Hodges Village	Mass.	Thames	French River	31	26.2	22.3	35,600
Hop Brook	Conn.	Housatonic	Hop Brook	16	25.0	23.8	26,400
Hopkinton	N. H.	Merrimack	Contoocook River	426	17.4	14.7	135,000
Knightville	Mass.	Connecticut	Westfield River	162	18.8	17.6	160,000
Littleville	Mass.	Connecticut	Westfield River	52	25.1	22.4	98,000
Mad River	Conn.	Connecticut	Mad River	18	24.0	22.8	30,000
Mansfield Hollow	Conn.	Thames	Natchaug River	159	19.8	18.5	125,000
Nookagee	Mass.	Merrimack	Phillips Brook	11	21.8	20.2	17,750
Northfield	Conn.	Housatonic	Northfield Brook	5.7	24.4	23.2	9,000
North Hartland	Vt.	Connecticut	Ottauquechee River	220	19.3	17.2	199,000
North Springfield	Vt.	Connecticut	Black River	158	20.0	18.3	157,000
Otter Brook	N. H.	Connecticut	Otter Brook	47	19.1	17.9	45,000
Phillips	Mass.	Merrimack	Phillips Brook	5.0	24.2	23.0	7,700
Sucker Brook	Conn.	Connecticut	Sucker Brook	3.4	22.4	21.4	6,500
Surry Mountain	N. H.	Connecticut	Ashuelot River	100	22.2	19.6	63,000
Thomaston	Conn.	Housatonic	Naugatuck River	97	24.5	22.4	158,000

TABLE B.1 (Page 2 of 17)

Project	State	River Basin	Stream	Drainage Area (sq.mi.)	Basin Average (in inches) Prec.	Runoff	PMF Peak Discharge (cfs)
Townshend	Vt.	Connecticut	West River	278	21.3	17.2	228,000
Trumbull	Conn.	Pequonnook	Pequonnook River	14	23.0	21.8	26,700
Tully	Mass.	Connecticut	Tully River	50	20.0	16.6	47,000
Union Village	Vt.	Connecticut	Ompompanoosuc River	126	17.0	15.8	110,000
Vermont-Yankee	Vt.	Connecticut	Connecticut River	6,266			480,000
Waterbury	Vt.	Winooski	Waterbury River	109	18.9	16.0	128,000
West Hill	Mass.	Blackstone	West River	28	28.0	25.6	26,000
West Thompson	Conn.	Thames	Quinebaug River	74	20.4	17.5	85,000
Westville	Mass.	Thames	Quinebaug River	32	25.4	22.8	38,400
Whitemanville	Mass.	Merrimack	Whitman River	18	21.4	19.8	25,000
Wrightsville	Vt.	Winooski	North Branch	68	20.2	17.3	74,000
			North Atlantic Region (Mid-Atlantic Sub-region)				
Almond	N. Y.	Susquehanna	Canacadea Creek	56	22.0	18.8	59,000
Alvin R. Bush	Pa.	Susquehanna	Kettle Creek	226	24.0	21.1	154,000
Aquashicola	Pa.	Delaware	Aquashicola Creek	66	28.0	24.2	42,500
Arkport	N. Y.	Susquehanna	Canister River	31	22.5	17.7	33,400
Aylesworth	Pa.	Susquehanna	Aylesworth Creek	6.2	23.8	22.0	13,700
Baird	W. Va.	Potomac	Buffalo Creek	10	34.0	30.2	14,600
Beltzville	Pa.	Delaware	Pohopoco Creek	97	27.1	25.6	68,000
Bloomington	Md.	Potomac	North Branch	263	22.2	17.6	196,000
Blue Marsh	Pa.	Delaware	Tulpehockan Creek	175	24.0	21.3	110,600
Burketown	Va.	Potomac	North River	375	24.3	21.2	272,200
Cabins	W. Va.	Potomac	South Branch	314	20.8	16.8	195,900
Chambersburg	Md.	Potomac	Conococheague River	141	28.9	26.0	81,400
Christiana	Del.	Delaware	Christiana River	41	32.1	28.3	39,200
Cootes Store	Va.	Potomac	North Fork River	215	22.5	19.1	140,200
Cowanesque	Pa.	Susquehanna	Cowanesque River	298	21.9	18.5	285,000
Curwensville	Pa.	Susquehanna	Susquehanna River	365	22.0	18.9	205,000
Dawsonville	Md.	Potomac	Seneca Creek	101	30.4	27.1	161,900
Douglas Point	Md.	Potomac	Potomac River	13,117	13.4	10.2	1,490,000
East Sidney	N. Y.	Susquehanna	Oulelot River	102	24.0	22.1	99,900
Edes Fort	W. Va.	Potomac	Cacapon River	679	21.2	17.3	410,800
Fairview	Md.	Potomac	Conococleaque Creek	494	22.9	18.8	150,100
Foster Joseph Sayers	Pa.	Susquehanna	Bald Eagle Creek	339	21.8	19.0	251,000
Francis E. Walter	Pa.	Delaware	Lehigh River	288	22.4	19.8	170,000

Project	State	River Basin	Stream	Drainage Area (sq.mi.)	Basin Average (in inches) Prec.	Runoff	PMF Peak Discharge (cfs)
Franklin	W. Va.	Potomac	South Branch	182	24.2	20.6	174,000
Frederick	Md.	Potomac	Monocacy River	817	23.2	20.9	363,400
Front Royal	Va.	Potomac	S.Fk.Shenandoah River	1,638	18.0	14.3	419,000
Fulton (Harrisburg)	Pa.	Susquehanna	Susquehanna River	24,100	12.7	8.2	1,750,000
Gathright	Va.	James	Jackson River	344	24.4	21.3	246,000
Gen. Edgar Jadwin	Pa.	Delaware	Dyberry Creek	65	24.8	24.0	119,700
Great Cacapon	W. Va.	Potomac	Cacapon River	677	21.2	17.3	373,400
Harriston	Va.	Potomac	South River	222	29.6	26.5	153,700
Hawk Mountain	Pa.	Delaware	E.Br. Delaware River	812	16.5	12.7	202,000
Headsville	W. Va.	Potomac	Patterson Creek	219	23.4	19.0	176,000
John H. Kerr	Va.	Roanoke	Roanoke River	7,800	16.8	12.9	1,000,000
Karo	W. Va.	Potomac	South Branch	1,577	18.9	14.9	430,000
Keyser	W. Va.	Potomac	North Branch	495	21.5	16.3	279,200
Kitzmiller	Md.	Potomac	North Branch	225	22.3	17.1	120,200
Leesburg	Va.	Potomac	Goose Creek	338	26.5	24.2	340,900
Lewistown	Md.	Potomac	Fishing Creek	7.1	34.8	32.7	12,200
Licking Creek	W. Va.	Potomac	Licking Creek	158	29.0	26.1	125,800
Little Cacapon	W. Va.	Potomac	Little Cacapon River	101	29.7	27.4	122,700
Maiden Creek	Pa.	Delaware	Maiden Creek	161	27.3	23.5	118,000
Martinsburg	W. Va.	Potomac	Opequon Creek	272	27.2	24.1	174,600
Mikville	W. Va.	Potomac	Shenandoah River	3,040	16.2	11.7	592,000
Moorefield	W. Va.	Potomac	South Branch	1,173	18.0	14.0	389,700
Moorefield	W. Va.	Potomac	So. Fk. South Branch	283	21.1	17.1	173,800
Newark	Del.	Delaware	White Clay River	66	29.8	26.0	103,000
North Anna	Va.	Pamunkey(York)	North Anna River	343	25.0	21.3	220,000
North Mountain	W. Va.	Potomac	Back Creek	231	27.9	24.8	256,000
Peach Bottom	Pa.	Susquehanna	Susquehanna River	27,000	12.7	8.2	1,750,000
Perryman	Md.	Chesapeake Bay	Bush River	118			87,400
Petersburg	W. Va.	Potomac	South Branch	642	19.3	15.3	208,700
Philpott	Va.	Roanoke	Smith River	212	27.5	24.3	160,000
Prompton	Pa.	Delaware	Lackawaxen River	60	25.0	24.2	87,190
Raystown	Pa.	Susquehanna	Juniata River (Br.)	960	21.4	17.5	353,400
Royal Glen	Md.	Potomac	South Branch	640	19.3	15.3	208,700
Salem Church	Va.	Rappahannock	Rappahannock River	1,598	23.6	19.6	552,000
Savage River	Md.	Potomac	Savage River	105	26.3	22.2	107,400
Seneca	Md.	Potomac	Potomac River	11,400	13.5	10.3	1,393,000
Sharpsburg	Md.	Potomac	Antietem Creek	281	26.6	23.5	154,900

TABLE B.1 (Page 4 of 17)

Project	State	River Basin	Stream	Drainage Area (sq.mi.)	Basin Average (in inches) Prec.	Runoff	PMF Peak Discharge (cfs)
Sherrill Drive	Md.	Potomac	Rock Creek	62	30.6	28.3	111,900
Six Bridge	Md.	Potomac	Monocacy River	308	27.1	24.0	225,000
Springfield	W. Va.	Potomac	South Branch	1,471	17.5	15.5	405,000
Staunton	Va.	Potomac	South Branch Shen.	325	25.0	21.3	226,000
Stillwater	Pa.	Susquehanna	Lacawanna River	37	27.3	24.1	39,600
Summit	N. J.	Delaware	Delaware River	11,100			1,000,000
Surry	Va.	James	James River	9,517			1,000,000
Tioga-Hammond	Pa.	Susquehanna	Tioga River	402	23.5	19.2	318,000
Tocks Island	N. J.	Delaware	Delaware River	3,827	13.3	10.5	576,300
Tonoloway	Md.	Potomac	Tonoloway Creek	112	29.9	26.8	117,600
Town Creek	Md.	Potomac	Town Creek	144	27.5	25.2	102,900
Trenton	N. J.	Delaware	Delaware River	6,780			830,000
Trexler	Pa.	Delaware	Jordon Creek	52	25.2	22.6	55,500
Tri-Towns	W. Va.	Potomac	North Branch	478	21.6	16.4	268,000
Verplanck	N. Y.	Hudson	Hudson River	12,650	14.0	9.7	1,100,000
Washington, D. C.	Md.	Potomac	Potomac River	11,560	13.4	10.2	1,280,000
Waynesboro	Va.	Potomac	South River	136	29.6	26.5	116,000
West Branch	W. Va.	Potomac	Conococheague River	78	30.7	27.0	78,700
Whitney Point	N. Y.	Susquehanna	Otselie River	255	20.7	19.1	102,000
Winchester	Va.	Potomac	Opeqnon Creek	120	28.9	25.8	142,100
York Indian Rock	Pa.	Susquehanna	Codorus Creek	94	22.1	17.7	74,300
			South Atlantic-Gulf Region				
Allatoona	Ga.	Alabama-Coosa	Etowah River	1,110	22.2	19.8	440,000
Alvin W. Vogtle	Ga.	Savannah	Savannah River	6,144	21.8	14.5	1,001,000
Bridgewater	N. C.	Santee	Catawba River	380			187,000
Buford	Ga.	Apalachicola	Chattahoochee River	1,040	21.7	19.7	428,900
Carters	Ga.	Alabama-Coosa	Coosawattee River	376	26.6	22.3	203,100
Catawba	N. C.	Santee	Catawba River	3,020		16.6	674,000
Cherokee	N. C.	Congaree-Santee	Broad River	1,550			560,000
Claiborne	Ala.	Alabama-Coosa	Alabama River	21,520	14.9	12.3	682,500
Clark Hill	Ga.	Savannah	Savannah River	6,144	21.8	14.5	1,140,000
Coffeeville	Ala.	Tombigbee	Black Warrior River	18,600	13.6	11.2	743,400
Cowans Ford	N. C.	Santee	Catawba River	1,790			636,000
Demopolis	Ala.	Tombigbee	Tombigbee River	15,300	16.7	14.3	1,068,000
Falls Lake	N. C.	Neuse	Neuse River	760	23.2	21.2	323,000

TABLE B.1 (Page 5 of 17)

Project	State	River Basin	Stream	Drainage Area (sq.mi.)	Basin Average (in inches) Prec.	Runoff	PMF Peak Discharge (cfs)
Gainsville	Ala.	Tombigbee	Tombigbee River	7,142	19.6	16.8	702,400
Hartwell	Ga.	Savannah	Savannah River	2,088	24.8	18.8	875,000
Holt	Ala.	Warrior	Warrior River	4,232	22.1	19.2	650,000
Howards Mill	N. C.	Cape Fear	Deep River	626	26.8	24.2	305,000
Jim Woodruff	Fla.	Apalachicola	Apalachicola River	17,150	17.6	12.3	1,133,800
John H. Bankhead	Ala.	Tombigbee	Black Warrior River	3,900	22.3	19.4	670,300
Jones Bluff	Ala.	Alabama	Alabama River	16,300	14.2	11.6	664,000
Lazer Creek	Ga.	Apalachicola	Lazer Creek	1,410	24.6	20.7	303,600
Lookout Shoals	N. C.	Santee	Catawba River	1,450			492,000
Lower Auchumpkee	Ga.	Apalachicola	Flint River	1,970	23.7	19.8	355,600
McGuire	N. C.	Santee	Catawba River	1,770			750,000
Millers Ferry	Ala.	Alabama	Alabama River	20,700	14.7	12.1	844,000
Mountain Island	N. C.	Santee	Catawba River	1,860			362,000
New Hope	N. C.	Cape Fear	New Hope River	1,690	22.0	19.4	511,000
Oconee	S. C.	Savannah	Keowee River	439	26.5	23.5	450,000
Oconee	S. C.	Savannah	Little River	148		26.6	245,000
Okatibbee	Miss.	Pascagoula	Okatibbee Creek	154	33.0	28.4	87,700
Oxford	N. C.	Santee	Catawba River	1,310			479,000
Perkins	N. C.	Pee Dee	Yadkin River	2,473			440,600
Randleman	N. C.	Cape Fear	Deep River	169	28.6	26.0	126,000
Reddies	N. C.	Pee Dee	Reddies River	94	28.0	24.8	174,200
Rhodhiss	N. C.	Santee	Catawba River	1,090			379,000
Shearon Harris	N. C.	Cape Fear	White Oak Creek	79			163,500
Sprewell Bluff	Ga.	Apalachicola	Flint River	1,210	25.8	21.3	318,000
Trotters Shoals	Ga.	Savannah	Savannah River	2,900	24.0	19.1	800,000
Walter F. George	Ga.	Apalachicola	Chattahoochee River	7,460	16.6	15.2	843,000
Warrior	Ala.	Tombigbee	Black Warrior River	5,828	19.5	16.6	554,000
West Point	Ga.	Apalachicola	Chattahoochee River	3,440	21.9	17.4	440,000
W. Kerr Scott	N. C.	Pee Dee	Yadkin River	348	25.6	21.5	318,000
			Great Lakes Region				
Bedford	Ohio	Cuyahoga	Tinkers Creek	91	28.6	25.9	79,000
Bristol	N. Y.	Oswego	Mud Creek	29	29.9	28.1	64,900
Fall Creek	N. Y.	Oswego	Fall Creek	123	17.1	16.1	63,400
Ithaca	N. Y.	Oswego	Six Mile Creek	43	26.9	25.1	77,900
Jamesville	N. Y.	Oswego	Butternut Creek	37	26.0	24.1	35,200
Linden	N. Y.	Niagara	Little Tonawanda Creek	22	30.8	29.0	64,400

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Project	State	River Basin	Stream	Drainage Area (sq.mi.)	Basin Average (in inches) Prec.	Runoff	PMF Peak Discharge (cfs)
Mount Morris	N. Y.	Genesee River	Genesee River	1,077	17.0	14.6	385,000
Onondago	N. Y.	Lake Ontario	Onondago Creek	68	24.2	23.3	61,800
Oran	N. Y.	Oswego	Limestone Creek	47	25.1	23.4	80,790
Portageville	N. Y.	Genesee	Genesee River	983	17.8	15.8	359,000
Quanicassee	Mich.	Saginaw Bay	Saginaw River	6,260			440,000
Quanicassee	Mich.	Saginaw Bay	Tittabawassee River	2,400			270,000
Quanicassee	Mich.	Saginaw Bay	Quanicassee River	70			46,000
Standard Corners	N. Y.	Genesee	Genesee River	265	22.3	20.3	189,900
			Ohio Region				
Alum Creek	Ohio	Ohio	Alum Creek	123	24.6	21.8	110,000
Barkley	Ky.	Ohio	Cumberland River	8,700	22.6	21.5	1,000,000
Barren	Ky.	Ohio	Barren River	940	17.6	16.9	531,000
Beaver Valley	Pa.	Ohio	Ohio River	23,000			1,500,000
Beech Fork	W. Va.	Ohio	Twelve Pole Creek	78	26.4	23.5	84,000
Big Blue	Ind.	Ohio	Big Blue River	269	23.5	21.2	161,000
Big Darby	Ohio	Ohio	Big Darby Creek	441	24.1	21.3	294,000
Big Pine	Ind.	Ohio	Big Pine Creek	326	22.4	20.4	174,000
Big Walnut	Ind.	Ohio	Big Walnut Creek	197	24.0	22.0	144,000
Birch	W. Va.	Ohio	Birch River	142	28.4	25.2	102,000
Bluestone	W. Va.	Ohio	New River	4,565		13.8	410,000
Booneville	Ky.	Ohio	So. Fk. Kentucky River	665	23.2	21.0	425,000
Brookville	Ind.	Ohio	Whitewater River	379	24.2	22.1	272,000
Buckhorn	Ky.	Ohio	M. Fk.Kentucky River	408	23.8	21.5	239,000
Burnsville	W. Va.	Ohio	Little Kanawha River	165	24.8	22.3	138,800
Caesar Creek	Ohio	Ohio	Caesar Creek	237	24.1	21.9	230,200
Cagles Mill	Ind.	Ohio	Mill Creek	295	24.6	22.7	159,000
Carr Fork	Ky.	Ohio	No. Fk. Kentucky River	58	27.4	25.0	132,500
Cave Run	Ky.	Ohio	Licking River	826	22.8	20.6	510,000
Center Hill	Tenn.	Ohio	Caney Fork	2,174	22.3	21.8	696,000
Clarence J. Brown	Ohio	Ohio	Buck Creek	82	29.0	26.7	121,000
Claytor	Va.	Ohio	New River	2,382	22.3	18.0	1,109,000
Clifty Creek	Ind.	Ohio	Clifty Creek	145	24.9	23.0	112,900
Dale Hollow	Tenn.	Ohio	Obey River	935	23.8	23.3	435,000
Deer Creek	Ohio	Ohio	Deer Creek	278	22.9	20.1	160,000
Delaware	Ohio	Ohio	Olentangy River	381	22.7	20.4	296,000
Dewey	Ky.	Ohio	Big Sandy River	207	25.0	22.6	75,500

TABLE B.1 (Page 7 of 17)

Project	State	River Basin	Stream	Drainage Area (sq.mi.)	Basin Average (in inches) Prec.	Runoff	PMF Peak Discharge (cfs)
Dillon	Ohio	Ohio	Licking River	748	19.8	16.3	246,000
Dyes	Ohio	Ohio	Dyes Fork	44	30.7	27.8	49,500
Eagle Creek	Ky.	Ohio	Eagle Creek	292	24.7	22.1	172,800
E. Br. Clarion	Pa.	Ohio	E. Br. Clarion River	72	22.7	18.9	41,500
East Fork	Ohio	Ohio	E. Fk. Little Miami River	342	23.8	21.2	313,200
East Lynn	W. Va.	Ohio	Twelve Pole Creek	133	29.4	26.5	72,000
Fishtrap	Ky.	Ohio	Levisa Fk. Sandy River	395	26.1	23.2	320,000
Grayson	Ky.	Ohio	Little Sandy River	196	27.5	24.7	83,300
Green River	Ky.	Ohio	Green River	682	26.5	23.9	409,000
Helm	Ill.	Ohio	Skillet Fk. Wabash River	210	24.8	22.6	152,800
John W. Flannagan	Va.	Ohio	Pound River	222	27.6	24.9	235,800
J. Percy Priest	Tenn.	Ohio	Stones River	892	25.9	18.8	430,000
Kehoe	Ky.	Ohio	Tygarts Creek	127	26.0	23.4	105,900
Kinzua	Pa.	Ohio	Allegheny River	2,180	16.4	12.8	115,000
Lafayette	Ind.	Ohio	Wildcat Creek	791	20.6	18.5	182,000
Laurel	Ky.	Ohio	Laurel River	282	25.9	20.7	120,000
Leading Creek	W. Va.	Ohio	Leading Creek	146	25.0	22.5	131,000
Lincoln	Ill.	Ohio	Embarras River	915	21.2	19.0	502,000
Logan	Ohio	Ohio	Clear Creek	84	29.5	27.0	78,000
Louisville	Ill.	Ohio	Little Wabash River	661	22.1	19.9	310,000
Mansfield	Ind.	Ohio	Raccoon Creek	216	25.9	23.0	175,800
Martins Fork	Ky.	Ohio	Cumberland River	56	27.9	22.7	61,800
Meigs	Ohio	Ohio	Meigs Creek	72	29.5	26.6	72,100
Meigs	Ohio	Ohio	Meigs Creek	27	32.2	29.3	45,500
Mill Creek	Ohio	Ohio	Mill Creek	181	24.0	21.4	92,000
Mississinewa	Ind.	Ohio	Mississinewa River	809	20.6	18.4	196,000
Michael J. Kirwin	Ohio	Ohio	Mahoning River	80	26.0	20.1	51,800
Monroe	Ind.	Ohio	Salt Creek	441	25.9	25.4	366,000
Muddy Creek	Pa.	Ohio	Muddy Creek	61	22.8	19.6	59,300
Nolin	Ky.	Ohio	Nolin River	703	14.2	13.2	158,000
N. Br. Kokosing	Ohio	Ohio	N. Br. Kokosing River	44	25.4	22.6	50,000
N. Fk. Pound River	Va.	Ohio	N. Fk. Pound River	18	35.3	32.2	51,200
Paint Creek	Ohio	Ohio	Paint Creek	573	21.8	18.8	305,000
Paintsville	Ky.	Ohio	Paint Creek	92	26.3	23.8	77,500
Panthers Creek	W. Va.	Ohio	Panther Creek	24	36.7	33.9	59,800
Patoka	Ind.	Ohio	Patoka River	168	25.6	23.5	292,000
R. D. Bailey	W. Va.	Ohio	Guyandotte River	540	23.1	20.3	349,000
Rough River	Ky.	Ohio	Rough River	454	27.6	25.1	358,000

TABLE B.1 (Page 8 of 17)

Project	State	River Basin	Stream	Drainage Area (sq.mi.)	Basin Average (in inches) Prec.	Basin Average (in inches) Runoff	PMF Peak Discharge (cfs)
Rowlesburg	W. Va.	Ohio	Cheat River	936	21.2	18.4	331,000
Salamonia	Ind.	Ohio	Salamonia River	553	21.3	19.0	201,000
Stonewall Jackson	W. Va.	Ohio	West Fork River	102	24.7	22.2	85,500
Summersville	W. Va.	Ohio	Gauley River	803	23.8	21.1	412,000
Sutton	W. Va.	Ohio	Elk River	537	20.4	20.4	222,400
Taylorville	Ky.	Ohio	Salt River	353	24.8	22.2	426,000
Tom Jenkins	Ohio	Ohio	Hocking River	33	26.7	25.8	43,000
Union City	Pa.	Ohio	French Creek	222	20.3	17.8	87,500
Utica	Ohio	Ohio	N. Fk. Licking River	112	24.7	22.1	73,700
West Fork	W. Va.	Ohio	W. Fk. Little Kanawha	238	24.4	21.8	156,400
West Fk. Mill Ck.	Ohio	Ohio	Mill Creek	30	31.9	30.0	81,600
Whiteoak	Ohio	Ohio	Whiteoak Creek	214	24.5	21.6	134,000
Wolf Creek	Ky.	Ohio	Cumberland River	5,789	20.6	20.0	996,000
Woodcock	Pa.	Ohio	Woodcock Creek	46	23.5	20.9	37,700
Yatesville	Ky.	Ohio	Blaine Creek	208	25.2	22.6	118,000
Youghiogheny	Pa.	Ohio	Youghiogheny River	434		25.4	151,000
Zimmer, Wm. H.	Ohio	Ohio	Ohio River	70,800			2,150,000
			Tennessee Region				
Bellefonte	Ala.	Ohio	Tennessee River	23,340			1,160,000
Browns Ferry	Tenn.	Ohio	Tennessee River	27,130			1,200,000
Sequoyah	Tenn.	Ohio	Tennessee River	20,650			1,205,000
			Upper Mississippi Region				
Ames	Iowa	Upper Miss.	Skunk River	314	21.3	18.4	87,200
Byron	Ill.	Upper Miss.	Rock River	8,000			308,000
Bear Creek	Mo.	Upper Miss.	Bear Creek	28	29.0	26.2	38,000
Blue Earth	Minn.	Upper Miss.	Minnesota River	11,250	14.2	10.9	283,000
Blue Earth	Minn.	Upper Miss.	Blue Earth River	3,550	18.4	14.8	206,000
Carlyle	Ill.	Upper Miss.	Kaskaskia River	2,680	19.2	15.8	246,000
Clarence Cannon	Mo.	Upper Miss.	Salt River	2,318	21.8	15.7	476,200
Clinton	Ill.	Upper Miss.	Salt Creek	296			99,500
Coralville	Iowa	Upper Miss.	Iowa River	3,084	20.8	14.4	326,000
Duane Arnold	Iowa	Upper Miss.	Cedar River	6,250			316,000
Farmdale	Ill.	Upper Miss.	Farm Creek	26	24.0	22.1	67,300
Fondulac	Ill.	Upper Miss.	Fondulac Creek	5.4	21.4	19.9	21,200
Friends Creek	Ill.	Upper Miss.	Friends Creek	133	27.8	21.6	83,160

Project	State	River Basin	Stream	Drainage Area (sq.mi.)	Basin Average (in inches) Prec.	Runoff	PMF Peak Discharge (cfs)
Jefferson	Iowa	Upper Miss.	Raccoon River	1,532	21.7	19.0	267,300
LaFarge	Wisc.	Upper Miss.	Kickapoo River	266	22.8	18.9	128,000
Mankato	Minn.	Upper Miss.	Minnesota River	14,900	13.9	10.6	329,000
Meramec Park	Mo.	Upper Miss.	Meramec River	1,497	22.9	17.5	552,000
Montevideo	Minn.	Upper Miss.	Minnesota River	6,180	15.2	11.6	263,000
Monticello	Minn.	Upper Miss.	Mississippi River	13,900			365,000
New Ulm	Minn.	Upper Miss.	Minnesota River	9,500	14.4	11.1	263,000
New Ulm	Minn.	Upper Miss.	Cottonwood River	1,280	21.2	17.6	128,000
Oakley	Ill.	Upper Miss.	Sangamon River	808	23.5	17.2	178,000
Prairie Island	Minn.	Upper Miss.	Mississippi River	44,755			910,000
Red Rock	Iowa	Upper Miss.	Des Moines River	12,323	12.1	7.5	613,000
Rend	Ill.	Upper Miss.	Big Muddy River	488	27.5	21.5	308,200
Saylorville	Iowa	Upper Miss.	Des Moines River	5,823	13.8	10.3	277,800
Shelbyville	Ill.	Upper Miss.	Kaskaskia River	1,030	22.1	19.1	142,000
			Lower Mississippi Region				
Arkabutla	Miss.	Lower Miss.	Coldwater River	1,000	22.5	21.2	430,000
Enid	Miss.	Lower Miss.	Yacona River	560	25.4	24.7	204,900
Grenada	Miss.	Lower Miss.	Yalobusha River	1,320	24.0	23.1	390,800
Sardis	Miss.	Lower Miss.	Tallahatchia River	1,545	32.5	26.0	290,400
Union	Mo.	Lower Miss.	Bourbeuse River	771	25.0	19.9	264,000
Wappapello	Mo.	Lower Miss.	St. Francis River	1,310	13.0	11.7	344,000
			Souris-Red-Rainy Region				
Burlington	N. D.	Souris	Souris River	9,490	13.2	5.7	89,100
Fox Hole	N. D.	Souris	Des Lacs River	939	19.9	12.4	52,700
Homme	N. D.	Red of North	Park River	229	15.2	12.3	35,000
Kindred	N. D.	Red of North	Sheyenne River	3,020	13.4	8.6	68,700
Lake Ashtabula	N. D.	Red of North	Sheyenne River	983	12.4	9.5	86,500
Orwell	Minn.	Red of North	Otter Tail River	1,820	17.1	14.7	25,500
			Missouri Region				
Bear Creek	Colo.	Missouri	Bear Creek	236	24.4	6.7	225,000
Big Bend	S. D.	Missouri	Missouri River	5,840		9.0	725,000
Blue Springs	Mo.	Missouri	Blue Springs Creek	33	26.5	23.8	42,400
Blue Stem	Nebr.	Missouri	Olive Br. Salt Creek	17	25.0	21.7	69,200
Bowman-Haley	N. D.	Missouri	Grand River	446	15.5	12.7	110,000
Branched Oak	Nebr.	Missouri	Oak Creek	89	20.1	16.8	93,600

TABLE B.1 (Page 10 of 17)

Project	State	River Basin	Stream	Drainage Area (sq. mi.)	Basin Average (in inches) Prec.	Runoff	PMF Peak Discharge (cfs)
Braymer	Mo.	Missouri	Shoal Creek	390	24.7	22.2	173,800
Brookfield	Mo.	Missouri	West Yellow Creek	140	24.5	22.0	64,500
Bull Hook	Mont.	Missouri	Bull Hook Creek	54		10.8	26,200
Chatfield	Colo.	Missouri	South Platte River	3,018	13.2	2.0	584,500
Cherry Creek	Colo.	Missouri	Cherry Creek	385	23.9	9.5	350,000
Clinton	Kans.	Missouri	Wakarusa River	367	23.6	22.4	153,500
Cold Brook	S. D.	Missouri	Cold Brook	70		6.4	95,700
Conestoga	Nebr.	Missouri	Holmes Creek	15	25.2	21.9	52,000
Cottonwood Springs	S. D.	Missouri	Cheyenne River	26	18.7	11.1	74,700
Dry Fork	Mo.	Missouri	Fishing River	3.2	26.1	22.5	19,460
East Fork	Mo.	Missouri	Fishing River	19	25.7	24.1	62,700
Fort Scott	Kans.	Missouri	Marmaton River	279	23.8	22.7	198,000
Fort Peck	Mont.	Missouri	Missouri River	57,725		3.2	360,000
Fort Randall	S. D.	Missouri	Missouri River	14,150		3.7	849,000
Fort St. Vrain	Colo.	Missouri	South Platte River	4,700			500,000
Garrison	N. D.	Missouri	Missouri River	123,215		2.7	1,026,000
Gavins Point	Nebr.	Missouri	Missouri River	16,000		3.3	642,000
Grove	Kans.	Missouri	Soldier Creek	259	23.8	22.7	79,800
Harlan County	Nebr.	Missouri	Republican River	7,141	7.6	2.8	485,000
Harry S. Truman	Mo.	Missouri	Osage River	7,856		13.1	1,060,000
Hillsdale	Kans.	Missouri	Big Bull Creek	144	25.4	24.3	190,500
Holmes	Nebr.	Missouri	Antelope Creek	5.4	27.1	23.8	41,600
Kanopolis	Kans.	Missouri	Smoky Hill River	2,560	6.9	3.6	456,300
Linneus	Mo.	Missouri	Locust River	546	23.7	21.2	242,300
Long Branch	Mo.	Missouri	E. Fk. Little Chariton	109	24.5	21.9	66,500
Longview	Mo.	Missouri	Blue River	50	26.2	23.4	74,800
Melvern	Kans.	Missouri	Marias des Cygnes River	349	23.1	22.1	182,000
Mercer	Mo.	Missouri	Weldon River	427	21.0	17.8	274,000
Milford	Kans.	Missouri	Republican River	3,620	8.8	5.0	757,400
Mill Lake	Mo.	Missouri	Mill Creek	9.5	27.7	26.4	13,000
Oahe	S. D.	Missouri	Missouri River	62,550		6.5	946,000
Olive Creek	Nebr.	Missouri	Olive Br. Salt Creek	8.2	26.0	22.7	36,650
Onag	Kans.	Missouri	Vermillion Creek	301	23.5	22.2	251,000
Pattonsburg	Mo.	Missouri	Grand River	2,232	18.8	16.3	400,100
Pawnee	Nebr.	Missouri	Pawnee Br. Salt Creek	36	23.5	20.2	59,000
Perry	Kans.	Missouri	Delaware River	1,117	21.5	18.4	387,400
Pioneer	Colo.	Missouri	Republican River	918	15.0	8.3	390,000
Pomme de Terre	Mo.	Missouri	Pomme de Terre River	611	23.9	21.6	362,000

Project	State	River Basin	Stream	Drainage Area (sq.mi.)	Basin Average (in inches) Prec.	Runoff	PMF Peak Discharge (cfs)
Pomona	Kans.	Missouri	110 Mile Creek	322	26.2	25.2	186,000
Rathbun	Iowa	Missouri	Chariton River	549	23.7	21.1	188,000
Smithville	Mo.	Missouri	Little Platte River	213	23.9	20.2	185,000
Stagecoach	Nebr.	Missouri	Hickman Br. Salt Creek	9.7	26.0	22.7	50,500
Stockton	Mo.	Missouri	Sac River	1,160	19.7	18.9	470,000
Thomas Hill	Mo.	Missouri	Little Chariton River	147	25.0	23.0	79,000
Tomahawk	Kans.	Missouri	Tomahawk Creek	24	26.4	24.8	26,800
Trenton	Mo.	Missouri	Thompson River	1,079	22.6	20.1	342,400
Tuttle Creek	Kans.	Missouri	Big Blue River	9,556	14.5	8.1	798,000
Twin Lakes	Nebr.	Missouri	S. Br. Middle Creek	11	25.9	22.6	56,000
Wagon Train	Nebr.	Missouri	Hickman Br. Salt Creek	16	25.2	21.9	53,500
Wilson	Kans.	Missouri	Saline River	1,917	20.2	10.8	252,000
Wolf-Coffee	Kans.	Missouri	Blue River	45	26.1	24.5	58,000
Yankee Hill	Nebr.	Missouri	Cardwell Br. Salt Creek	8.4	26.0	22.7	58,400
			Arkansas-White-Red Region				
Arcadia	Okla.	Arkansas	Deep Fork River	105	28.5	24.9	144,000
Bayou Bodcau	La.	Red	Bayou Bodcau	656	35.3	33.6	168,700
Beaver	Ark.	White	White River	1,186	24.3	22.4	480,000
Bell Foley	Ark.	Arkansas	Strawberry River	78	26.4	23.5	57,000
Big Hill	Kans.	Arkansas	Big Hill Creek	37	25.4	23.6	47,500
Big Pine	Tex.	Red	Big Pine Creek	95	31.3	29.3	86,000
Birch	Okla.	Arkansas	Birch Creek	66	29.0	26.0	91,000
Blakely Mountain	Ark.	Red	Ouachita River	1,105	21.5	19.6	418,000
Blue Mountain	Ark.	Arkansas	Petit Jean River	500	21.8	18.2	258,000
Boswell	Okla.	Red	Boggy Creek	2,273	27.6	20.8	405,000
Broken Bow	Okla.	Red	Mountain Fork	754	32.5	29.4	569,000
Bull Shoals	Ark.	White	White River	6,036	15.2	13.0	765,000
Candy	Okla.	Arkansas	Candy Creek	43	29.3	27.5	67,500
Canton	Okla.	Arkansas	North Canadian River	7,600	12.4	4.1	371,000
Cedar Point	Kans.	Arkansas	Cedar Creek	119	25.4	22.6	208,000
Clayton	Okla.	Red	Jackfort Creek	275	31.3	29.3	240,000
Clearwater	Mo.	White	Black River	898	16.0	13.8	432,000
Conchas	N. Mex.	Arkansas	South Canadian River	7,409	4.8	3.0	582,000
Cooper	Tex.	Red	South Sulphur River	476	30.9	29.2	194,400
Copan	Okla.	Arkansas	Little Caney River	505	26.2	21.1	169,000
Council Grove	Kans.	Arkansas	Grand River	246	25.5	22.7	250,000
County Line	Mo.	White	James River	153	27.2	25.3	133,000

TABLE B.1 (Page 12 of 17)

Project	State	River Basin	Stream	Drainage Area (sq.mi.)	Basin Average (in inches) Prec.	Runoff	PMF Peak Discharge (cfs)
DeGray	Ark.	Red	Caddo River	453	28.4	26.0	397,000
Denison	Okla.	Red	Red River	33,783	12.9	6.5	1,830,000
DeQueen	Ark.	Red	Rolling Fork	169	35.5	32.5	254,000
Dierks	Ark.	Red	Saline River	113	36.2	33.2	202,000
Douglas	Kans.	Arkansas	Little Walnut Creek	238	26.7	22.9	156,000
El Dorado	Kans.	Arkansas	Walnut River	234	26.8	22.8	196,000
Elk City	Kans.	Arkansas	Elk River	634	23.0	20.3	319,000
Eufaula	Okla.	Arkansas	Canadian River	8,405	15.9	10.9	700,000
Fall River	Kans.	Arkansas	Fall River	556	27.1	23.0	442,000
Ferrells Bridge	Tex.	Red	Cypress Creek	880	31.1	28.1	367,000
Fort Gibson	Okla.	Arkansas	Grand River	9,477	16.2	12.6	865,000
Fort Supply	Okla.	Arkansas	Wolf Creek	1,494	20.5	15.7	547,000
Gillham	Ark.	Red	Cossatot River	271	34.6	31.5	355,000
Great Salt Plains	Okla.	Arkansas	Salt Fk. Arkansas River	3,200	16.7	9.3	412,000
Greers Ferry	Ark.	Red	Little Red River	1,146	17.9	17.5	630,000
Heyburn	Okla.	Arkansas	Polecat Creek	123	26.3	24.2	151,000
Hugo	Okla.	Red	Kiamichi River	1,709	27.1	25.8	339,000
Hulah	Okla.	Arkansas	Caney River	732	16.5	13.5	239,000
John Martin	Colo.	Arkansas	Arkansas River	18,130	7.4	2.0	630,000
John Redmond	Kans.	Arkansas	Grand River	3,015	18.2	15.6	638,000
Kaw	Okla.	Arkansas	Arkansas River	7,250	14.5	9.9	774,000
Keystone	Okla.	Arkansas	Arkansas River	22,351	12.9	6.7	1,035,000
Lake Kemp	Tex.	Red	Wichita River	2,086	23.7	19.2	566,000
Lukfata	Okla.	Red	Glover Creek	291	34.6	31.5	349,000
Marion	Kans.	Arkansas	Cottonwood River	200	24.8	21.9	160,000
Millwood	Ark.	Red	Little River	4,144	28.4	25.3	442,000
Narrows	Ark.	Red	Little Missouri River	237	25.0	23.0	194,000
Neodesha	Kans.	Arkansas	Verdigris River	1,160	18.7	16.6	287,000
Nimrod	Ark.	Arkansas	Fourche La Fave River	680	20.2	17.2	228,000
Norfolk	Ark.	White	North Fork White River	1,765	15.7	12.8	372,000
Oologah	Okla.	Arkansas	Verdigris River	4,339	17.8	13.9	451,000
Optima	Okla.	Arkansas	North Canadian River	2,341	13.8	9.0	386,000
Pat Mayse	Tex.	Red	Sanders Creek	175	31.8	29.4	150,000
Pine Creek	Okla.	Red	Little River	635	32.8	29.8	523,000
Robert S. Kerr	Okla.	Arkansas	Arkansas River	64,386	10.0	5.8	1,884,000
Sand	Okla.	Arkansas	Sand Creek	137	31.3	28.3	154,000
Shidler	Okla.	Arkansas	Salt Creek	99	27.3	24.0	104,100
Skiatook	Okla.	Arkansas	Hominy Creek	354	27.8	23.8	147,800
Table Rock	Mo.	White	White River	4,020	18.3	15.4	657,000

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Project	State	River Basin	Stream	Drainage Area (sq.mi.)	Basin Average (in inches) Prec.	Runoff	PMF Peak Discharge (cfs)
Tenkiller Ferry	Okla.	Arkansas	Illinois River	1,610	20.4	17.6	406,000
Texarkana	Tex.	Red	Sulphur River	3,400	26.6	20.1	451,000
Toronto	Kans.	Arkansas	Verdigris River	730	23.9	21.1	400,000
Towanda	Kans.	Arkansas	Whitewater River	422	24.3	20.5	198,000
Trinidad	Colo.	Arkansas	Purgatorie River	671	10.0	4.5	296,000
Tuskahoma	Okla.	Red	Kiamichi River	347	16.5	14.6	188,400
Wallace Lake	La.	Red	Cypress Bayou	260	38.4	35.6	197,000
Waurika	Okla.	Red	Beaver Creek	562	26.5	22.2	354,000
Webbers Falls	Okla.	Arkansas	Arkansas River	48,127	10.7	6.1	1,518,000
Wister	Okla.	Arkansas	Poteau River	993	25.9	23.2	339,000
			Texas-Gulf Region				
Addicks	Tex.	San Jacinto	South Mayde Creek	129	29.7	27.9	68,670
Aquilla	Tex.	Brazos	Aquilla Creek	294	31.2	28.6	283,800
Aubrey	Tex.	Trinity	Elm Fork Trinity River	692	28.5	26.0	445,300
Bardwell	Tex.	Trinity	Waxahachie Creek	178	31.1	28.3	163,500
Barker	Tex.	San Jacinto	Buffalo Bayou	150	29.4	27.9	55,900
Belton	Tex.	Brazos	Leon River	3,560	29.4	20.6	608,400
Benbrook	Tex.	Trinity	Clear Fork Trinity River	429	28.2	21.1	290,100
Big Sandy	Tex.	Sabine	Big Sandy Creek	196	36.2	32.2	125,200
Blieders Creek	Tex.	Guadalupe	Blieders Creek	15	43.8	34.6	70,300
Brownwood	Tex.	Colorado	Pecan Bayou	1,544	27.8	21.0	676,200
Canyon Lake	Tex.	Guadalupe	Guadalupe River	1,432	24.5	16.9	687,000
Carl L. Estes	Tex.	Sabine	Sabine River	1,146	34.5	30.4	277,000
Coleman	Tex.	Colorado	Colorado River	287	30.9	24.1	267,800
Comanche Peak	Tex.	Brazos	Squaw Creek	64	39.1	34.1	149,000
Ferguson	Tex.	Brazos	Navasota River	1,782	26.0	22.4	355,800
Gonzales	Tex.	Guadalupe	San Marcos River	1,344	24.9	15.4	633,900
Grapevine	Tex.	Trinity	Denton Creek	695	26.5	21.5	319,400
Hords Creek	Tex.	Colorado	Hords Creek	48	28.9	23.4	92,400
Lake Fork	Tex.	Sabine	Lake Fork Creek	507	33.8	29.7	247,600
Lakeview	Tex.	Trinity	Mountain Creek	232	31.6	28.8	335,000
Laneport	Tex.	Brazos	San Gabriel River	709	28.9	23.7	521,000
Lavon	Tex.	Trinity	East Fork, Trinity River	770	26.2	23.4	430,300
Lewisville	Tex.	Trinity	Elm Fork, Trinity River	1,660	23.2	20.5	632,200
Millican	Tex.	Brazos	Navasota River	2,120	25.5	22.4	393,400
Navarro Mills	Tex.	Trinity	Richland Creek	320	33.6	30.5	280,500
Navasota	Tex.	Brazos	Navasota River	1,341	27.2	24.2	327,400

Project	State	River Basin	Stream	Drainage Area (sq.mi.)	Basin Average (in inches) Prec.	Runoff	PMF Peak Discharge (cfs)
North Fork	Tex.	Brazos	N. Fk. San Gabriel River	246	31.7	26.6	265,800
Pecan Bayou	Tex.	Colorado	Pecan Bayou	316	30.7	23.8	236,200
Proctor	Tex.	Brazos	Leon River	1,265	27.0	21.4	459,200
Roanoke	Tex.	Trinity	Denton Creek	604	28.9	24.1	313,600
Rockland	Tex.	Neches	Neches River	3,557	21.0	17.2	150,400
Sam Rayburn	Tex.	Neches	Angelina River	3,449	23.7	20.6	395,600
San Angelo	Tex.	Colorado	North Concho River	1,511	21.2	13.1	614,500
Somerville	Tex.	Brazos	Yogua Creek	1,006	22.0	13.6	415,700
South Fork	Tex.	Brazos	S. Fk. San Gabriel River	123	32.6	27.4	145,300
Stillhouse Hollow	Tex.	Brazos	Lampasas River	1,318	27.7	22.5	686,400
Tennessee Colony	Tex.	Trinity	Trinity River	12,687	25.1	20.4	575,600
Town Bluff	Tex.	Neches	Neches River	7,573	18.9	15.7	326,000
Waco Lake	Tex.	Brazos	Bosque River	1,670	25.7	20.6	622,900
Whitney	Tex.	Brazos	Brazos River	17,656	15.7	7.7	700,000
			Rio Grande Region				
Abiquiu	N. M.	Rio Grande	Rio Grande	3,159		8.2	130,000
Alamogordo	N. M.	Rio Grande	Pecos River	3,917		1.9	277,000
Cochita	N. M.	Rio Grande	Rio Grande	4,065	4.6	1.9	320,000
Jemez Canyon	N. M.	Rio Grande	Jemez Canyon	1,034	9.2	3.7	220,000
Los Esteros	N. M.	Rio Grande	Pecos River	2,434	12.2	4.7	352,000
Two Rivers	N. M.	Rio Grande	Rio Hondo	1,027			281,400
			Lower Colorado Region				
Alamo	Ariz.	Colorado	Bill Williams River	4,770	12.0	3.5	580,000
McMicken	Ariz.	Colorado	Aqua Fria River	247		3.3	52,000
Whitlow Ranch	Ariz.	Colorado	Queen Creek	143	11.5	9.7	230,000
Painted Rock	Ariz.	Colorado	Gila River	50,800	7.7	2.8	620,000
			Great Basin Region				
Little Dell	Utah	Jordon (Great)	Dell Creek	16	8.1	6.0	23,000
Mathews Canyon	Nev.	Great Basin	Mathews Canyon	34	8.6	7.4	35,000
Pine Canyon	Nev.	Great Basin	Pine Canyon	45	8.2	6.6	38,000
			Columbia-North Pacific Region				
Applegate	Oreg.	Rogue	Applegate River	223		28.9	99,500
Blue River	Oreg.	Columbia	S. Fk. McKenzie River	88		22.7	39,500

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Project	State	River Basin	Stream	Drainage Area (sq.mi.)	Basin Average (in inches) Prec.	Runoff	PMF Peak Discharge (cfs)
Bonneville	Oreg.	Columbia	Columbia River	240,000		22.1	2,720,000
Cascadia	Oreg.	Columbia	South Santiam River	179		42.2	115,000
Chief Joseph	Wash.	Columbia	Columbia River	75,000		29.0	1,550,000
Cottage Grove	Oreg.	Columbia	Coast Fk. Willamette River	104		29.7	45,000
Cougar	Oreg.	Columbia	S. Fk. McKenzie River	208		34.2	98,000
Detroit	Oreg.	Columbia	North Santiam River	438		36.0	203,000
Dorena	Oreg.	Columbia	Row River	265		34.6	131,600
Dworshak	Ida.	Columbia	N. Fk. Clearwater River	2,440		70.5	280,000
Elk Creek	Oreg.	Rogue	Elk Creek	132		32.6	63,500
Fall Creek	Oreg.	Columbia	Willamette River	184		33.8	100,000
Fern Ridge	Oreg.	Columbia	Long Tom River	252		20.3	48,600
Foster	Oreg.	Columbia	South Santiam River	494		40.8	260,000
Green Peter	Oreg.	Columbia	Middle Santiam River	277		41.3	160,000
Gate Creek	Oreg.	Columbia	Gate Ck. McKenzie River	50		46.3	37,000
Hills Creek	Oreg.	Columbia	Middle Fk. Willamette River	389		33.0	197,000
Holley	Oreg.	Columbia	Calapooia River	105		35.8	59,000
Howard A. Hanson	Wash.	Green	Green River	225		26.8	164,000
Ice Harbor	Wash.	Columbia	Snake River	109,000		13.9	954,000
John Day	Oreg.	Columbia	Columbia River	226,000		21.1	2,650,000
Libby	Mont.	Columbia	Kootenai River	9,070		35.5	282,000
Little Goose	Wash.	Columbia	Snake River	103,900		14.6	850,000
Lookout Point	Oreg.	Columbia	Middle Fk. Wilamette River	991		30.8	360,000
Lost Fork	Oreg.	Rogue	Lost Fk. Rogue River	674		22.7	169,000
Lower Granite	Wash.	Columbia	Snake River	103,400		14.7	850,000
Lower Monumental	Wash.	Columbia	Snake River	108,500		14.0	850,000
Lucky Peak	Ida.	Columbia	Boise River	2,650		32.5	123,000
McNary	Oreg.	Columbia	Columbia River	214,000		23.0	2,610,000
Mud Mountain	Wash.	Puyallup	White River	400		33.9	186,000
Ririe	Ida.	Columbia	Willow Ck. Snake River	620		5.4	47,000
The Dalles	Oreg.	Columbia	Columbia River	237,000		21.1	2,660,000
Wynoochee	Wash.	Chechalis	Wynoochee River	41		69.9	52,500
Zintel	Wash.	Columbia	Zintel Canyon Snake River	19		7.8	40,500
			California Region				
Bear	Cal.	San Joaquin	Bear Creek	72	13.6	13.6	30,400
Big Dry Creek	Cal.	San Joaquin	Big Dry Creek	91	19.0	13.8	17,000
Black Butte	Cal.	Sacramento	Stony Creek	741	19.7	12.3	154,000
Brea	Cal.	Santa Ana	Brea Creek	23	10.4	6.6	37,000

TABLE B.1 (Page 16 of 17)

Project	State	River Basin	Stream	Drainage Area (sq.mi.)	Basin Average (in inches)		PMF Peak Discharge (cfs)
					Prec.	Runoff	
Buchanan	Cal.	San Joaquin	Chowchilla River	235	26.0	20.1	127,000
Burns	Cal.	San Joaquin	Burns Creek	74	17.4	10.6	26,800
Butler Valley	Cal.	Mad	Mad River	352		35.2	137,000
Carbon Canyon	Cal.	Santa Ana	Santa Ana River	19	10.4	10.3	56,000
Cherry Valley	Cal.	San Joaquin	Cherry Creek	117	24.3	23.1	60,000
Comanche	Cal.	San Joaquin	Mokelumne River	618	25.0	19.9	261,000
Coyote Valley	Cal.	Russian	East Fk. Russian River	105		22.9	57,000
Dry Creek	Cal.	Russian	Dry Creek	82	21.3	15.6	45,000
Farmington	Cal.	San Joaquin	Little John Creek	212	11.3	10.9	56,000
Folsom	Cal.	Sacramento	American River	1,875	21.2	17.5	615,000
Fullerton	Cal.	Santa Ana	Fullerton Creek	5.0	9.0	6.8	16,000
Hansen	Cal.	Los Angeles	Tujunga Wash	147		9.8	130,000
Hidden Lake	Cal.	San Joaquin	Fresno River	234	27.9	18.4	114,000
Isabella	Cal.	San Joaquin	Kern River	2,073	27.1	6.5	235,000
Knights Valley	Cal.	Russian	Franz-Maacama Creek	59	31.6	28.9	44,300
Lakeport	Cal.	Sacramento	Scotts Creek	52	30.9	24.0	36,100
Lopez	Cal.	Los Angeles	Pacoima Creek	34		20.8	32,000
Mariposa	Cal.	San Joaquin	Mariposa Creek	108	18.6	13.0	43,000
Martis Creek	Cal.	Truckee	Martis Creek	39	26.5	12.7	12,400
Marysville	Cal.	Sacramento	Yuba River	1,324	38.9	27.0	460,000
Mojave River	Cal.	Mojave	Mojave River	215	40.4	30.4	186,000
New Bullards Bar	Cal.	Sacramento	North Yuba River	489	38.9	25.7	226,000
New Exchequer	Cal.	San Joaquin	Merced River	1,037	27.1	15.9	396,000
New Hogan	Cal.	San Joaquin	Calaveras River	362		18.3	132,000
New Melones	Cal.	San Joaquin	Stanislaus River	897	25.8	16.3	355,000
Oroville	Cal.	Sacramento	Feather River	2,600	23.3	22.8	720,000
Owens	Cal.	San Joaquin	Owens Creek	26	14.4	9.2	11,400
Pine Flat	Cal.	San Joaquin	Kings River	1,542	28.5	14.4	437,000
Prado	Cal.	Santa Ana	Santa Ana River	2,233	26.3	13.0	700,000
San Antonio	Cal.	Santa Ana	San Antonio Creek	27		13.0	60,000
Santa Fe	Cal.	San Gabriel	San Gabriel River	236		35.5	194,000
Sepulveda	Cal.	Los Angeles	Los Angeles River	152		15.0	220,000

TABLE B.1 (Page 17 of 17)

Project	State	River Basin	Stream	Drainage Area (sq.mi.)	Basin Average (in inches) Prec.	Runoff	PMF Peak Discharge (cfs)
Success	Cal.	San Joaquin	Tule River	383	32.5	12.6	200,000
Terminus	Cal.	San Joaquin	Kaweah River	560	40.1	24.8	290,000
Tuolumne	Cal.	San Joaquin	Tuolumne River	1,533	25.1	20.2	602,000
Whittier Narrows	Cal.	San Gabriel	San Gabriel River	554	17.4	13.7	305,000

APPENDIX C

SIMPLIFIED METHODS OF ESTIMATING PROBABLE MAXIMUM SURGES

TABLE OF CONTENTS

FIGURES

TABLES

C.1 INTRODUCTION

This appendix presents timesaving methods of estimating the maximum stillwater level of the probable maximum surge (PMS) from hurricanes at open-coast sites on the Atlantic Ocean and Gulf of Mexico. Use of the methods herein will reduce both the time necessary for applicants to prepare license applications and the NRC staff's review effort.

The procedures are based on PMS values determined by the NRC staff and its consultants and by applicants for licenses that have been reviewed and accepted by the staff. The information in this appendix was developed from a study made by Nunn, Snyder, and Associates, through a contract with NRC (Ref. 1).

The PMS data are shown in Tables C.1 through C.21 and on maps of the Atlantic and Gulf Coasts (Figures C.1 and C.2). Suggestions for interpolating between these values are included.

Limitations on the use of these generalized methods of estimating PMS are identified in Section C.4. These limitations should be considered in detail in assessing the applicability of the methods at specific sites.

Applicants for licenses for nuclear facilities at sites on the open coast of the Atlantic Ocean or the Gulf of Mexico have the option of using these methods in lieu of more precise but laborious methods contained in Appendix A. The results of application of the methods in this appendix will in many cases be accepted by the NRC staff with no further verification.

C.2 SCOPE

The data and procedures in this appendix apply only to open-coast areas of the Gulf of Mexico and the Atlantic Ocean.

Future studies are planned to determine the applicability of similar generalized methods and to develop such methods, if feasible, for other areas. These studies, to be included in similar appendices, are anticipated for the Great Lakes and the Pacific Coast, including Hawaii and Alaska.

C.3 PROBABLE MAXIMUM SURGE LEVELS FROM HURRICANES

The data presented in this appendix consist of all determinations of hurricane-induced PMS peak levels at open-coast locations computed by the NRC staff or their consultants, or by applicants and accepted by the staff. The data are shown in Tables C.1 through C.21 and on Figures C.1 and C.2. All represent stillwater levels for open-coast conditions.

C.3.1 Methods Used

All PMS determinations in Table C.1 were made by NRC consultants for this study (Ref. 1) or for earlier studies except Pass Christian, Brunswick, Chesapeake Bay Entrance, Forked River—Oyster Creek, Millstone, Pilgrim, and Hampton Beach.

The computations by the consultants were made using the NRC surge computer program, which is adapted from References 2, 3, and 4. Probable maximum hurricane data were taken from Reference 5. Ocean bottom topography for the computations was obtained from the most detailed available Nautical Charts published by the National Ocean Survey, NOAA. The traverse line used for the probable maximum hurricane surge estimate was drawn from the selected coastal point to the edge of the continental shelf or to an ocean depth of 600 feet MLW and was one hurricane radius to the right of the storm track. The radius to maximum winds was oriented at an angle of 115° from the storm track. The traverse was oriented perpendicular to the ocean-bed contours near shore. The ocean-bed profile along the traverse line was determined by roughly averaging the topography of cross sections perpendicular to the traverse line and extending a maximum of 5 nautical miles to either side. The 10-mile-wide cross sections were narrowed uniformly to zero at the selected site starting 10 nautical miles from shore. It was assumed that the peak of the PMS coincided with the 10% exceedance high spring tide[1] plus initial rise.[2] Slightly different procedures were used for postulating the traverse lines and profiles for the Crystal River and St. Lucie determinations.

In each case the maximum water level resulted from use of the high translation speed for the hurricane in combination with the large radius to maximum wind as defined in Reference 5. Detailed data for the computed PMS values are shown in Tables C.1 through C.20. Ocean-bed profile data for Pass Christian, Crystal River, St. Lucie, Chesapeake Bay Mouth, and Hampton Beach are shown in Table C.21.

The water levels resulting from these computations are open-coast stillwater levels upon which waves and wave runup should be superimposed.

C.3.2 Use of Data in Estimating PMS

Estimates of the PMS stillwater level at open-coast sites other than those shown in Tables C.1 through C.21 and on Figures C.1 and C.2 may be obtained as follows:

[1]The 10% exceedance high spring tide is the predicted maximum monthly astronomical tide exceeded by 10% of the predicted maximum monthly astronomical tides over a 21-year period.

[2]Initial rise (also called forerunner or sea level anomaly) is an anomalous departure of the tide level from the predicted astronomical tide.

1. Using topographic maps or maps showing soundings, such as the Nautical Charts, determine an ocean bed profile to a depth of 600 ft MLW, using the methods outlined above. Compare this profile with the profiles of the locations shown in Tables C.2 through C.21. With particular emphasis on shallow water depths, select the location or locations in the general area with the most similar profiles. An estimate of the wind setup may be interpolated from the wind setup data for these locations.

2. Pressure setup may be interpolated between locations on either side of the site.

3. Initial rise, as shown in Table C.1, may be interpolated between locations on either side of the site.

4. The 10% exceedance high spring tide may be computed from predicted tide levels in Reference 6; it may be obtained from the Coastal Engineering Research Center, U.S. Army Corps of Engineers, Ft. Belvoir, Va.; it may be interpolated, using the tide relations in Reference 6; or it may be obtained from Appendix A.

5. An estimate of the PMS open-coast stillwater level at the desired site will be the sum of the values from Steps 1 through 4, above.

C.3.3 Wind-Wave Effects

Coincident wave heights and wave runup should be computed and superimposed on the PMS stillwater level obtained by the foregoing procedures. Acceptable methods are given in Reference 2 and in Appendix A.

C.4 LIMITATIONS

1. The NRC staff will continue to accept for review detailed PMS analyses that result in less conservative estimates. In addition, previously reviewed and approved detailed PMS analyses at specific sites will continue to be acceptable even though the data and procedures in this appendix result in more conservative estimates.

2. The PMS estimates obtained as outlined in Section C.3.2 are maximum stillwater levels. Coincident wind-wave effects should be added.

3. The PMS estimates obtained from the methods in Section C.3.2 are valid only for open-coast sites, i.e., at the point at which the surge makes initial landfall. If the site of interest has appreciably different off-shore bathymetry, or if the coastal geometry differs or is complex, such as for sites on an estuary, adjacent to an inlet, inshore of barrier islands, etc., detailed studies of the effect of such local conditions should be made. Reference 2 provides guidance on such studies.

REFERENCES

1. Nunn, Snyder, and Associates, "Probable Maximum Flood and Hurricane Surge Estimates," unpublished report to NRC, June 13, 1975 (available in the public document room).

2. U. S. Army Coastal Engineering Research Center, "Shore Protection Manual," Second Edition, 1975.

3. B. R. Bodine, "Storm Surge on the Open Coast: Fundamental and Simplified Prediction," Technical Memorandum No. 35, U.S. Army Coastal Engineering Research Center, 1971.

4. George Pararas-Caryannis, "Verification Study of a Bathystrophic Storm Surge Model," Technical Memorandum No. 50, U.S. Army Coastal Engineering Research Center, May 1975.

5. U. S. Weather Bureau (now U.S. Weather Service, NOAA), "Meteorological Characteristics of the Probable Maximum Hurricane, Atlantic and Gulf Coasts of the United States," Hurricane Research Interim Report, HUR 7-97 and HUR 7-97A, 1968.

6. U. S. Department of Commerce, NOAA, "Tide Tables," annual publications.

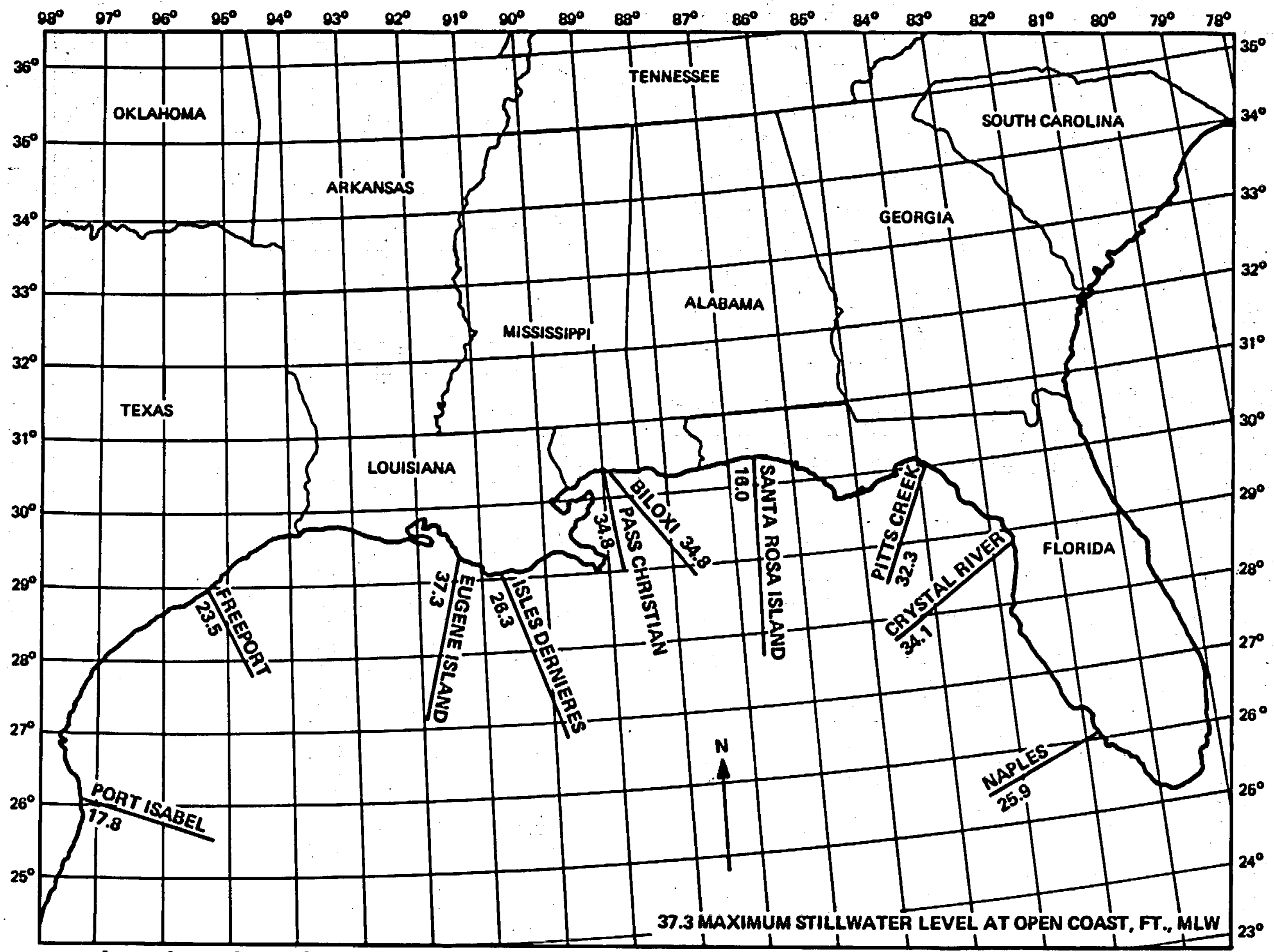

FIGURE C.1 PROBABLE MAXIMUM SURGE ESTIMATES – GULF COAST

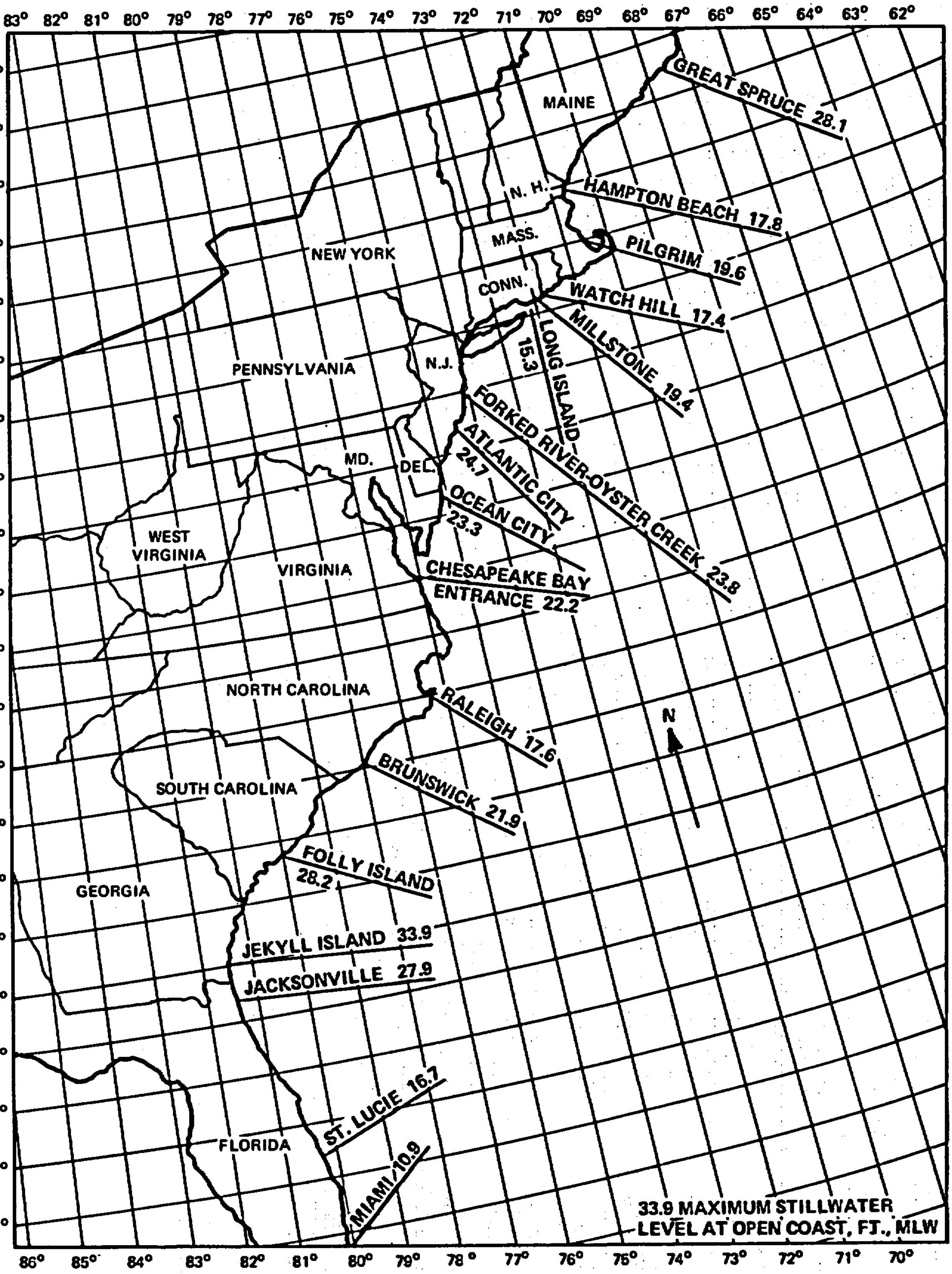

FIGURE C.2 PROBABLE MAXIMUM SURGE ESTIMATES – ATLANTIC COAST

TABLE C.1

PROBABLE MAXIMUM SURGE DATA

(LOCATIONS INDICATED ON FIGURES C.1 and C.2)

DISTANCE FROM SHORELINE, NAUTICAL MILES, FOR SELECTED WATER DEPTHS, FEET MLW									PROBABLE MAXIMUM SURGE AT OPEN COAST SHORE LINE				
OPEN-COAST LOCATION AND TRAVERSE	TRAVERSE AZIMUTH DEG.	MIN.	DEPTH, FEET, ALONG TRAVERSE FROM OPEN COAST SHORE LINE — DISTANCE, NAUTICAL MILES, TO DEPTH INDICATED: 10	20	50	100	200	600	WIND SETUP, FT.	PRESSURE SETUP, FT.	INITIAL RISE, FT.	10% EXC. HIGH TIDE, FT. MLW (c)	TOTAL SURGE, FT. MLW (c)
PORT ISABEL	86	30	0.23	0.49	1.94	11.10	33.10	44.0	10.07	3.57	2.50	1.70	17.84
FREEPORT	152	00	0.20	0.55	5.50	24.0	55.5	70.9	15.99	2.89	2.40	2.20	23.48
EUGENE ISLAND	192	30	2.00	20.00	30.00	44.1	60.0	90.0	29.74	3.29	2.00	2.30	37.34
ISLE DERNIERES	165	00	0.62	1.75	11.90	30.4	45.3	58.5	18.61	3.29	2.00	2.40	26.30
PASS CHRISTIAN (a)								77.0	28.87	2.88	0.80	2.30	34.85
BILOXI	160	00	3.40	11.20	30.00	50.1	69.2	78.0	27.77	2.98	1.50	2.50	34.76
SANTA ROSA ISLAND	183	00	0.09	0.18	0.48	11.9	20.9	45.0	9.12	3.25	1.50	2.10	15.97
PITTS CREEK	205	00	8.84	9.23	24.30	69.4	107.0	132.0	24.67	2.31	1.20	4.10	32.28
CRYSTAL RIVER (a)			2.31		31.40			127.0	26.55	2.65	0.60	4.30	34.10
NAPLES	248	00	0.17	0.79	15.70	45.6	85.8	145.0	18.47	2.90	1.00	3.50	25.87
MIAMI	100	00	0.17	0.94	2.01	2.2	2.7	3.9	2.51	3.90	0.90	3.60	10.91
ST. LUCIE (a)			0.10					18.7	8.25	3.80	0.98	3.70	16.73
JACKSONVILLE	90	00	0.10	0.20	2.58	30.0	55.0	62.5	16.46	3.23	1.30	6.90	27.90
JEKYLL ISLAND	108	00	2.60	4.00	15.60	39.6	64.3	72.6	20.63	3.34	1.20	8.70	33.87
FOLLY ISLAND	150	00	0.19	2.17	12.00	32.8	47.0	57.6	17.15	3.23	1.00	6.80	28.18
BRUNSWICK									12.94	2.20	1.00	5.80	21.94
RALEIGH	135	00	0.12	0.30	1.75	12.0	25.4	35.2	8.84	3.09	1.00	4.70	17,63
CHESAPEAKE BAY ENTRANCE (a)								62.0	17.30(b)	(b)	1.10	3.80	22.20
OCEAN CITY	110	00	0.12	0.26	3.67	17.8	45.0	59.0	14.30	2.83	1.14	5.00	23.27
ATLANTIC CITY	146	00	0.20	0.85	5.00	23.1	58.4	70.0	15.32	2.57	1.10	5.70	24.70
FORKED RIVER - OYSTER CREEK									18.08(b)	(b)	1.00	4.70	23.78
LONG ISLAND	166	00	0.09	0.18	1.35	4.8	27.2	68.4	8.73	2.46	0.97	3.10	15.26
MILLSTONE									12.41	2.20	1.00	3.80	19.41
WATCH HILL POINT	166	00	0.07	0.14	0.64	1.6	34.3	84.0	10.01	2.42	0.96	4.00	17.39
PILGRIM												11.90	19.60
HAMPTON BEACH (a)	115	00	0.22	0.31	0.71	2.0	7.2	40.0	4.25	2.23	0.83	10.50	17.81
GREAT SPRUCE ISLAND	148	00	0.04	0.08	0.20	1.1	6.3	173.0	9.73	1.82	0.56	16.00	28.11

a. See Table C.21 for ocean-bed profile.
b. Combined wind and pressure setup.
c. Most values in these columns have been updated by the U.S. Army Coastal Engineering Research Center and differ from those in the original documents.

TABLE C.2

SUMMARY-PERTINENT PROBABLE MAXIMUM HURRICANE (PMH), STORM SURGE COMPUTATIONAL DATA AND RESULTANT WATER LEVEL

LOCATION PORT ISABEL LAT. 26°04.3' LONG. 97°09.4'; TRAVERSE-AZIMUTH 86°-30' DEGREE; LENGTH 42.1 NAUTICAL MILES
TEXAS

PROBABLE MAXIMUM HURRICANE INDEX CHARACTERISTICS ZONE C AT LOCATION 26° 04' DEGREE NORTH

PARAMETER DESIGNATIONS	SPEED OF TRANSLATION SLOW (ST)	MODERATE (MT)	HIGH (HT)
CENTRAL PRESSURE INDEX P_o INCHES	26.42	26.42	26.42
PERIPHERAL PRESSURE P_n INCHES	31.30	31.30	31.30
RADIUS TO MAXIMUM WIND LARGE RADIUS NAUT. MI.	20	20	20
TRANSLATION SPEED F_v (FORWARD SPEED) KNOTS	4	11	28
MAXIMUM WIND SPEED V_x M.P.H.	147	151	161
INITIAL DISTANCE-NAUT.MI.[1/] FROM 20 MPH WIND AT SHORE TO MAX. WIND	398	374	318

Note: Maximum wind speed is assumed to be on the traverse that is to right of storm track a distance equal to the radius to maximum wind.

[1/] Initial distance is distance along traverse from shoreline to maximum wind when leading 20 mph isovel intersects shoreline. Storm diameter between 20 mph isovels is approximately double the initial distance.

OCEAN BED PROFILE

TRAVERSE DISTANCE FROM SHORE (NAUT.MI.)	WATER DEPTH BELOW MLW (FEET)
0	0
0.2	9.0
0.5	20.5
1.0	35.0
1.5	43.0
2.0	51.0
3.0	58.5
5.0	69.0
10	95.5
15	116
20	138
30	171
40	266
44	600
50	1,850

LATITUDE ø 26° 05' DEGREE AT TRAVERSE MID-POINT FROM SHORE TO 600-FOOT DEPTH

PMH COMPUTATIONAL COEFFICIENT AND WATER LEVEL (SURGE) ESTIMATES

COEFFICIENTS

BOTTOM FRICTION FACTOR 0.0030

WIND STRESS CORRECTION FACTOR 1.10

WATER LEVEL DATA

(AT OPEN COAST SHORELINE)

COMPONENTS	PMH SPEED OF TRANSLATION ST (FEET)	MT (FEET)	HT (FEET)
WIND SETUP			10.07
PRESSURE SETUP			3.57
INITIAL WATER LEV.			2.50
ASTRONOMICAL TIDE LEVEL			1.70
TOTAL-SURGE STILL WATER LEV. FEET MLW			17.84

TABLE C.3

SUMMARY-PERTINENT PROBABLE MAXIMUM HURRICANE (PMH), STORM SURGE COMPUTATIONAL DATA AND RESULTANT WATER LEVEL

LOCATION FREEPORT, TEXAS LAT. 28° 56' LONG. 95° 22'; TRAVERSE-AZIMUTH 152 DEGREE; LENGTH 70.9 NAUTICAL MILES

PROBABLE MAXIMUM HURRICANE INDEX CHARACTERISTICS ZONE C AT LOCATION 28° 56' DEGREE NORTH			
PARAMETER DESIGNATIONS	SPEED OF TRANSLATION		
	SLOW (ST)	MODERATE (MT)	HIGH (HT)
CENTRAL PRESSURE INDEX P_o INCHES	26.69	26.69	26.69
PERIPHERAL PRESSURE P_n INCHES	31.25	31.25	31.25
RADIUS TO MAXIMUM WIND LARGE RADIUS NAUT. MI.	26.0	26.0	26.0
TRANSLATION SPEED F_v (FORWARD SPEED) KNOTS	4	11	28.0
MAXIMUM WIND SPEED V_x M.P.H.	139	143	153
INITIAL DISTANCE-NAUT.MI. 1/ FROM 20 MPH WIND AT SHORE TO MAX. WIND	491	458	390

Note: Maximum wind speed is assumed to be on the traverse that is to right of storm track a distance equal to the radius to maximum wind.

1/ Initial distance is distance along traverse from shoreline to maximum wind when leading 20 mph isovel intersects shoreline. Storm diameter between 20 mph isovels is approximately double the initial distance.

OCEAN BED PROFILE	
TRAVERSE DISTANCE FROM SHORE (NAUT.MI.)	WATER DEPTH BELOW MLW (FEET)
0	0
1.0	30
2.0	32
3.0	37
4.0	40
5.0	47
10.0	66
15.0	78
20.0	90
30.0	114
40.0	132
50.0	168
60.0	240
70.0	570
70.9	600

LATITUDE ϕ 28° 26' DEGREE AT TRAVERSE MID-POINT FROM SHORE TO 600-FOOT DEPTH

PMH COMPUTATIONAL COEFFICIENT AND WATER LEVEL (SURGE) ESTIMATES

COEFFICIENTS

BOTTOM FRICTION FACTOR 0.0030

WIND STRESS CORRECTION FACTOR 1.10

WATER LEVEL DATA

(AT OPEN COAST SHORELINE)

COMPONENTS	PMH SPEED OF TRANSLATION		
	ST	MT	HT
	FEET		
WIND SETUP			15.99
PRESSURE SETUP			2.89
INITIAL WATER LEV.			2.40
ASTRONOMICAL TIDE LEVEL			2.20
TOTAL-SURGE STILL WATER LEV. FEET MLW			23.48

TABLE C.4

SUMMARY-PERTINENT PROBABLE MAXIMUM HURRICANE (PMH), STORM SURGE COMPUTATIONAL DATA AND RESULTANT WATER LEVEL

LOCATION EUGENE ISLAND, LOUISIANA LAT. 29° 20' LONG. 91° 21' ; TRAVERSE-AZIMUTH 192°30' DEGREE: LENGTH 90 NAUTICAL MILES

PROBABLE MAXIMUM HURRICANE INDEX CHARACTERISTICS ZONE B AT LOCATION 29° 20' DEGREE NORTH			
PARAMETER DESIGNATIONS	SPEED OF TRANSLATION		
	SLOW (ST)	MODERATE (MT)	HIGH (HT)
CENTRAL PRESSURE INDEX P_o INCHES	26.87	26.87	26.87
PERIPHERAL PRESSURE P_n INCHES	31.24	31.24	31.24
RADIUS TO MAXIMUM WIND LARGE RADIUS NAUT. MI.	29.0	29.0	29.0
TRANSLATION SPEED F_v (FORWARD SPEED) KNOTS	4	11	28.0
MAXIMUM WIND SPEED V_x M.P.H.	141	144	153
INITIAL DISTANCE-NAUT.MI.[1/] FROM 20 MPH WIND AT SHORE TO MAX. WIND	534	484	412

Note: Maximum wind speed is assumed to be on the traverse that is to right of storm track a distance equal to the radius to maximum wind.

1/ Initial distance is distance along traverse from shoreline to maximum wind when leading 20 mph isovel intersects shoreline. Storm diameter between 20 mph isovels is approximately double the initial distance.

OCEAN BED PROFILE	
TRAVERSE DISTANCE FROM SHORE (NAUT.MI.)	WATER DEPTH BELOW MLW (FEET)
0.0	0
1.0	5
2.0	10
3.0	12
5.0	15
10.0	15
15.0	18
20.0	20
30.0	50
40	60
50	140
60	200
70	260
80	320
90	600

LATITUDE ø 28° 40' DEGREE AT TRAVERSE MID-POINT FROM SHORE TO 600-FOOT DEPTH

PMH COMPUTATIONAL COEFFICIENT AND WATER LEVEL (SURGE) ESTIMATES

COEFFICIENTS

BOTTOM FRICTION FACTOR 0.0030

WIND STRESS CORRECTION FACTOR 1.10

WATER LEVEL DATA

(AT OPEN COAST SHORELINE)

COMPONENTS	PMH SPEED OF TRANSLATION		
	ST	MT	HT
	FEET		
WIND SETUP			29.74
PRESSURE SETUP			3.29
INITIAL WATER LEV.			2.00
ASTRONOMICAL TIDE LEVEL			2.30
TOTAL-SURGE STILL WATER LEV. FEET MLW			37.34

TABLE C.5

SUMMARY-PERTINENT PROBABLE MAXIMUM HURRICANE (PMH), STORM SURGE COMPUTATIONAL DATA AND RESULTANT WATER LEVEL

LOCATION ISLE DERNIERES, LOUISIANA   LAT. 29°02.9' LONG. 90°42.5': TRAVERSE-AZIMUTH 165 DEGREE: LENGTH 58.5 NAUTICAL MILES

PROBABLE MAXIMUM HURRICANE INDEX CHARACTERISTICS ZONE B AT LOCATION 29° 03' DEGREE NORTH			
PARAMETER DESIGNATIONS	SPEED OF TRANSLATION SLOW (ST)	MODERATE (MT)	HIGH (HT)
CENTRAL PRESSURE INDEX P_o INCHES	26.88	26.88	26.88
PERIPHERAL PRESSURE P_n INCHES	31.25	31.25	31.25
RADIUS TO MAXIMUM WIND LARGE RADIUS NAUT. MI.	29	29	29
TRANSLATION SPEED F_v (FORWARD SPEED) KNOTS	4	11	28
MAXIMUM WIND SPEED V_x M.P.H.	140	144	153
INITIAL DISTANCE-NAUT.MI.[1] FROM 20 MPH WIND AT SHORE TO MAX. WIND	528	487	394

Note: Maximum wind speed is assumed to be on the traverse that is to right of storm track a distance equal to the radius to maximum wind.

[1] Initial distance is distance along traverse from shoreline to maximum wind when leading 20 mph isovel intersects shoreline. Storm diameter between 20 mph isovels is approximately double the initial distance.

OCEAN BED PROFILE	
TRAVERSE DISTANCE FROM SHORE (NAUT.MI.)	WATER DEPTH BELOW MLW (FEET)
0	0
0.2	6.0
0.5	9.0
1.0	13.0
1.5	17.5
2.0	22.5
3.0	26.0
5.0	32.0
7.0	34.0
7.5	28.0
8.0	25.5
8.5	25.0
9.0	28.5
9.5	34.0
10.0	42.5
15.0	62.0
20.0	56.0
30.0	97.9
40.0	152.0
50.0	243
58.5	600
60.0	688

LATITUDE ø 28°34.4 DEGREE AT TRAVERSE MID-POINT FROM SHORE TO 600-FOOT DEPTH

PMH COMPUTATIONAL COEFFICIENT AND WATER LEVEL (SURGE) ESTIMATES

COEFFICIENTS

BOTTOM FRICTION FACTOR 0.0030

WIND STRESS CORRECTION FACTOR 1.10

WATER LEVEL DATA

(AT OPEN COAST SHORELINE)

COMPONENTS	PMH SPEED OF TRANSLATION ST	MT	HT
	FEET		
WIND SETUP			18.61
PRESSURE SETUP			3.29
INITIAL WATER LEV.			2.00
ASTRONOMICAL TIDE LEVEL			2.40
TOTAL-SURGE STILL WATER LEV. FEET MLW			26.30

TABLE C.6

SUMMARY-PERTINENT PROBABLE MAXIMUM HURRICANE (PMH), STORM SURGE COMPUTATIONAL DATA AND RESULTANT WATER LEVEL

LOCATION BILOXI MISSISSIPPI LAT. 30°23.6' LONG. 88°53.6'; TRAVERSE-AZIMUTH 160 DEGREE; LENGTH 77 NAUTICAL MILES

PROBABLE MAXIMUM HURRICANE INDEX CHARACTERISTICS ZONE B AT LOCATION 30° 24' DEGREE NORTH			
PARAMETER DESIGNATIONS	SPEED OF TRANSLATION SLOW (ST)	MODERATE (MT)	HIGH (HT)
CENTRAL PRESSURE INDEX P_o INCHES	26.9	26.9	26.9
PERIPHERAL PRESSURE P_n INCHES	31.23	31.23	31.23
RADIUS TO MAXIMUM WIND LARGE RADIUS NAUT. MI.	30	30	30
TRANSLATION SPEED F_v (FORWARD SPEED) KNOTS	4	11	28
MAXIMUM WIND SPEED V_x M.P.H.	139	143	153
INITIAL DISTANCE-NAUT.MI.1/ FROM 20 MPH WIND AT SHORE TO MAX. WIND	525	498	396

Note: Maximum wind speed is assumed to be on the traverse that is to right of storm track a distance equal to the radius to maximum wind.

1/ Initial distance is distance along traverse from shoreline to maximum wind when leading 20 mph isovel intersects shoreline. Storm diameter between 20 mph isovels is approximately double the initial distance.

OCEAN BED PROFILE	
TRAVERSE DISTANCE FROM SHORE (NAUT.MI.)	WATER DEPTH BELOW MLW (FEET)
0	0
0.2	3.0
0.5	2.0
1.0	6.5
1.5	9.0
2.0	9.0
3.0	9.5
5.0	12.0
9.0	9.5
9.5	11.0
10.0	14.0
10.5	18.5
11.0	17.5
11.5	23.0
12.0	29.0
13	34.5
15	41.5
20	45.0
25	47.0
30	50.0
40	65.0
50	99.0
60	164
70	203
78	600
80	744
LATITUDE ø 29° 50' DEGREE AT TRAVERSE MID-POINT FROM SHORE TO 600-FOOT DEPTH	

PMH COMPUTATIONAL COEFFICIENT AND WATER LEVEL (SURGE) ESTIMATES

COEFFICIENTS

BOTTOM FRICTION FACTOR 0.0030

WIND STRESS CORRECTION FACTOR 1.10

WATER LEVEL DATA

(AT OPEN COAST SHORELINE)

COMPONENTS	PMH SPEED OF TRANSLATION ST (FEET)	MT (FEET)	HT (FEET)
WIND SETUP			27.77
PRESSURE SETUP			2.98
INITIAL WATER LEV.			1.50
ASTRONOMICAL TIDE LEVEL			2.50
TOTAL-SURGE STILL WATER LEV. FEET MLW			34.76

1.59-52

TABLE C.7

SUMMARY-PERTINENT PROBABLE MAXIMUM HURRICANE (PMH), STORM SURGE COMPUTATIONAL DATA AND RESULTANT WATER LEVEL

LOCATION SANTA ROSA ISLAND, ALABAMA LAT. 30°23.7' LONG. 86°37.7': TRAVERSE-AZIMUTH 183 DEGREE: LENGTH 44.7 NAUTICAL MILES

PROBABLE MAXIMUM HURRICANE INDEX CHARACTERISTICS ZONE B AT LOCATION 30° 24' DEGREE NORTH	SPEED OF TRANSLATION		
PARAMETER DESIGNATIONS	SLOW (ST)	MODERATE (MT)	HIGH (HT)
CENTRAL PRESSURE INDEX P_o INCHES	26.88	26.88	26.88
PERIPHERAL PRESSURE P_n INCHES	31.20	31.20	31.20
RADIUS TO MAXIMUM WIND LARGE RADIUS NAUT. MI.	29	29	29
TRANSLATION SPEED F_v (FORWARD SPEED) KNOTS	4	11	28
MAXIMUM WIND SPEED V_x M.P.H.	140	144	153
INITIAL DISTANCE-NAUT.MI.1/ FROM 20 MPH WIND AT SHORE TO MAX. WIND	528	487	394

Note: Maximum wind speed is assumed to be on the traverse that is to right of storm track a distance equal to the radius to maximum wind.

1/ Initial distance is distance along traverse from shoreline to maximum wind when leading 20 mph isovel intersects shoreline. Storm diameter between 20 mph isovels is approximately double the initial distance.

OCEAN BED PROFILE	
TRAVERSE DISTANCE FROM SHORE (NAUT.MI.)	WATER DEPTH BELOW MLW (FEET)
0	0
0.2	22
0.5	52
1.0	66
1.5	66
2.0	66
3.0	73
5.0	76
10	88
15	120
20	182
30	377
40	510
45	600
50	756

LATITUDE Ø 30°1.3' DEGREE AT TRAVERSE MID-POINT FROM SHORE TO 600-FOOT DEPTH

PMH COMPUTATIONAL COEFFICIENT AND WATER LEVEL (SURGE) ESTIMATES

COEFFICIENTS

BOTTOM FRICTION FACTOR 0.0030

WIND STRESS CORRECTION FACTOR 1.10

WATER LEVEL DATA

(AT OPEN COAST SHORELINE)

COMPONENTS	PMH SPEED OF TRANSLATION ST	MT	HT
	F E E T		
WIND SETUP			9.12
PRESSURE SETUP			3.25
INITIAL WATER LEV.			1.50
ASTRONOMICAL TIDE LEVEL			2.10
TOTAL-SURGE STILL WATER LEV. FEET MLW			15.97

TABLE C.8

SUMMARY-PERTINENT PROBABLE MAXIMUM HURRICANE (PMH), STORM SURGE COMPUTATIONAL DATA AND RESULTANT WATER LEVEL

LOCATION PITTS CREEK LAT. 30°01.1' LONG. 83° 53': TRAVERSE-AZIMUTH 205 DEGREE: LENGTH 110 NAUTICAL MILES
FLORIDA

PROBABLE MAXIMUM HURRICANE INDEX CHARACTERISTICS ZONE A AT LOCATION 30° 01' DEGREE NORTH			
PARAMETER DESIGNATIONS	SPEED OF TRANSLATION		
	SLOW (ST)	MODERATE (MT)	HIGH (HT)
CENTRAL PRESSURE INDEX P_o INCHES	26.79	26.79	26.79
PERIPHERAL PRESSURE P_n INCHES	30.22	30.22	30.22
RADIUS TO MAXIMUM WIND LARGE RADIUS NAUT. MI.	26	26	26
TRANSLATION SPEED F_v (FORWARD SPEED) KNOTS	4	11	21
MAXIMUM WIND SPEED V_x M.P.H.	138	142	146
INITIAL DISTANCE-NAUT.MI.1/ FROM 20 MPH WIND AT SHORE TO MAX. WIND	354	322	278

Note: Maximum wind speed is assumed to be on the traverse that is to right of storm track a distance equal to the radius to maximum wind.

1/ Initial distance is distance along traverse from shoreline to maximum wind when leading 20 mph isovel intersects shoreline. Storm diameter between 20 mph isovels is approximately double the initial distance.

OCEAN BED PROFILE	
TRAVERSE DISTANCE FROM SHORE (NAUT.MI.)	WATER DEPTH BELOW MLW (FEET)
0	0
0.2	1.0
0.5	2.0
1.0	3.0
1.5	4.0
2.0	5.0
3.0	6.5
5.0	9.0
10	22.0
15	31.0
20	41.0
30	62.0
40	78.0
50	81.0
60	84.0
70	101.0
80	117.0
90	144.0
100	180.0
110	210.0
120	280.0
130	543.0
132	600.0
140	846
LATITUDE ø 29° 03' DEGREE AT TRAVERSE MID-POINT FROM SHORE TO 600-FOOT DEPTH	

PMH COMPUTATIONAL COEFFICIENT AND WATER LEVEL (SURGE) ESTIMATES

COEFFICIENTS

BOTTOM FRICTION FACTOR 0.0030

WIND STRESS CORRECTION FACTOR 1.10

WATER LEVEL DATA

(AT OPEN COAST SHORELINE)

COMPONENTS	PMH SPEED OF TRANSLATION		
	ST	MT	HT
	FEET		
WIND SETUP			24.67
PRESSURE SETUP			2.31
INITIAL WATER LEV.			1.20
ASTRONOMICAL TIDE LEVEL			4.10
TOTAL-SURGE STILL WATER LEV. FEET MLW			32.28

TABLE C.9

SUMMARY-PERTINENT PROBABLE MAXIMUM HURRICANE (PMH), STORM SURGE COMPUTATIONAL DATA AND RESULTANT WATER LEVEL

LOCATION NAPLES FLORIDA LAT. 26°01.4' LONG. 81°46.2'; TRAVERSE-AZIMUTH 248 DEGREE; LENGTH 145 NAUTICAL MILES

PROBABLE MAXIMUM HURRICANE INDEX CHARACTERISTICS ZONE A AT LOCATION 26° 01' DEGREE NORTH

PARAMETER DESIGNATIONS	SPEED OF TRANSLATION SLOW (ST)	MODERATE (MT)	HIGH (HT)
CENTRAL PRESSURE INDEX P_o INCHES	26.24	26.24	26.24
PERIPHERAL PRESSURE P_n INCHES	31.30	31.30	31.30
RADIUS TO MAXIMUM WIND LARGE RADIUS NAUT. MI.	15	15	15
TRANSLATION SPEED F_v (FORWARD SPEED) KNOTS	4	11	17
MAXIMUM WIND SPEED V_x M.P.H.	150	154	158
INITIAL DISTANCE-NAUT.MI.1/ FROM 20 MPH WIND AT SHORE TO MAX. WIND	292	270	256

Note: Maximum wind speed is assumed to be on the traverse that is to right of storm track a distance equal to the radius to maximum wind.

1/ Initial distance is distance along traverse from shoreline to maximum wind when leading 20 mph isovel intersects shoreline. Storm diameter between 20 mph isovels is approximately double the initial distance.

OCEAN BED PROFILE

TRAVERSE DISTANCE FROM SHORE (NAUT.MI.)	WATER DEPTH BELOW MLW (FEET)
0	0
0.2	12.0
0.5	18.0
1.0	21.5
1.5	22.0
2.0	24.5
3.0	27.0
5.0	30.0
10	41.0
15	48.5
20	59.5
30	75.0
40	90.0
50	108
60	144
70	165
80	186
90	210
100	228
110	249
120	252
130	432
140	452
145	600
150	1,200

LATITUDE Ø 25° 35' DEGREE AT TRAVERSE MID-POINT FROM SHORE TO 600-FOOT DEPTH

PMH COMPUTATIONAL COEFFICIENT AND WATER LEVEL (SURGE) ESTIMATES

COEFFICIENTS

BOTTOM FRICTION FACTOR 0.0030

WIND STRESS CORRECTION FACTOR 1.10

WATER LEVEL DATA

(AT OPEN COAST SHORELINE)

COMPONENTS	PMH SPEED OF TRANSLATION ST (FEET)	MT (FEET)	HT (FEET)
WIND SETUP	13.49	15.87	18.47
PRESSURE SETUP	3.29	2.87	2.90
INITIAL WATER LEV.	1.00	1.00	1.00
ASTRONOMICAL TIDE LEVEL	3.60	3.60	3.50
TOTAL-SURGE STILL WATER LEV. FEET MLW	21.38	23.35	25.87

1.59-55

TABLE C.10

SUMMARY-PERTINENT PROBABLE MAXIMUM HURRICANE (PMH), STORM SURGE COMPUTATIONAL DATA AND RESULTANT WATER LEVEL

LOCATION MIAMI FLORIDA LAT. 25°47.2' LONG. 80°07.8'; TRAVERSE-AZIMUTH 100 DEGREE; LENGTH 3.9 NAUTICAL MILES

PROBABLE MAXIMUM HURRICANE INDEX CHARACTERISTICS ZONE 1 AT LOCATION 25° 47.2' DEGREE NORTH

PARAMETER DESIGNATIONS	SPEED OF TRANSLATION SLOW (ST)	MODERATE (MT)	HIGH (HT)
CENTRAL PRESSURE INDEX P_o INCHES	26.09	26.09	26.09
PERIPHERAL PRESSURE P_n INCHES	31.30	31.30	31.30
RADIUS TO MAXIMUM WIND LARGE RADIUS NAUT. MI.	14	14	14
TRANSLATION SPEED F_v (FORWARD SPEED) KNOTS	4	11	17
MAXIMUM WIND SPEED V_x M.P.H.	152	156	160
INITIAL DISTANCE-NAUT.MI.1/ FROM 20 MPH WIND AT SHORE TO MAX. WIND	274	258	243

Note: Maximum wind speed is assumed to be on the traverse that is to right of storm track a distance equal to the radius to maximum wind.

1/ Initial distance is distance along traverse from shoreline to maximum wind when leading 20 mph isovel intersects shoreline. Storm diameter between 20 mph isovels is approximately double the initial distance.

OCEAN BED PROFILE

TRAVERSE DISTANCE FROM SHORE (NAUT.MI.)	WATER DEPTH BELOW MLW (FEET)
0	0
0.2	12
0.5	16
1.5	25
2.0	47
3.0	266
3.9	600
5.0	822

LATITUDE ϕ 25°46.9 DEGREE AT TRAVERSE MID-POINT FROM SHORE TO 600-FOOT DEPTH

PMH COMPUTATIONAL COEFFICIENT AND WATER LEVEL (SURGE) ESTIMATES

COEFFICIENTS

BOTTOM FRICTION FACTOR 0.0025

WIND STRESS CORRECTION FACTOR 1.10

WATER LEVEL DATA

(AT OPEN COAST SHORELINE)

COMPONENTS	PMH SPEED OF TRANSLATION ST (FEET)	MT (FEET)	HT (FEET)
WIND SETUP	2.06	2.37	2.51
PRESSURE SETUP	3.97	3.82	3.90
INITIAL WATER LEV.	0.90	0.90	0.90
ASTRONOMICAL TIDE LEVEL	3.60	3.60	3.60
TOTAL-SURGE STILL WATER LEV. FEET MLW	10.53	10.68	10.91

TABLE C.11

SUMMARY-PERTINENT PROBABLE MAXIMUM HURRICANE (PMH), STORM SURGE COMPUTATIONAL DATA AND RESULTANT WATER LEVEL

LOCATION JACKSONVILLE FLORIDA LAT. 30° 21' LONG. 81° 24.3; TRAVERSE-AZIMUTH 90 DEGREE; LENGTH 62.5 NAUTICAL MILES

PROBABLE MAXIMUM HURRICANE INDEX CHARACTERISTICS
ZONE 2 AT LOCATION 30° 21' DEGREE NORTH

PARAMETER DESIGNATIONS	SPEED OF TRANSLATION: SLOW (ST)	MODERATE (MT)	HIGH (HT)
CENTRAL PRESSURE INDEX P_o INCHES	26.67	26.67	26.67
PERIPHERAL PRESSURE P_n INCHES	31.21	31.21	31.21
RADIUS TO MAXIMUM WIND LARGE RADIUS NAUT. MI.	38	38	38
TRANSLATION SPEED F_v (FORWARD SPEED) KNOTS	4	11	22
MAXIMUM WIND SPEED V_x M.P.H.	138	142	149
INITIAL DISTANCE-NAUT.MI.1/ FROM 20 MPH WIND AT SHORE TO MAX. WIND	407	372	334

Note: Maximum wind speed is assumed to be on the traverse that is to right of storm track a distance equal to the radius to maximum wind.

1/ Initial distance is distance along traverse from shoreline to maximum wind when leading 20 mph isovel intersects shoreline. Storm diameter between 20 mph isovels is approximately double the initial distance.

OCEAN BED PROFILE

TRAVERSE DISTANCE FROM SHORE (NAUT.MI.)	WATER DEPTH BELOW MLW (FEET)
0	0
0.2	20
0.5	25
1.0	32
1.5	37
2.0	43
3.0	55
5.0	59
10.0	66
12.0	66
14.0	72
15.0	73
20.0	80
30.0	100
40.0	117
50.0	131
60.0	270
62.5	600
70.0	948

LATITUDE ø 30° 21' DEGREE AT TRAVERSE MID-POINT FROM SHORE TO 600-FOOT DEPTH

PMH COMPUTATIONAL COEFFICIENT AND WATER LEVEL (SURGE) ESTIMATES

COEFFICIENTS

BOTTOM FRICTION FACTOR 0.0025

WIND STRESS CORRECTION FACTOR 1.10

WATER LEVEL DATA

(AT OPEN COAST SHORELINE)

COMPONENTS	PMH SPEED OF TRANSLATION: ST (FEET)	MT (FEET)	HT (FEET)
WIND SETUP			16.46
PRESSURE SETUP			3.23
INITIAL WATER LEV.			1.30
ASTRONOMICAL TIDE LEVEL			6.90
TOTAL-SURGE STILL WATER LEV. FEET MLW			27.90

TABLE C.12

SUMMARY-PERTINENT PROBABLE MAXIMUM HURRICANE (PMH), STORM SURGE COMPUTATIONAL DATA AND RESULTANT WATER LEVEL

LOCATION JEKYLL ISLAND, GEORGIA LAT. 31° 05' LONG. 81° 24.5': TRAVERSE-AZIMUTH 108 DEGREE: LENGTH 72.6 NAUTICAL MILES

PROBABLE MAXIMUM HURRICANE INDEX CHARACTERISTICS ZONE 2 AT LOCATION 31° 05' DEGREE NORTH			
PARAMETER DESIGNATIONS	SPEED OF TRANSLATION SLOW (ST)	MODERATE (MT)	HIGH (HT)
CENTRAL PRESSURE INDEX P_o INCHES	26.72	26.72	26.72
PERIPHERAL PRESSURE P_n INCHES	31.19	31.19	31.19
RADIUS TO MAXIMUM WIND LARGE RADIUS NAUT. MI.	40	40	40
TRANSLATION SPEED F_v (FORWARD SPEED) KNOTS	4	11	23
MAXIMUM WIND SPEED V_x M.P.H.	135	141	147
INITIAL DISTANCE-NAUT.MI.1/ FROM 20 MPH WIND AT SHORE TO MAX. WIND	400	380	336

Note: Maximum wind speed is assumed to be on the traverse that is to right of storm track a distance equal to the radius to maximum wind.

1/ Initial distance is distance along traverse from shoreline to maximum wind when leading 20 mph isovel intersects shoreline. Storm diameter between 20 mph isovels is approximately double the initial distance.

OCEAN BED PROFILE	
TRAVERSE DISTANCE FROM SHORE (NAUT.MI.)	WATER DEPTH BELOW MLW (FEET)
0	0
0.2	3.0
0.5	4.0
1.0	6.0
1.5	6.5
2.0	7.0
3.0	12.0
4.0	20.0
5.0	23.5
6.0	29.5
7.0	35.5
8.0	35.0
10.0	39.5
15.0	49.0
20.0	57.0
25.0	65.0
30.0	73.0
40.0	101.0
50.0	115.0
60.0	131.0
70.0	291.0
72.6	600.0
80.0	1,030.0

LATITUDE ø 30° 53' DEGREE AT TRAVERSE MID-POINT FROM SHORE TO 600-FOOT DEPTH

PMH COMPUTATIONAL COEFFICIENT AND WATER LEVEL (SURGE) ESTIMATES

COEFFICIENTS

BOTTOM FRICTION FACTOR 0.0025

WIND STRESS CORRECTION FACTOR 1.10

WATER LEVEL DATA

(AT OPEN COAST SHORELINE)

COMPONENTS	PMH SPEED OF TRANSLATION ST	MT	HT
	F E	E	T
WIND SETUP			20.63
PRESSURE SETUP			3.34
INITIAL WATER LEV.			1.20
ASTRONOMICAL TIDE LEVEL			8.70
TOTAL-SURGE STILL WATER LEV. FEET MLW			33.87

TABLE C.13

SUMMARY-PERTINENT PROBABLE MAXIMUM HURRICANE (PMH), STORM SURGE COMPUTATIONAL DATA AND RESULTANT WATER LEVEL

LOCATION FOLLY ISLAND LAT. 32° 39' LONG. 79° 56.6': TRAVERSE-AZIMUTH 150 DEGREE: LENGTH 57.6 NAUTICAL MILES
SOUTH CAROLINA

PROBABLE MAXIMUM HURRICANE INDEX CHARACTERISTICS
ZONE 2 AT LOCATION 32° 39' DEGREE NORTH

PARAMETER DESIGNATIONS	SPEED OF TRANSLATION SLOW (ST)	MODERATE (MT)	HIGH (HT)
CENTRAL PRESSURE INDEX P_o INCHES	26.81	26.81	26.81
PERIPHERAL PRESSURE P_n INCHES	31.13	31.13	31.13
RADIUS TO MAXIMUM WIND LARGE RADIUS NAUT. MI.	40	40	40
TRANSLATION SPEED F_v (FORWARD SPEED) KNOTS	4	13	29
MAXIMUM WIND SPEED V_x M.P.H.	134	139	148
INITIAL DISTANCE-NAUT.MI.1/ FROM 20 MPH WIND AT SHORE TO MAX. WIND	400	364	311

Note: Maximum wind speed is assumed to be on the traverse that is to right of storm track a distance equal to the radius to maximum wind.

1/ Initial distance is distance along traverse from shoreline to maximum wind when leading 20 mph isovel intersects shoreline. Storm diameter between 20 mph isovels is approximately double the initial distance.

OCEAN BED PROFILE

TRAVERSE DISTANCE FROM SHORE (NAUT.MI.)	WATER DEPTH BELOW MLW (FEET)
0	0
0.2	10.5
0.5	12.0
1.0	14.0
1.5	16.5
2.0	18.0
3.0	29.5
5.0	39.0
10.0	46.0
15.0	56.0
20.0	65.0
30.0	85.0
40.0	138.0
50.0	227.0
57.6	600.0
60.0	1,800.0

LATITUDE ø 32° 25' DEGREE AT TRAVERSE MID-POINT FROM SHORE TO 600-FOOT DEPTH

PMH COMPUTATIONAL COEFFICIENT AND WATER LEVEL (SURGE) ESTIMATES

COEFFICIENTS

BOTTOM FRICTION FACTOR 0.0025

WIND STRESS CORRECTION FACTOR 1.10

WATER LEVEL DATA

(AT OPEN COAST SHORELINE)

COMPONENTS	PMH SPEED OF TRANSLATION ST (FEET)	MT (FEET)	HT (FEET)
WIND SETUP			17.15
PRESSURE SETUP			3.23
INITIAL WATER LEV.			1.00
ASTRONOMICAL TIDE LEVEL			6.80
TOTAL-SURGE STILL WATER LEV. FEET MLW			28.18

TABLE C.14

SUMMARY-PERTINENT PROBABLE MAXIMUM HURRICANE (PMH), STORM SURGE COMPUTATIONAL DATA AND RESULTANT WATER LEVEL

LOCATION RALEIGH BAY, NORTH CAROLINA LAT. 34° 54' LONG. 76° 15.3': TRAVERSE-AZIMUTH 135 DEGREE: LENGTH 35.2 NAUTICAL MILES

PROBABLE MAXIMUM HURRICANE INDEX CHARACTERISTICS ZONE 3 AT LOCATION 34° 54' DEGREE NORTH			
PARAMETER DESIGNATIONS	SPEED OF TRANSLATION SLOW (ST)	MODERATE (MT)	HIGH (HT)
CENTRAL PRESSURE INDEX P_o INCHES	26.89	26.89	26.89
PERIPHERAL PRESSURE P_n INCHES	31.00	31.00	31.00
RADIUS TO MAXIMUM WIND LARGE RADIUS NAUT. MI.	35	35	35
TRANSLATION SPEED F_v (FORWARD SPEED) KNOTS	5	17	38
MAXIMUM WIND SPEED V_x M.P.H.	130	137	149
INITIAL DISTANCE-NAUT.MI.1/ FROM 20 MPH WIND AT SHORE TO MAX. WIND	385	346	280

Note: Maximum wind speed is assumed to be on the traverse that is to right of storm track a distance equal to the radius to maximum wind.

1/ Initial distance is distance along traverse from shoreline to maximum wind when leading 20 mph isovel intersects shoreline. Storm diameter between 20 mph isovels is approximately double the initial distance.

OCEAN BED PROFILE	
TRAVERSE DISTANCE FROM SHORE (NAUT.MI.)	WATER DEPTH BELOW MLW (FEET)
0	0
0.2	16
0.5	28
1.0	40
1.5	46
2.0	54
3.0	64
5.0	72
10.0	92
15.0	112
20.0	124
30.0	264
35.2	600
40.0	900

LATITUDE ∅ 34°41.4 DEGREE AT TRAVERSE MID-POINT FROM SHORE TO 600-FOOT DEPTH

PMH COMPUTATIONAL COEFFICIENT AND WATER LEVEL (SURGE) ESTIMATES

COEFFICIENTS

BOTTOM FRICTION FACTOR 0.0025

WIND STRESS CORRECTION FACTOR 1.10

WATER LEVEL DATA

(AT OPEN COAST SHORELINE)

COMPONENTS	PMH SPEED OF TRANSLATION ST (FEET)	MT (FEET)	HT (FEET)
WIND SETUP			8.84
PRESSURE SETUP			3.09
INITIAL WATER LEV.			1.00
ASTRONOMICAL TIDE LEVEL			4.70
TOTAL-SURGE STILL WATER LEV. FEET MLW			17.63

TABLE C.15

SUMMARY-PERTINENT PROBABLE MAXIMUM HURRICANE (PMH), STORM SURGE COMPUTATIONAL DATA AND RESULTANT WATER LEVEL

LOCATION OCEAN CITY, MARYLAND LAT. 38° 20' LONG. 75° 04.9': TRAVERSE-AZIMUTH 110 DEGREE: LENGTH 59 NAUTICAL MILES

PROBABLE MAXIMUM HURRICANE INDEX CHARACTERISTICS ZONE 4 AT LOCATION 38° 20' DEGREE NORTH			
PARAMETER DESIGNATIONS	SPEED OF TRANSLATION SLOW (ST)	MODERATE (MT)	HIGH (HT)
CENTRAL PRESSURE INDEX P_o INCHES	27.05	27.05	27.05
PERIPHERAL PRESSURE P_n INCHES	30.77	30.77	30.77
RADIUS TO MAXIMUM WIND LARGE RADIUS NAUT. MI.	38	38	38
TRANSLATION SPEED F_v (FORWARD SPEED) KNOTS	10	26	48
MAXIMUM WIND SPEED V_x M.P.H.	124	133	146
INITIAL DISTANCE-NAUT.MI.1/ FROM 20 MPH WIND AT SHORE TO MAX. WIND	350	293	251

Note: Maximum wind speed is assumed to be on the traverse that is right of storm track a distance equal to the radius to maximum wind.

1/ Initial distance is distance along traverse from shoreline to maximum wind when leading 20 mph isovel intersects shoreline. Storm diameter between 20 mph isovels is approximately double the initial distance.

OCEAN BED PROFILE	
TRAVERSE DISTANCE FROM SHORE (NAUT.MI.)	WATER DEPTH BELOW MLW (FEET)
0	0
0.2	17
0.5	32
1.0	29
1.5	35
2.0	45
3.0	38
4.0	56
5.0	61
6	71
7	56
8	60
9	58
10	59
11	65
12	64
13	70
14	62
15	70
16	78
18	103
20	90
25	134
30	121
35	134
40	146
50	255
58	600
60	840
LATITUDE Ø 38°14.3 DEGREE AT TRAVERSE MID-POINT FROM SHORE TO 600-FOOT DEPTH	

PMH COMPUTATIONAL COEFFICIENT AND WATER LEVEL (SURGE) ESTIMATES

COEFFICIENTS

BOTTOM FRICTION FACTOR 0.0025

WIND STRESS CORRECTION FACTOR 1.10

WATER LEVEL DATA

(AT OPEN COAST SHORELINE)

COMPONENTS	PMH SPEED OF TRANSLATION ST	MT	HT
	FEET		
WIND SETUP			14.30
PRESSURE SETUP			2.83
INITIAL WATER LEV.			1.14
ASTRONOMICAL TIDE LEVEL			5.00
TOTAL-SURGE STILL WATER LEV. FEET MLW			23.27

TABLE C.16

SUMMARY-PERTINENT PROBABLE MAXIMUM HURRICANE (PMH), STORM SURGE COMPUTATIONAL DATA AND RESULTANT WATER LEVEL

LOCATION ATLANTIC CITY, NEW JERSEY LAT. 39° 21' LONG. 74° 25': TRAVERSE-AZIMUTH 146 DEGREE: LENGTH 70 NAUTICAL MILES

PROBABLE MAXIMUM HURRICANE INDEX CHARACTERISTICS ZONE 4 AT LOCATION 39° 21' DEGREE NORTH

PARAMETER DESIGNATIONS	SPEED OF TRANSLATION SLOW (ST)	MODERATE (MT)	HIGH (HT)
CENTRAL PRESSURE INDEX P_o INCHES			27.12
PERIPHERAL PRESSURE P_n INCHES			30.70
RADIUS TO MAXIMUM WIND LARGE RADIUS NAUT. MI.			40
TRANSLATION SPEED F_v (FORWARD SPEED) KNOTS			49
MAXIMUM WIND SPEED V_x M.P.H.			142
INITIAL DISTANCE-NAUT.MI.[1/] FROM 20 MPH WIND AT SHORE TO MAX. WIND			

Note: Maximum wind speed is assumed to be on the traverse that is to right of storm track a distance equal to the radius to maximum wind.

1/ Initial distance is distance along traverse from shoreline to maximum wind when leading 20 mph isovel intersects shoreline. Storm diameter between 20 mph isovels is approximately double the initial distance.

OCEAN BED PROFILE

TRAVERSE DISTANCE FROM SHORE (NAUT.MI.)	WATER DEPTH BELOW MLW (FEET)
0	0
0.2	10.0
0.5	15.0
1.0	22.0
2.0	38.0
5.0	50.0
10.0	72.0
20.0	90.0
30.0	120.0
40.0	138.0
50.0	162.0
60.0	210.0
65.0	258.0
70.0	600.0

LATITUDE ∅ 38° 53' DEGREE AT TRAVERSE MID-POINT FROM SHORE TO 600-FOOT DEPTH

PMH COMPUTATIONAL COEFFICIENT AND WATER LEVEL (SURGE) ESTIMATES

COEFFICIENTS

BOTTOM FRICTION FACTOR 0.0025

WIND STRESS CORRECTION FACTOR 1.10

WATER LEVEL DATA

(AT OPEN COAST SHORELINE)

COMPONENTS	PMH SPEED OF TRANSLATION ST (FEET)	MT (FEET)	HT (FEET)
WIND SETUP			15.32
PRESSURE SETUP			2.57
INITIAL WATER LEV.			1.10
ASTRONOMICAL TIDE LEVEL			5.70
TOTAL-SURGE STILL WATER LEV. FEET MLW			24.70

TABLE C.17

SUMMARY-PERTINENT PROBABLE MAXIMUM HURRICANE (PMH), STORM SURGE COMPUTATIONAL DATA AND RESULTANT WATER LEVEL

LOCATION LONG ISLAND, CONNECTICUT LAT. 41° 00' LONG. 72° 01.8': TRAVERSE-AZIMUTH 166 DEGREE: LENGTH 68.4 NAUTICAL MILES

PROBABLE MAXIMUM HURRICANE INDEX CHARACTERISTICS ZONE 4 AT LOCATION 41° 00' DEGREE NORTH

PARAMETER DESIGNATIONS	SPEED OF TRANSLATION SLOW (ST)	MODERATE (MT)	HIGH (HT)
CENTRAL PRESSURE INDEX P_o INCHES	27.26	27.26	27.26
PERIPHERAL PRESSURE P_n INCHES	30.56	30.56	30.56
RADIUS TO MAXIMUM WIND LARGE RADIUS NAUT. MI.	48	48	48
TRANSLATION SPEED F_v (FORWARD SPEED) KNOTS	15	34	51
MAXIMUM WIND SPEED V_x M.P.H.	115	126	136
INITIAL DISTANCE-NAUT.MI.1/ FROM 20 MPH WIND AT SHORE TO MAX. WIND	346	293	259

Note: Maximum wind speed is assumed to be on the traverse that is to right of storm track a distance equal to the radius to maximum wind.

1/ Initial distance is distance along traverse from shoreline to maximum wind when leading 20 mph isovel intersects shoreline. Storm diameter between 20 mph isovels is approximately double the initial distance.

OCEAN BED PROFILE

TRAVERSE DISTANCE FROM SHORE (NAUT.MI.)	WATER DEPTH BELOW MLW (FEET)
0	0
0.2	22
0.5	38
1.0	43
1.5	53
2.0	67
3.0	82
5.0	102
10.0	132
15.0	145
20.0	170
30.0	212
40.0	240
50.0	260
60.0	302
68.4	600
70.0	870

LATITUDE ø 40° 27' DEGREE AT TRAVERSE MID-POINT FROM SHORE TO 600-FOOT DEPTH

PMH COMPUTATIONAL COEFFICIENT AND WATER LEVEL (SURGE) ESTIMATES

COEFFICIENTS

BOTTOM FRICTION FACTOR 0.0025

WIND STRESS CORRECTION FACTOR 1.10

WATER LEVEL DATA

(AT OPEN COAST SHORELINE)

COMPONENTS	PMH SPEED OF TRANSLATION ST (FEET)	MT (FEET)	HT (FEET)
WIND SETUP			8.73
PRESSURE SETUP			2.46
INITIAL WATER LEV.			0.97
ASTRONOMICAL TIDE LEVEL			3.10
TOTAL-SURGE STILL WATER LEV. FEET MLW			15.26

TABLE C.18

SUMMARY-PERTINENT PROBABLE MAXIMUM HURRICANE (PMH), STORM SURGE COMPUTATIONAL DATA AND RESULTANT WATER LEVEL

LOCATION WATCH HILL POINT, RHODE ISLAND LAT. 41°18.9' LONG. 71 50': TRAVERSE-AZIMUTH 166 DEGREE: LENGTH 84 NAUTICAL MILES

PROBABLE MAXIMUM HURRICANE INDEX CHARACTERISTICS ZONE 4 AT LOCATION 41° 19' DEGREE NORTH			
PARAMETER DESIGNATIONS	SPEED OF TRANSLATION SLOW (ST)	MODERATE (MT)	HIGH (HT)
CENTRAL PRESSURE INDEX P_o INCHES	27.29	27.29	27.29
PERIPHERAL PRESSURE P_n INCHES	30.54	30.54	30.54
RADIUS TO MAXIMUM WIND LARGE RADIUS NAUT. MI.	49	49	49
TRANSLATION SPEED F_v (FORWARD SPEED) KNOTS	15	35	51
MAXIMUM WIND SPEED V_x M.P.H.	113	126	134
INITIAL DISTANCE-NAUT.MI.1/ FROM 20 MPH WIND AT SHORE TO MAX. WIND	348	284	255

Note: Maximum wind speed is assumed to be on the traverse that is to right of storm track a distance equal to the radius to maximum wind.

1/ Initial distance is distance along traverse from shoreline to maximum wind when leading 20 mph isovel intersects shoreline. Storm diameter between 20 mph isovels is approximately double the initial distance.

OCEAN BED PROFILE	
TRAVERSE DISTANCE FROM SHORE (NAUT.MI.)	WATER DEPTH BELOW MLW (FEET)
0	0
0.2	28
0.5	40
1.0	77
1.5	98
2.0	119
3.0	117
4.0	114
5.0	128
6.0	114
7.0	113
8.0	117
9.0	118
10.0	93
11.0	70
12.0	65
13.0	51
14.0	56
15.0	77
20.0	131
30.0	191
40.0	222
50.0	245
60.0	254
70.0	283
80.0	338
84.0	600
90.0	1,488

LATITUDE ø 40° 38' DEGREE AT TRAVERSE MID-POINT FROM SHORE TO 600-FOOT DEPTH

PMH COMPUTATIONAL COEFFICIENT AND WATER LEVEL (SURGE) ESTIMATES

COEFFICIENTS

BOTTOM FRICTION FACTOR 0.0025

WIND STRESS CORRECTION FACTOR 1.10

WATER LEVEL DATA

(AT OPEN COAST SHORELINE)

COMPONENTS	PMH SPEED OF TRANSLATION ST (FEET)	MT (FEET)	HT (FEET)
WIND SETUP			10.01
PRESSURE SETUP			2.42
INITIAL WATER LEV.			0.96
ASTRONOMICAL TIDE LEVEL			4.00
TOTAL-SURGE STILL WATER LEV. FEET MLW			17.39

TABLE C.19

SUMMARY-PERTINENT PROBABLE MAXIMUM HURRICANE (PMH), STORM SURGE COMPUTATIONAL DATA AND RESULTANT WATER[1] LEVEL

LOCATION HAMPTON BEACH, NEW HAMPSHIRE LAT. 42° 57' LONG. 70° 47.1'; TRAVERSE-AZIMUTH 115 DEGREE; LENGTH 40 NAUTICAL MILES

PROBABLE MAXIMUM HURRICANE INDEX CHARACTERISTICS
ZONE 4 AT LOCATION 42° 57' DEGREE NORTH

PARAMETER DESIGNATIONS	SPEED OF TRANSLATION SLOW (ST)	MODERATE (MT)	HIGH (HT)
CENTRAL PRESSURE INDEX P_o INCHES	27.44	27.44	27.44
PERIPHERAL PRESSURE P_n INCHES	30.42	30.42	30.42
RADIUS TO MAXIMUM WIND LARGE RADIUS NAUT. MI.	57	57	57
TRANSLATION SPEED F_v (FORWARD SPEED) KNOTS	17	37	52
MAXIMUM WIND SPEED V_x M.P.H.	107	118	127
INITIAL DISTANCE-NAUT.MI.1/ FROM 20 MPH WIND AT SHORE TO MAX. WIND	353	290	262

Note: Maximum wind speed is assumed to be on the traverse that is to right of storm track a distance equal to the radius to maximum wind.

1/ Initial distance is distance along traverse from shoreline to maximum wind when leading 20 mph isovel intersects shoreline. Storm diameter between 20 mph isovels is approximately double the initial distance.

OCEAN BED PROFILE

TRAVERSE DISTANCE FROM SHORE (NAUT.MI.)	WATER DEPTH BELOW MLW (FEET)
0	0
0.2	8
0.5	40
1.0	64
1.5	82
2.0	100
3.0	105
5.0	156
10.0	258
15.0	336
20.0	266
25.0	210
30.0	322
35.0	433
40.0	600

LATITUDE ø 42° 48' DEGREE AT TRAVERSE MID-POINT FROM SHORE TO 600-FOOT DEPTH

PMH COMPUTATIONAL COEFFICIENT AND WATER LEVEL (SURGE) ESTIMATES

COEFFICIENTS

BOTTOM FRICTION FACTOR 0.0025

WIND STRESS CORRECTION FACTOR 1.10

WATER LEVEL DATA

(AT OPEN COAST SHORELINE)

COMPONENTS	PMH SPEED OF TRANSLATION ST (FEET)	MT (FEET)	HT (FEET)
WIND SETUP			4.25
PRESSURE SETUP			2.23
INITIAL WATER LEV.			0.83
ASTRONOMICAL TIDE LEVEL			10.50
TOTAL-SURGE STILL WATER LEV. FEET MLW			17.81

TABLE C.20

SUMMARY-PERTINENT PROBABLE MAXIMUM HURRICANE (PMH), STORM SURGE COMPUTATIONAL DATA AND RESULTANT WATER LEVEL

LOCATION GREAT SPRUCE ISLAND, MAINE LAT. 44°33.4' LONG. 67° 30'; TRAVERSE-AZIMUTH 148 DEGREE; LENGTH 178.6 NAUTICAL MILES

PROBABLE MAXIMUM HURRICANE INDEX CHARACTERISTICS ZONE 4 AT LOCATION 44° 33' DEGREE NORTH

PARAMETER DESIGNATIONS	SPEED OF TRANSLATION SLOW (ST)	MODERATE (MT)	HIGH (HT)
CENTRAL PRESSURE INDEX P_o INCHES	27.61	27.61	27.61
PERIPHERAL PRESSURE P_n INCHES	30.25	30.25	30.25
RADIUS TO MAXIMUM WIND LARGE RADIUS NAUT. MI.	64	64	64
TRANSLATION SPEED F_v (FORWARD SPEED) KNOTS	19	39	53
MAXIMUM WIND SPEED V_x M.P.H.	102	114	122
INITIAL DISTANCE-NAUT.MI.[1/] FROM 20 MPH WIND AT SHORE TO MAX. WIND	352	288	262

Note: Maximum wind speed is assumed to be on the traverse that is to right of storm track a distance equal to the radius to maximum wind.

1/ Initial distance is distance along traverse from shoreline to maximum wind when leading 20 mph isovel intersects shoreline. Storm diameter between 20 mph isovels is approximately double the initial distance.

OCEAN BED PROFILE

TRAVERSE DISTANCE FROM SHORE (NAUT.MI.)	WATER DEPTH BELOW MLW (FEET)
0	0
0.2	50
0.5	96
1.0	95
1.5	125
2.0	125
3.0	165
4.0	247
5.0	188
10.0	233
15.0	438
20.0	570
30.0	271
40.0	511
50.0	443
60.0	377
70.0	334
80.0	278
90.0	168
100.0	250
110.0	301
120.0	345
130.0	258
140.0	249
150.0	288
160.0	291
170.0	318
178.6	600
180.0	1,620

LATITUDE 43°17.8' DEGREE AT TRAVERSE MID-POINT FROM SHORE TO 600-FOOT DEPTH

PMH COMPUTATIONAL COEFFICIENT AND WATER LEVEL (SURGE) ESTIMATES

COEFFICIENTS

BOTTOM FRICTION FACTOR 0.0025

WIND STRESS CORRECTION FACTOR 1.10

WATER LEVEL DATA

(AT OPEN COAST SHORELINE)

COMPONENTS	PMH SPEED OF TRANSLATION ST	MT	HT
	F E	E	T
WIND SETUP			9.73
PRESSURE SETUP			1.82
INITIAL WATER LEV.			0.56
ASTRONOMICAL TIDE LEVEL			16.00
TOTAL-SURGE STILL WATER LEV. FEET MLW			28.11

TABLE C.21

OCEAN BED PROFILES

PASS CHRISTIAN		CRYSTAL RIVER		ST. LUCIE		CHESAPEAKE BAY MOUTH		HAMPTON BEACH*	
Nautical Miles from Shore	Depth, ft, MLW	Nautical Miles from Shore	Depth, ft, MLW	Nautical Miles from Shore	Depth, ft, MLW	Nautical Miles from Shore	Depth, ft, MLW	Nautical Miles from Shore	Depth, ft, MLW
1	3	0.55	3	0.1	10	5	44	0.5	20
2	9	2.31	10	10	90	10	56	4	120
5	12	6.25	14	16	390	30	102	10	250
10	13	8.33	9	18.7	600	50	178	25	250
15	35	31.4	50			55	240	44	600
20	36	100	180			62	600		
30	40	113	300						
40	52	127	600						
50	90								
60	160								
70	335								
77	600								

* As developed for Seabrook

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