METEOROLOGICAL/HYDROLOGICAL FLOOD STANDARDS

MHF-1 Flood Event Data Sources

A. The modeling of floods in Florida shall involve meteorological, hydrological, and other relevant data sources.

B. The model shall incorporate relevant data sources in order to account for meteorological and hydrological events and circumstances occurring either inside or outside of Florida that result in or contribute to flooding in Florida.

C. Flood model calibration and validation shall be scientifically justified based upon historical data consistent with peer reviewed or publically developed data sources.

D. Calibration and validation shall encompass relevant flood event data sources required to model flood, which shall include, but not be limited to, coastal and inland flooding, as well as any partitions or subsets.

E. Any trends, weighting, or partitioning shall be justified and consistent with currently accepted scientific literature and statistical techniques.

Purpose: This standard requires that the flood model include coastal and inland flooding as a minimum. Coastal flooding includes storm surge, and inland flooding includes riverine, lacustrine, and surface water flooding.

This standard requires that utilized data sources associated with each type of flooding be documented, and the stochastic flood event data sources be scientifically defensible. If other flood sub-perils are included, they are to be identified.

Relevant Forms: GF-2A, Meteorological/Hydrological Flood Standards
Meteorologist Expert Certification
GF-2B, Meteorological/Hydrological Flood Standards
Hydrologist Expert Certification
MHF-2, Coastal Flood Characteristics by Annual Exceedance Probability
MHF-3, Inland Flood Characteristics by Annual Exceedance Probability
AF-2, Total Flood Statewide Loss Costs
SF-4, Average Annual Zero Deductible Statewide Flood Loss Costs – Historical versus Modeled

Disclosures

1. Specify relevant data sources, their release dates, and the time periods used to develop and implement flood frequencies for coastal and inland flooding into the

flood model.

2. Where the flood model incorporates modification, partitioning, or adjustment of the historical data leading to differences between modeled climatological and historical data, justify each modification and describe how it is incorporated.

3. Describe any assumptions or calculations used in the flood model relating to future conditions (e.g., sea level rise, changes in precipitation patterns, changes in storm frequency or severity).

4. Provide citations to all data sources used to develop and support the land-use evaluation methodology, including publicly developed or peer reviewed information.

5. State whether the model includes flooding other than coastal and inland flooding. State whether the other flooding types are independent of the minimum required sub-perils of coastal and inland flooding.

6. Provide a completed Form MHF-2, Coastal Flood Characteristics by Annual Exceedance Probability, for coastal flooding, which includes data for flood extent and flood depth corresponding to modeled 0.1, 0.02, 0.01, and 0.002 annual exceedance probabilities. Provide a link to the location of the form [insert hyperlink here].

7. Provide a completed Form MHF-3, Inland Flood Characteristics by Annual Exceedance Probability, for inland flooding which includes data for flood extent and flood depth corresponding to modeled 0.1, 0.02, 0.01, and 0.002 annual exceedance probabilities. Provide a link to the location of the form [insert hyperlink here].

Audit

1. The modeling organization’s data sources will be reviewed.

2. Justification for any modification, partitioning, or adjustment to historical data and the impact on flood model parameters and characteristics will be reviewed.

3. Modeled frequencies will be compared with the observed spatial distribution of flood frequencies across Florida using methods documented in currently accepted scientific literature. The goodness-of-fit of modeled to historical statewide and regional coastal and inland flood frequencies as provided in Form MHF-2, Coastal Flood Characteristics by Annual Exceedance Probability, and Form MHF-3, Inland Flood Characteristics by Annual Exceedance Probability, will be reviewed.

4. Historical data used as the basis for the model’s flood extent/flow and elevation or depth will be reviewed. The appropriateness of the model’s stochastic flood extent/flow and elevation or depth with reference to the historical flood databases will be reviewed.

MHF-2 Flood Parameters (Inputs)

A. The flood model shall be developed with consideration given to flood parameters that are scientifically appropriate for modeling coastal and inland flooding. The modeling organization shall justify the use of all flood parameters based on information documented in currently accepted scientific literature.

B. Any differences in the treatment of flood parameters between historical and stochastic events shall be justified.

C. The land use and land cover (LULC) database shall be consistent with the National Land Cover Database (NLCD) 2006 or later. Use of alternate datasets shall be justified.

D. Treatment of soil effects on inland flooding shall be consistent with current scientific and technical literature.

E. The grid cell size used in the flood model shall be scientifically justified.

Purpose: This standard requires that the modeling organization use only scientifically sound information for determining coastal and inland flooding parameters. Flood parameters are inputs to the flood model and are needed by the model to define or determine the nature, severity, and physical characteristics associated with coastal and inland flooding.

This standard requires that the flood model be implemented consistently with contemporary soil categories and LULC distributions.

Note: The NLCD products are created by the Multi-Resolution Land Characteristics (MRLC) Consortium, a partnership of Federal agencies led by the U.S. Geological Survey (USGS) and are updated every five years.

This standard requires that any differences in the treatment of flood parameters between historical and stochastic flood events be justified.

Relevant Forms: GF-2A, Meteorological/Hydrological Flood Standards
Meteorologist Expert Certification
GF-2B, Meteorological/Hydrological Flood Standards
Hydrologist Expert Certification
SF-1, Distributions of Stochastic Flood Parameters (Coastal, Inland)

Disclosures

1. For coastal and inland flood model components, identify and justify the various flood parameters used in model.

2. For coastal and inland flood model components, describe the dependencies among model parameters and specify any assumed mathematical dependencies among these parameters.

3. For coastal and inland flood model components, describe the dependencies which exist among and between each of the model components.

4. Identify whether physical flood parameters are modeled as random variables, functions, or fixed values for the stochastic flood event generation. Provide rationale for the choice of parameter representations.

5. Describe how any physical flood parameters are treated differently in the historical and stochastic flood event sets and provide rationale.

6. For coastal flood analyses, describe how the coastline is segmented (or partitioned) in determining the parameters for flood frequency used in the flood model.

7. For inland flood analyses associated with riverine and lacustrine flooding, describe how the rivers, lakes, and associated floodplains are segmented (or partitioned) in determining the parameters for flood frequency used in the flood model.

8. For inland flood analyses associated with surface water flooding, describe how the affected area is segmented (or partitioned) in determining the parameters for flood frequency used in the flood model.

9. Describe how any flood parameters change or evolve during an individual flood life cycle (e.g., the functional representation of Manning's roughness varying with flood depth).

10. Describe any assumptions or calculations used in the flood model relating to antecedent conditions (e.g., groundwater levels, lake levels, river discharges, tides, soil moisture).

11. For coastal modeling, describe any assumptions or calculations for wave setup (wave radiation stress~~es~~) and their impact on storm surge stillwater elevations.

12. Provide the grid resolution or other area partitioning used to model the flood extent and depth and how the hydrological characteristics are determined on these scales.

13. Provide the source, resolution, and accuracy of the topography and bathymetry throughout the flood model domain. Provide the grid cell size(s) used in the flood model.

14. Describe in detail the methods by which ground elevation data is associated with address databases referenced in Standard GF-3, Insured Exposure Location, and how this associated data is used in the flood model.

~~14.~~15. Describe any assumptions or calculations used in the flood model relating to flood-induced erosion or topographic changes.

~~15.~~16. As applicable, describe the methods used to account for soil infiltration and percolation rates and soil moisture condition in the flood model. Provide citations to all data sources used to develop and support the soil infiltration and percolation rate or soil moisture condition methodology, including publicly developed or peer reviewed information.

~~16.~~17. Provide the collection and publication dates of the soil and LULC data used in the flood model, and justify the data's applicability and timeliness for Florida.

~~17.~~18. Describe the methodology used to convert LULC information into a spatial distribution of hydrological parameters, including roughness coefficients, throughout the flood model domain.

~~18.~~19. For each parameter used in the flood model, provide the horizontal and vertical projection and datum references, if applicable. If any horizontal or vertical datum conversions are required, provide conversion factors and describe the conversion methodology utilized.

Audit

1. All flood parameters used in the flood model will be reviewed.

2. Graphical depictions of flood parameters as used in the flood model will be reviewed. Descriptions and justification of the following will be reviewed:
    a. The dataset basis for any fitted distributions, the methods used, and any smoothing techniques employed,
    b. The modeled dependencies among correlated parameters in the flood model and how they are represented,
    c. The dependencies between the coastal and inland flooding analyses.

3. Scientific literature cited in Standard GF-1, Scope of the Flood Model and Its Implementation, may be reviewed to determine applicability.

4. The initial conditions for each flood event and how the flood event is initialized in an individual event calculation will be reviewed.

5. Any modeling organization specific research performed to develop the soil infiltration and percolation rates or soil moisture conditions used in the flood model will be reviewed, if applicable. The databases used will be reviewed in the context of the cited scientific literature.

6. Any modeling organization specific methodology used to incorporate LULC information into the food model will be reviewed. The databases used will be reviewed in the context of the cited scientific literature.

MHF-3 Wind and Pressure Fields for Storm Surge

A. Modeling of wind and pressure fields shall be employed to drive storm surge models due to tropical cyclones.

B. Modeling of wind and pressure fields shall be employed to drive storm surge models due to non-tropical cyclones, unless non-tropical storm surge affects are otherwise incorporated into the flood model results. Exclusion of non-tropical cyclone storm surge affects shall be scientifically justified.

C. The wind and pressure fields shall be based on contemporary scientific literature or developed using scientifically defensible methods.

D. Wind and pressure fields that drive coastal flood models shall be modeled for a time period that extends from at least before the storm's passage over the continental shelf waters of Florida and adjacent states to at least the time the storm no longer affects coastal flooding in Florida.

E. The features of modeled wind and pressure fields shall be consistent with those of historical storms affecting Florida.

Purpose: Wind is the dominant feature of tropical cyclones that drives storm surge and storm surge is frequently the dominant component of the associated flooding. The representation of the windfield and related pressure field is, therefore, crucial to storm surge modeling, as is the propagation of these fields along storm tracks, which determines their duration over ocean waters relevant for surges affecting Florida. This standard requires that the wind and pressure fields used to drive storm surge as part of flood models are scientifically sound and have been evaluated using comparison to historical storms affecting Florida. Non-tropical cyclones need not be explicitly modeled with wind and pressure fields but are not exempt from consideration in the flood model results.

Relevant Forms: GF-2A, Meteorological/Hydrological Flood Standards Meteorologist Expert Certification
GF-2B, Meteorological/Hydrological Flood Standards Hydrologist Expert Certification
AF-2, Total Flood Statewide Loss Costs

Disclosures

1. Describe the modeling of the wind and pressure fields for tropical cyclones. State and justify the choice of the parametric forms and the parameter values.

2. Describe the modeling of the wind and pressure fields for non-tropical cyclones, if implemented.

3. Provide the historical data used to estimate parameters and to develop stochastic storm sets.

4. Provide a rotational (*y*-axis) versus radial (*x*-axis) plot of the average or default wind and pressure fields for tropical cyclones. Provide such plots for non-tropical cyclones, if non-tropical cyclones are modeled explicitly.

5. Describe how the parametric windfields are translated to surface windfields used for storm surge development (e.g., numerically via planetary boundary layer models or parametrically via empirical surface wind reduction factors and inflow angles). Discuss the associated uncertainties.

6. Describe how storm translation is accounted for when computing surface windfields.

7. Describe and justify the averaging of observational windspeeds for use in the storm surge model.

Audit

1. All external data sources that affect the modeled wind and pressure fields associated with storm surge will be identified and their appropriateness reviewed.

2. Calibration and evaluation of wind and pressure fields will be reviewed. Accepted scientific comparisons of simulated wind and pressure fields to historical storms will be reviewed.

3. The sensitivity of flood extent and depth results to changes in the representation of wind and pressure fields will be reviewed.

4. The over-land evolution of simulated wind and pressure fields and its impact on the simulated flooding will be reviewed.

5. The derivation of surface water wind stress from surface windspeed will be reviewed. If a sea-surface drag coefficient is employed, how it is related to the surface windspeed will be reviewed. A comparison of the sea-surface drag coefficient to coefficients from the scientific literature will be reviewed.

6. The treatment of uncertainty in the factors used to convert from a reference windfield to a geographic distribution of surface winds and the impact of the resulting winds upon the storm surge will be reviewed and compared with currently accepted scientific literature.

MHF-4 Flood Characteristics (Outputs)

A. Flood extent and depth generated by the flood model shall be consistent with observed historical floods affecting Florida.

B. Methods for deriving flood extent and depth shall be scientifically defensible and technically sound.

C. Methods for deriving wave conditions in coastal flooding shall be scientifically defensible and technically sound.

D. Modeled flood characteristics shall be sufficient for the calculation of flood damage.

Purpose: This standard requires that the modeling organization use scientifically sound information for determining inland and coastal flooding characteristics.

This standard requires that the resulting surface flood extent, depth, and other characteristics be representative of historical floods in Florida.

This standard requires that comparison of flood characteristics produced by the stochastic flood events and historical flood events be documented and variations justified.

Relevant Forms:
GF-2A, Meteorological/Hydrological Flood Standards Meteorologist Expert Certification
GF-2B, Meteorological/Hydrological Flood Standards Hydrologist Expert Certification
MHF-1, Historical Event Flood Extent and Elevation or Depth Validation Maps
MHF-2, Coastal Flood Characteristics by Annual Exceedance Probability
MHF-3, Inland Flood Characteristics by Annual Exceedance Probability
AF-2, Total Flood Statewide Loss Costs

Disclosures

1. Provide comparisons of the modeled and historical flood extents and elevations or depths for the following storm events: Hurricane Andrew (1992), Hurricane Ivan (2004), Hurricane Jeanne (2004), Hurricane Wilma (2005), Tropical Storm Fay (2008), Unnamed storm in East Florida (May 2009), Unnamed storm on Panhandle (July 2013), and one additional Florida storm of the modeling organization's choosing. For whichever storms data are not available, the modeling organization may substitute an alternate historical storm of their choosing. Describe and justify the appropriateness of the databases used in the flood extent and elevation or depth validations.

2. Demonstrate that the coastal flood and inland flood model components each incorporate flood parameters necessary for simulating flood damage. Demonstrate that each of these flood model components accommodate the varied geographic, geologic, hydrologic, hydraulic, and LULC conditions in Florida. Provide justification for validation using any historical events not specified in Disclosure 1.

3. For each of the coastal storm events in Disclosure 1, provide a comparison of the Envelope of High Water (EOHW) to NOAA's Sea, Lake, and Overland Surges from Hurricanes (SLOSH), if such data are available.

4. For each of the storm events in Disclosure 1 resulting in inland flooding, provide a comparison of the modeled flood peak flow with recorded flow data from selected United States Geological Survey (USGS) or Florida Water Management District (FWMD) gaging stations. Provide the rationale for gaging station selections.

5. Provide a map comparing simulated water elevations or depths to observed water elevations or depths for each storm event in Disclosure 1.

6. For coastal flooding, describe how the flood model accounts for wave generation and decay, wave breaking, wave runup, and other wave effects.

7. Identify all hydrological variables that affect the flood extent, depth, and other flood characteristics.

8. For inland and coastal modeling, state if and describe how the flood model accounts for flood velocity, flood duration, flood-induced erosion, flood-borne debris, salinity (saltwater versus freshwater flooding), contaminated floodwaters, and the likelihood of mold following flooding.

9. Describe the effect of any assumptions or calculations relating to antecedent conditions on the flood characteristics.

10. Disclose if and how the interaction of inland and coastal flooding is modeled. If it is not, then justify its neglect.

~~10.~~11. Describe and provide visual depictions of how the characteristics of each flood model component are utilized in or interface with the other components.

~~11.~~12. Demonstrate the consistency of the modeled flood extent and elevation or depth with observed floods affecting Florida. Describe and justify the appropriateness of the databases used in the flood extent and elevation or depth validations.

~~12.~~13. Describe any variations in the treatment of the flood model flood extent and elevation or depth for stochastic versus historical floods and justify this variation.

~~13~~14. Provide a completed Form MHF-1, Historical Event Flood Extent and Elevation or Depth Validation Maps. Explain any differences between modeled flood extent and

elevation or depth and historical flood extent and elevation or depth. Provide a link to the location of the form [insert hyperlink here].

Audit

1. The method and supporting material for determining flood extent and elevation or depth for coastal and inland flooding will be reviewed.

2. Any modeling organization specific research performed to calculate the flood extent and depth and wave conditions will be reviewed along with the associated databases.

3. Any modeling organization specific research performed to derive the hydrological characteristics associated with the topography, soil conditions, and LULC distributions for the flood extent and depth will be reviewed.

4. The flood parameters used in calculating the flood loss costs for the historical flood events given in Disclosure 1 will be reviewed. Calculations based on flood model results for coastal and inland flooding, specification of flood parameters (including temporal and/or spatial variation where applicable) used in the flood model for all storm events, and the resulting temporal and spatial distributions of any flood characteristics contributing to flood damage will be reviewed. These will be reviewed with Form AF-2, Total Flood Statewide Loss Costs.

5. Time-based contour animations (capable of being paused) to demonstrate scientifically reasonable temporal evolution of flood characteristics will be reviewed. (Trade Secret item to be provided during the closed meeting portion of the Commission meeting to review the flood model for acceptability.)

6. Comparisons of the flood peak flow calculated in the flood model with records from USGS or FWMD gaging stations will be reviewed.

7. Calculation of relevant characteristics in the flood model, such as flood extent, depth, and waves, will be reviewed. The methods by which each flood model component utilizes the characteristics of or interfaces with other flood model components, if applicable, will be reviewed.

8. The modeled interaction of inland and coastal flooding will be reviewed. If it is not modeled, justification for its neglect will be reviewed.

~~8.~~9. Form MHF-1, Historical Event Flood Extent and Elevation or Depth Validation Maps, will be reviewed.

~~9.~~10. The comparison of the calculated characteristics with historical flood events will be reviewed. The selected locations and corresponding storm events will be reviewed to verify sufficient representation of the varied geographic areas. If a single storm is used for both coastal and inland flooding validation, then its appropriateness will be reviewed.

~~10.~~11. The comparison of the EOHW to NOAA's SLOSH, if such data are available, will be reviewed.

MHF-5 Flood Probability Distributions

A. Flood probability, its geographic variation, and the associated flood extent and elevation or depth shall be scientifically defensible and shall be consistent with flooding observed for Florida.

B. Flood probability distributions for storm surge affected areas shall include tropical, and if modeled, non-tropical events.

C. Probability distributions for coastal wave conditions, if modeled, shall include both tropical and non-tropical events.

D. Any additional probability distributions of flood parameters and modeled characteristics shall be consistent with historical floods for Florida resulting from coastal and inland flooding.

Purpose: This standard requires that the probability of occurrence of floods and associated flood extent and elevation or depth reasonably reflect the historical record with respect to geographical locations. This standard addresses consideration of rainfall events in adjacent states which could result in flooding in Florida (e.g., rainfall in the Chattahoochee River watershed in North Georgia contributes to Apalachicola River flooding).

This standard requires that the probability of occurrence of flood extent and elevation or depth be determined by combining storm surge from tropical and non-tropical events. Such combination can be through explicit modeling of both types of events, or by statistically combining non-tropical flood frequency information with explicitly modeled tropical event flood frequency.

This standard requires that the probability distributions of flood parameters not treated as constants and modeled characteristics be consistent with those documented in official meteorological and hydrological databases. Consistent means that spatial distributions of modeled flood probabilities accurately depict coastal and inland flooding in Florida.

Relevant Forms:
- GF-2A, Meteorological/Hydrological Flood Standards Meteorologist Expert Certification
- GF-2B, Meteorological/Hydrological Flood Standards Hydrologist Expert Certification
- MHF-2, Coastal Flood Characteristics by Annual Exceedance Probability
- MHF-3, Inland Flood Characteristics by Annual Exceedance Probability
- AF-2, Total Flood Statewide Loss Costs
- SF-1, Distributions of Stochastic Flood Parameters (Coastal, Inland)

Disclosures

1. List assumptions used in creating the database(s) containing flood parameters and characteristics.

2. Describe how non-tropical and tropical event coastal storm surge flood probability distributions are combined, if applicable. Provide one example demonstrating the process.

3. Provide the rationale for each of the probability distributions used for relevant flood parameters and characteristics.

4. Demonstrate that simulated flood extent and elevation or depth frequencies are consistent with historical frequencies.

Audit

1. The consistency in accounting for similar flood parameters and characteristics across Florida and segments in adjacent states will be reviewed.

2. The method and supporting material for generating stochastic coastal and inland flood events will be reviewed.

3. Any modeling organization specific research performed to develop the functions used for simulating flood model characteristics and to develop flood databases will be reviewed.

4. Form SF-1, Distributions of Stochastic Flood Parameters (Coastal, Inland), will be reviewed for the probability distributions and data sources.

5. Comparisons of modeled flood probabilities and characteristics for coastal and inland flooding against the available historical record will be reviewed. Modeled probabilities from any subset, trend, or fitted function will be reviewed, compared, and justified against this historical record. In the case of partitioning, modeled probabilities from the partition and its complement will be reviewed and compared with the complete historical record.

MHF-6 Modeling of Regional/Local Flood Control Measures

A. The flood model's treatment of flood control measures and spatial variation in performance shall be consistent with historical records and with current state-of-the-science. **TO BE REVISITED ON OCTOBER 8**

B. The modeling organization shall have a documented procedure for reviewing available flood control data and shall update the flood model control databases as necessary.

C. Any treatment of the potential failure of flood control measures shall be based upon currently accepted scientific literature, empirical studies, or engineering analyses.

Purpose: This standard requires that large scale flood control measures are accounted for and updated as necessary. It also requires that any treatment of the potential failure of flood control measures properly reflects the scientific and engineering basis.

Flood control measures are those measures undertaken outside the building footprint and on a larger scale, to reduce the presence, depth or energy of flow or waves that affect personal residential structures. Flood control measures may include, but not be limited to:

- Flood barriers and their corresponding location, dimensions, and strength (e.g., dams, levees, floodwalls, seawalls)
- Flow diversions, retention ponds and water storage areas, including associated catch basins, channels, culverts, gates, pumps, etc.
- Intentional or accidental release of water from behind flood barriers or from water storage areas.

Relevant Forms: GF-2A, Meteorological/Hydrological Flood Standards
Meteorologist Expert Certification
GF-2B, Meteorological/Hydrological Flood Standards
Hydrologist Expert Certification

Disclosures

1. List the flood control measures incorporated in the flood model and the sources of all data employed.

2. Describe the methodology to account for flood control measures in the flood model and indicate if these measures can be set (either to on or off) in the flood model.

3. Describe if flood control measures which require human intervention or ongoing maintenance are incorporated into the flood model. Disclose the consideration given, if any, for the time required to construct, install or activate such measures, as compared with warning time that may be available before a flood event. Disclose the

consideration given, if any, for the likelihood of construction/installation/activation based on reports for past storm events.

4. Provide the probability distributions of flood extent, depth, and other characteristics showing the impact of flood control measures versus no flood control measures.

5. Describe how a determination is made to update any flood control measure modeling databases or the time period planned for regular updating of databases.

6. Describe and justify the methodology used to account for the potential failure or alteration of flood control measures in the flood model and if the level of failure can be adjusted in the flood model.

7. State whether the flood model incorporates intentional discharge of flood waters by governmental or other human actions for flood control purposes. If so, describe how this is handled in the flood model.

8. State to what degree, if any, each flood control measure considers future conditions and sea level rise.

Audit

1. Treatment of flood control measures incorporated in the flood model will be reviewed.

2. The documented procedure addressing the updating of flood control measures as necessary will be reviewed.

3. The methodology and justification used to account for the potential failure or alteration of flood control measures in the flood model will be reviewed.

4. The probability distribution for flooding scenarios incorporating the failure of flood control measures will be reviewed.

5. If the flood model incorporates discharge of flood waters by governmental or other human actions, the methodology used in the flood model will be reviewed.

MHF-7 Logical Relationships Among Flood Parameters and Characteristics

A. Water surface elevation shall increase with increasing terrain roughness, all other factors held constant, if applicable.

B. Rate of discharge shall increase with increase in steepness in the topography, all other factors held constant.

C. Inland flood extent and depth associated with riverine and lacustrine flooding shall increase with increasing discharge, all other factors held constant.

D. The coincidence of storm surge and inland flooding shall not decrease the flood extent and depth, all other factors held constant.

E. Storm surge shall increase with greater over-water storm size, as measured by the area enclosed by threshold windspeed or pressure contours, all other factors held constant.

F. Storm surge shall increase with shallower bathymetry, all other factors held constant.

G. Maximum storm surge height shall increase with increasing onshore windspeeds, all other factors held constant.

H. Heights of locally generated coastal waves shall increase with increasing windspeed, subject to depth, fetch, and wind duration limits, all other factors held constant, if applicable.

Purpose: This standard requires that the relationships among the parameters and characteristics of the flood model are logically consistent.

Relevant Forms: GF-2A, Meteorological/Hydrological Flood Standards Meteorologist Expert Certification
GF-2B, Meteorological/Hydrological Flood Standards Hydrologist Expert Certification

Disclosures

1. Provide a sample graph of water surface elevation and discharge versus time associated with inland flooding for modeling organization defined locations within each region in Florida defined in *Figure 3*: Panhandle, North Florida, East Florida, Southeast Florida, and Southwest Florida. Discuss how the flood characteristics exhibit logical relationships.

2. Provide sample plots and tabulations of storm surge elevations and associated wave conditions, if applicable, at Atlantic Ocean, Gulf of Mexico, and bay/estuarine locations around the Florida coastline. The number of examples should be sufficient to demonstrate logical relationships with geographic, oceanographic, hydraulic, and meteorological conditions.

3. Describe the analysis performed in order to demonstrate the logical relationships in this standard.

Audit

1. The analysis performed to ~~demonstrating~~ demonstrate the logical relationships ~~in this standard~~ will be reviewed.

2. Methods (including any software) used in verifying the logical relationships will be reviewed.

Form MHF-1: Historical Event Flood Extent and Elevation or Depth Validation Maps

Purpose: This form illustrates the flood model's ability to simulate historical flood events.

A. Provide color coded contour maps with appropriate base map data illustrating modeled flood extents and depths for the following historical Florida flood events:

Hurricane Andrew (1992)
Hurricane Ivan (2004)
Hurricane Jeanne (2004)
Hurricane Wilma (2005)
Tropical Storm Fay (2008)
Unnamed Storm in East Florida (May 2009)
Unnamed Storm on Panhandle (July 2013)
Storm chosen by modeling organization

If data are not available, the modeling organization may substitute a historical storm of their choosing.

B. Provide corresponding color coded contour maps with modeled flood elevations or depths for each of the historical events, contoured at no more than one foot intervals. Explain the procedures for converting flood elevation contours to depth contours.

Elevation datum shall be North American Vertical Datum of 1988 (NAVD88).

Plot the locations and values associated with validation points (maximum flood elevations or depths from observations such as gage data, water marks, etc.) on each contour map for the historical events.

Provide sources of the validation data.

Provide the resolution of the model elevation or depth grid used on each contour map.

Demonstrate the consistency of the modeled flood extent and elevation or depth with observed flood extent and elevation or depth for each historical event.

C. Explain any differences between the modeled flood extent and elevation or depth and the historical floods observations. Include an explanation if the differences are impacted by flood control measures.

D. Include Form MHF-1, Historical Event Flood Extent and Elevation or Depth Validation Maps, in a submission appendix.

Form MHF-2: Coastal Flood Characteristics by Annual Exceedance Probability

Purpose: This form illustrates the simulations of key coastal flood characteristics at a range of locations and annual exceedance probabilities.

Define one study area subject to coastal flooding within each of five Florida geographic regions (see *Figure 3*): Panhandle, North Florida, East Florida, Southeast Florida, and Southwest Florida. The extent of each study area shall be determined by the modeling organization and shall be large enough to encompass at least one county. The modeling organization shall create the underlying grid for this form.

Provide, for each study area, 1) summary maps, and 2) graphs or tables, based on the underlying gridded data, for the following:

A. Flood extent and flood depth corresponding to modeled 0.1, 0.02, 0.01, and 0.002 annual exceedance probabilities. Flood extent and flood depth shall incorporate 1) wave effects, if modeled, and 2) the effects of erosion, if modeled.

B. If applicable, wave conditions associated with flood extents and flood depths in A. above.

C. To the degree that flood-induced erosion effects are included in the vulnerability model, the depth of erosion (original ground elevation minus eroded ground elevation) corresponding to modeled 0.1, 0.02, 0.01, and 0.002 annual exceedance probabilities.

D. To the degree that flow velocity effects are included in the vulnerability model, the flow velocity corresponding to modeled 0.1, 0.02, 0.01, and 0.002 annual exceedance probabilities.

E. To the degree that flood inundation duration effects are included in the vulnerability model, the duration of flood inundation corresponding to modeled 0.1, 0.02, 0.01, and 0.002 annual exceedance probabilities.

F. Indicate where and how flood extent, flood depth, and wave conditions are affected by flood control measures, and by failure of those measures. Flood conditions for both intact and failed measures shall be presented. **To be revisited with MHF-6**

G. To the degree that the following effects are included in the vulnerability model, indicate where and how flood-induced erosion, flow velocity, and flood inundation duration are affected by flood control measures, and by failure of those measures. Flood conditions for both intact and failed measures shall be presented. **To be revisited with MHF-6**

H. Include Form MHF-2, Coastal Flood Characteristics by Annual Exceedance Probability, in a submission appendix.

Form MHF-3: Inland Flood Characteristics by Annual Exceedance Probability

Purpose: This form illustrates the simulations of key inland flood characteristics at a range of locations and annual exceedance probabilities.

Define one study area subject to inland flooding within each of five Florida geographic regions (see *Figure 3*): Panhandle, North Florida, East Florida, Southeast Florida, and Southwest Florida. The extent of each study area shall be determined by the modeling organization and shall be large enough to encompass at least one county. The modeling organization shall create the underlying grid for this form.

Provide, for each study area, 1) summary maps, and 2) graphs or tables, based on the underlying gridded data, for the following:

A. Flood extent and flood depth corresponding to modeled 0.1, 0.02, 0.01, and 0.002 annual exceedance probabilities. Flood extent and flood depth shall incorporate the effects of erosion, if modeled. For locations subject to both inland and coastal flooding, this information should reflect only inland flooding.

B. To the degree that flood-induced erosion effects are included in the vulnerability model, the depth of erosion (original ground elevation minus eroded ground elevation) corresponding to modeled 0.1, 0.02, 0.01, and 0.002 annual exceedance probabilities.

C. To the degree that flow velocity effects are included in the vulnerability model, the flow velocity corresponding to modeled 0.1, 0.02, 0.01, and 0.002 annual exceedance probabilities.

D. To the degree that flood inundation duration effects are included in the vulnerability model, the duration of flood inundation corresponding to modeled 0.1, 0.02, 0.01, and 0.002 annual exceedance probabilities.

E. Indicate where and how flood extent and flood depth are affected by flood control measures, and by failure of those measures. Flood conditions for both intact and failed measures shall be presented. **To be revisited with MHF-6**

F. To the degree that the following effects are included in the vulnerability model, indicate where and how flood-induced erosion, flow velocity, and flood inundation duration are affected by flood control measures, and by failure of those measures. Flood conditions for both intact and failed measures shall be presented. **To be revisited with MHF-6**

G. Include Form MHF-3, Inland Flood Characteristics by Annual Exceedance Probability, in a submission appendix.

Figure 3

State of Florida
By Region