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COASTAL FLOOD CATEGORIES

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SUMMARY: This Eastern Region Supplement defines coastal flooding categories and provides impact-based definitions to be utilized by all coastal Eastern Region Weather Forecast Offices.

Signed

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Date

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1. Purpose. The purpose of this supplement is to define Regional coastal flood categories and impacts, address multiple impact scenarios, and provide examples.

2. Coastal Flood Categories. Coastal flood category definitions have historically been locally defined by the Weather Forecast Offices (WFOs). Coastal flood categories and impact statements provide several noteworthy benefits including:

- Conveying the seriousness and extent of flooding including the degree of threat to property and life
- Providing a reference of water depth/inundation (above ground level)
- Identifying property and locations that will likely be flooded (e.g., roads, houses, businesses, vehicles, etc.)
- Addressing damage and impacts from wave actions (and run up) where and when appropriate, and
- Eliciting a response by helping the user understand the threat and level of risk

By having coastal flood categories defined regionally, some additional operational benefits are realized, including:

- WFOs supporting the same State(s) will be consistent in the categorical thresholds
- WFOs performing backup operations will have better understanding of the risk/threat for flooding for the backup locations
- Region-wide depictions of the coastal flood threat will be based on common thresholds

Given the variable nature of the coastline, it is also important to tailor the coastal flooding definitions and impacts to the populations/environments that will be affected. **NOTE:** Depending on protective structures at the coastline, some flood impacts may be mitigated and thus, unique local thresholds may be reasonable to use.

For the purpose of this policy, the populations/environments are categorized in the following way:

- Urban locations: locations with man-made structures/vehicles present
- Natural: sand or mixed sand dunes, cobble dunes, bluffs, and rocky ledges
- Man-made protections: seawalls, bulkheads, and revetments

Coastal flood categories and impact statements will utilize these three environments to ensure the nature of the impacts and risks described remains consistent.

The coastal flood categories to be routinely used by WFOs are:

- Minor
- Moderate
- Major

Detailed definitions of each coastal flood category are provided in Section 2.1 and include the inundation level, erosion, and hazards typically observed with each category. On Advanced Hydrologic Prediction System (AHPS) webpages, these three flood categories will be utilized.

During an extreme, historically significant event, to effectively communicate the most life threatening of flood impacts, an additional coastal flood category is defined for field office use in warning products and messaging:

- Extreme/Record

This flood category should be reserved for catastrophic forecast flood events. The minor category is utilized for advisory products. The moderate, major and extreme categories are utilized with warning products.

NOTE: In some cases, the impacts of flood waters and coastal waves are a combined threat to life and property. For warning and advisory issuance, forecast impacts that may otherwise only reach a minor flood category designation, may necessitate being elevated to moderate or major due to forecast wave heights and/or wave run up; similarly for both the moderate and major flood categories. This categorical elevation is at the discretion of the forecaster. To support the office-to-office consistency of this elevation, this policy provides the categorical nature of wave impacts in Appendix A.

2.1 Definitions

2.1.1 Minor: Low threat to property and life; flooding of low-lying vulnerable locations near the waterfront. Generally 1 foot or less of inundation (depth of water above ground level) is expected in low lying vulnerable areas/normally dry land.

Typical impacts include:

- Flooding of parking lots, parks, and roads with only isolated road closures expected
- *Dunes*: Low to no threat to property; minor beach erosion with possible erosion to the front of some vulnerable dune structures
- *Revetments/Seawalls*: No damage is expected
- *Bluffs*: Spotty, limited erosion at the bases due to waves on top of inundation

2.1.2 Moderate: Elevated threat to property damage and care is needed to protect life. Widespread flooding of locations may occur near the waterfront including some damage to vulnerable structures. Generally 1-2 feet of inundation (depth of water above ground level) is expected in low lying areas.

Typical impacts include:

- Numerous road closures due to flooding and/or overwash debris. A few areas could become isolated due to the flooding of roads. Vehicles parked in vulnerable areas near the waterfront will likely become flooded. A few evacuations may be needed in the most vulnerable areas.
- *Dunes*: Some beach erosion with considerable erosion of protective dune structures due to breaking waves at the coast. Ponding of water behind dune structures will result in some flooding of roads and vulnerable structures.
- *Revetments/Seawalls*: Small rocks will be embedded in overtopping water and may result in damage to passing vehicles or pedestrians. There is no damage to roadway or larger rocks armoring revetment.
- *Bluffs*: Expect erosion of bluffs due to waves on top of an elevated water level. Any stairs on slopes of bluffs may be damaged and/or lose accessibility to the beach. The integrity of a few bluffs may be compromised.

2.1.3 Major: Significant threat to property and life. Many coastal communities will experience flood damage. Numerous structures will flood with sufficient depth to result in major damage. The most vulnerable homes and businesses near the waterfront could be severely damaged or destroyed. Anyone remaining in these areas will put their life at risk. Generally 2-4 feet of inundation (depth of water above ground level) is expected in low lying areas.

Typical impacts include:

- Vehicles left in areas vulnerable to flooding will be submerged and destroyed. Numerous roads and some structures will be severely flooded. Some neighborhoods will become

isolated. Evacuations will be necessary in some areas. Flood waters will extend well inland across relatively flat, low-lying terrain.

- *Dunes*: Severe erosion of protective dunes and substantial coastal damage is expected. Water levels will overtop and compromise some protective dune structures at the times of high tide. Expect significant damage and flooding of roads and property along the shoreline and behind protective dunes. In some areas complete erosion of the dunes is possible.
- *Revetments/Seawalls*: Elevated water will wash large rocks onto roadways adjacent to the revetment. Danger to vehicles and pedestrians on the roadway being washed into ocean or struck by rocks embedded in overtopping water. Large rocks armoring revetment could be displaced and there is the possibility of road damage.
- *Bluffs*: Expect severe erosion of bluffs due to waves on top of an abnormally high water level. Erosion may be severe enough for some bluffs to slump and threaten structures and/or parking areas near the edge. Some bluffs will become unstable and vulnerable to slumping from future storms. Stairs near the bluff base will be severely damaged.

2.1.4 Extreme/Record: Catastrophic threat to property and extreme risk to life. Coastal communities will experience extreme flood damage and will be uninhabitable for some time after the flooding and/or significant wave event. Anyone remaining in the area during the event will risk their life. Generally, over 4 feet of inundation (depth of water above ground level) is expected along with large destructive waves that will batter the coastline for an extended period of time.

Typical impacts include:

- Catastrophic destruction to any property (structures/vehicles) in the warned area and extreme risk to life of persons in the warned area. Areas will be uninhabitable for an extended time period.
- *Dunes*: Catastrophic erosion of protective dunes; new inlets/breaches may be created in the warned area. Piers connected to dunes will be damaged or destroyed.
- *Revetments/Seawalls*: Hardened structures will experience significant damage. The protection provided by these structures will be compromised.
- *Bluffs*: Catastrophic erosion of the bluff will occur; structures and stairways will be destroyed due to collapsing bluffs.

NOTE: the use of Extreme/Record Flood impacts should be rarely used in National Weather Service (NWS) warnings and only when extreme inundation and waves are forecast.

3. Using Flood Categories and Impacts in NWS Products

In general, the definitions and impacts defined and described in Section 2 should be used in NWS products such as AHPS and Coastal Flood Warnings, in NWS Impact-based Decision Support Services (IDSS) briefing packages and talking points, and in NWS social media postings. This supplement allows for localization of impacts; some examples are:

- Shallow flooding that extends well inland from the coast (but not exclusive to basements).
- The consolidation of inundation and wave impacts to more effectively communicate the extent of damaging impacts expected by the water level and waves (high velocity). For example, the forecast inundation category may be *Moderate*, but based on wave run up and expected damage from waves the impacts of the event could be categorized in warnings as *Major* due to the enhanced threat to property and life.
- Snow and ice pack may also exacerbate flooding impacts increasing flood risk due to water retention and damage due to ice impacting structures.

These special situations should be addressed in local impact statements of the Coastal Flood Warning products, whenever deemed appropriate.

Appendix A – Examples of Impact Statements Representing Flood Categories

Appendix A provides examples of impact statements that are representative of the flood categories defined in section 2.

There are many ways to convey impact information in NWS products. Below are some examples that are appropriate for the different coastal flood categories. Other locally-determined impact statements may be appropriate for unique coastlines with wetlands, marinas, and/or protective structures, etc. Locally-developed impacts statements should generally stay within the appropriate flood categories utilizing the depth of inundation as indicated by the categorical definitions in section 2.

Examples for Minor Flooding:

- Flooding will be limited to the most vulnerable shore roads and/or basements. The majority of roads will remain passable with only isolated closures. There is minimal threat to life and any impact on property will be minimal.
- Shallow flooding is expected in the most vulnerable locations near the waterfront and shoreline resulting in a low threat of property damage.
- Expect one foot or less of inundation in low lying, vulnerable areas. Some roads and low lying property including parking lots, parks, lawns, and homes with basements near the waterfront will experience shallow flooding.

Examples for Moderate Flooding:

- Widespread flooding of vulnerable areas will result in an elevated threat of property damage to homes and businesses near the waterfront and shoreline. Water will be 1-2 feet deep (above ground level) in some areas and will result in the closing of numerous roads and threaten homes and businesses.
- Expect widespread inundation of roads and low lying property including parking lots, parks, lawns, and homes with basements near the waterfront. Flooding will extend inland from the waterfront along tidal rivers and bays resulting in some road closures and possible flooding of vehicles. Some dune erosion will occur.

- Widespread flooding of vulnerable shore roads and/or basements due to the height of the storm tide and/or wave action. Numerous road closures will be needed. Lives may be at risk for people who put themselves in harm's way. Isolated damage of very vulnerable structures such as docks or house decks/porches near the time of high tide line will be observed.

Examples for Major Flooding:

- Severe flooding will cause extensive inundation and flooding of numerous roads and buildings resulting in a significant threat to property and life. Water will be 2 to 4 feet deep (above ground level) in some areas. Water will extend inland from the waterfront and shoreline and cause flooding of homes and businesses and it will isolate some neighborhoods. In some areas, battering waves will cause additional damage. Numerous roads will be impassable under several feet of water and vehicles submerged. Some areas will need to be evacuated.
- Coastal flooding will be severe enough to cause at least scattered structural damage along with widespread flooding of vulnerable shore roads and/or basements. Some vulnerable homes or businesses are severely damaged or destroyed. In some areas, battering waves will play a significant role. Numerous roads will be impassable, some with washouts severe enough to be life threatening if one attempted to cross on foot or by vehicle. Some neighborhoods will become isolated. Evacuation of some neighborhoods will be necessary.

Examples for Extreme/Record Flooding:

- Coastal flood impacts will be life threatening due to extreme inundation and/or battering of waves. Flood water depth will be 4 feet or more (above ground level) in some areas. Numerous homes and businesses will be flooded and destroyed. Many roads across the area will become impassable for an extended period of time causing neighborhoods to become flooded and isolated.
- Life threatening flooding will extend well inland from the waterfront and shoreline where the terrain is relatively flat. Flooding will occur in many areas which have not been flooded before. Numerous evacuations will be necessary to protect lives. Damage will be catastrophic and flooded areas may become uninhabitable for an extended time period.

Appendix B - Example Shoreline / Wave Run up / Beach Erosion Impact Statements

There are many ways to convey impact information in NWS products. Below are some examples when there are coastal wave-related impacts in addition to the coastal flood threat. The categorical nature of these wave impacts is provided below.

For minor wave impacts:

Dunes/Bluffs:

- Waves are forecast to not reach dunes, but will cause some erosion of the beach and/or spotty/limited erosion at bluff base.

- Breaking waves will result in beach erosion with only minor damage possible to dune structures.
- Some beach sand will be pushed onto parking lots and structures in areas without dunes. Walkways to beach will not be damaged.

Revetments/Seawalls:

- There will be no damage to structurally sound revetments, bulkheads or seawalls.

For moderate wave impacts:

Dunes/Bluffs:

- Large breaking waves will result in significant beach erosion and considerable erosion of dune structures.
- Moderate to significant erosion to the beach will occur. There will be some damage to dune structures that will result in some flooding of roadways and vulnerable structures behind protective dunes.
- Sand and/or cobble debris may block some roads.
- Bluff bases are eroded and damage to stairways could occur.

Revetments/Seawalls:

- Small rocks will be embedded in overtopping water and can result in damage to passing vehicles or pedestrians. There is no damage to roadway or larger rocks armoring revetments.

For major wave impacts:

Dunes/Bluffs:

- Large dangerous waves will cause severe beach erosion and coastal damage threatening life and property. Waves will overtop and compromise dunes.
- Complete erosion of protective dune structures in some areas will result in severe damage of property near the waterfront. Some areas will become isolated by flood waters.
- Sandy bluff coastlines will have significant erosion.
- Dangerous waves will pose a significant serious threat to property and life.

Revetments/Seawalls:

- Inundation and/or small to medium sized rock debris will cause vulnerable shoreline roads to become impassable.
- Waves will overtop and compromise seawalls and/or revetments. Water will flood areas behind the protective structures. Action is needed to protect life and property.
- Large rocks armoring the revetment may be displaced and coastal roadways may be damaged.

For extreme wave impacts:

Dunes/Bluffs:

- Extreme dune damage is expected. Water will inundate areas behind dunes, damage property, and be a serious threat to life.

- Battering waves will severely damage and/or destroy structures along barrier beaches. Water will surge inland for many blocks beyond dune structures and sea walls causing widespread severe damage destroying some homes and businesses.
- Coastal roadways will be destroyed.
- Sandy bluff coastlines will have extreme erosion and structures near bluff top may be at risk due to bluff collapse.

Revetments/Seawalls:

- Residents will need to evacuate areas along the shore where seawalls will become compromised.