

## APPENDIX G FLOOD RESISTANT CONSTRUCTION

**G101.1 General:** All buildings and structures erected in areas prone to flooding and/or coastal dunes shall be constructed and elevated as required by the provisions of Appendix G

### **G201 Definitions**

**G201.1 Definitions:** The following words and terms shall, for the purposes of Appendix G, and as used elsewhere in this document, have the meanings shown herein:

**A-Zones:** A Zones are synonymous with Flood-Hazard Zones.

**Base Flood Elevation:** The flood having a 1% chance of being equaled or exceeded in any given year and shall be used to define areas prone to flooding, and describe at a minimum, the depth or peak elevation of flooding.

**Basement/cellar:** Any area of the building having its floor subgrade (Below ground level) on all sides.

**Breakaway Wall:** A wall that is not part of the structural support of the building and intended, through its design and construction, to collapse under specific lateral loading forces, without causing damage to the elevated portion of the building or supporting foundation system.

**Coastal Dune:** Any natural hill, mound or ridge of sediment landward of a coastal beach deposited by wind action or storm overwash. Coastal Dune also means sediment deposited by artificial means and serving the purpose of storm damage prevention or flood control.

**Coastal Wetland Resource Area:** Any coastal wetland resource area subject to protection under the Wetlands Protection Act, M.G.L.c. 131, § 40, and the Wetlands Protection Act Regulations, 310 CMR 10.21 through 10.35. Coastal Wetland Resource Areas include barrier beaches, coastal beaches, coastal dunes, rocky intertidal shores, tidal flats, land subject to 100 year coastal storm flowage, coastal banks, land containing shellfish, lands subject to tidal action, and lands under an estuary, salt pond or certain streams, ponds, rivers, lakes or creeks within the coastal zone that are anadromous/catadromous fish runs.

**Conservation Commission:** Body comprised of members lawfully appointed pursuant to M.G.L.c. 40, § 8C. It shall also mean a mayor or board of selectmen, where no conservation commission has been established pursuant to M.G.L.c. 40, § 8C.

**Design Flood Elevation.** See Base Flood Elevation.

**Determination of Applicability:** A written finding by the issuing authority under the Wetlands Protection Act, M.G.L.c. 131, § 40 as to whether a site or the work proposed therein is subject to jurisdiction under the Wetlands Protection Act.

**Elevation:** The placement of a structure above flood level to minimize or prevent flood damages or to preserve the flood control and storm damage prevention functions of a coastal dune.

**Failure of a foundation:** a foundation that is no longer supporting the building or foundation or is determined by the building official to be unsafe or incapable of continuing to support the building. For example, failure of a foundation occurs when a building or structure or portion thereof falls off the foundation or when the building official determines there is a risk that the building or structure may fall off the foundation.

**Flood Hazard Boundary Map:** Flood Hazard Boundary Map (FHBM) means an official map of a community, issued by the Administrator, where the boundaries of the flood, mudslide (i.e., mudflow) related erosion areas have been designated as Zones A, M, and/or E.

(The above definition has been added.)

**Flood- Hazard Zones:** Areas subject to a 1 percent or greater chance of flooding in any given year and that are not subject to wave heights in excess of three feet. (A ZONES).

**Floodproofing:** Any combination of structural and non-structural additions, changes or adjustments to structures which reduce or eliminate flood damage to new or substantially improved structures.

**F.E.M.A.:** Federal Emergency Management Agency.

**Flood Insurance Rate Map:** Flood insurance rate map (FIRM) means an official map of a community, which delineates both the special hazard zones and the risk premium zones applicable to the community.

**High-hazard Zones (V Zones):** Areas of tidal influence which have been determined to be subject to wave run heights in excess of three feet or subject to high-velocity wave run-up or wave-induced erosion (V Zones).

**Highest Adjacent Grade:** The highest natural elevation of the ground surface, prior to construction, adjoining the proposed foundation walls of a structure.

**Impact Loads:** Loads induced by the collision of solid objects on a structure carried by floodwater.

**Interests Identified in the Wetlands Protection Act, M.G.L.c. 131, § 40:** Public or private ground water supply, flood control, storm damage prevention, prevention of pollution, protection of land containing shellfish, protection of fisheries, and protection of wildlife habitat.

**Issuing Authority under the Wetlands Protection Act, M.G.L.c. 131, § 40:** a conservation commission, mayor, the selectmen or the Department of Environmental Protection.

**Lateral Addition:** an addition that expands the footprint of a building or structure including a manufactured home.

**Lowest Floor:** The lowest floor of the lowest enclosed area (including basement/cellar). An unfinished or flood resistant enclosure, usable solely for parking of vehicles, building access, or incidental storage in an area other than a basement/cellar with appropriate hydrostatic openings as required in AppendixG.501.4 is not considered a building's lowest floor.

**Manufactured Home:** A structure that is transportable in one or more sections, built on a permanent chassis, designed for use with or without a permanent foundation when attached to the required utilities, and constructed to the Federal Mobile Home Construction and Safety Standards and rules and regulations promulgated by the U.S. Department of Housing and Urban Development. The term also includes mobile homes, park trailers, travel trailers and similar transportable structures that are placed on a site for 180 days or longer. The term “manufactured home” does not include a “recreational vehicle”.

**Manufactured Housing:** Manufactured Housing is synonymous with Manufactured Home.

**Notification of Non-Significance:** A written finding by the issuing authority under the Wetlands Protection Act, M.G.L.c. 131, § 40, that the area on which the proposed work is to be done or which the proposed work will alter is not significant to any of the interests identified in the Wetlands Protection Act.

**Order of Conditions:** Written requirements by the issuing authority under the Wetlands Protection Act, M.G.L.c. 131, §40 establishing the manner in which work shall be done for work proposed within areas subject to jurisdiction under the Wetlands Protection Act.

**Order of Resource Area Delineation:** Written findings by the issuing authority under the Wetlands Protection Act, M.G.L.c. 131 § 40 identifying the boundaries of the area(s) subject to jurisdiction under the Wetlands Protection Act.

**Recreational Vehicle:** A vehicle that is built on a single chassis 400 square feet or less when measured at the largest horizontal projection, designed to be self-propelled or permanently towable by a light duty truck, and designed primarily not for use as a permanent dwelling, but as temporary living quarters for recreational, camping, travel or seasonal use. A recreational vehicle is ready for highway use, if it is on wheels or a jacking system, is attached to the site only by quick disconnect type utilities and security devices, and has no permanently attached additions.

**Scouring:** The erosion or washing away of slopes or soil by velocity waters.

**Special Hazard Zones:** An area having special flood, and/or flood-related erosion hazards and shown on Flood Hazard Boundary Map or FIRM as Zone A, AO, A1-30, AE, A99, AH, VO, V1-30, VE, V.

**Start of Construction:** The date the building permit was issued, provided the actual start of construction, repair, reconstruction, placement, or other improvement was within 180 days of the permit date. The actual start means the first placement of permanent construction of a structure on a site, such as the pouring of slab or footings, the installation of piles, the construction of columns, or any work beyond the stage of excavation or the placement of a manufactured home on a foundation.

**Structure (this definition is intended utilized with this Appendix):** A walled and roofed building, including a gas or liquid storage tank, that is principally above ground and affixed to a permanent site, as well as a manufactured home.

**Substantial Damage:** Damage of any origin sustained by a building or structure including a manufactured home whereby the cost of restoring the building or structure to its before damaged condition would equal or exceed 50 percent of the market value of the building or structure before the damage occurred.

**Substantial Improvements:** Substantial improvement means any reconstruction, rehabilitation, addition, repair or improvement of a structure, the cost of which equals or exceeds 50% of the market value of the structure before the "start of construction" of the improvement. This term includes structures which have incurred "Substantial damage", regardless of the actual repair work performed. Substantial improvement does not, however, include either:

1. any project for improvement of a structure to correct existing violations of state or local health, sanitary, or safety codes which have been identified by the local code enforcement official and which are the minimum necessary to assure safe living conditions or
2. any alteration of a "Historic structure", provided that the alteration will not preclude the structure's continued designation as a "historic structure."

Note 1: The following items can be excluded from the cost of improvement or repair: plans, specifications, survey, permits, and other items which are separate from or incidental to the repair of the damaged or improved building. i.e. debris removal/cartage.

Note 2: The latest Assessors' structure value may be used, provided that the Assessors certify that said value is based on 100% valuation, less depreciation.

**Substantial Repair of a Foundation:** Work to repair and/or replace a foundation that results in the repair or replacement of the portion of the foundation walls with a perimeter along the base of the foundation that equals or exceeds 50% of the perimeter of the base of the entire foundation measured in linear feet. The term "substantial repair of a foundation" also includes

a building or structure including a manufactured home that has incurred a failure of a foundation regardless of the actual work done to repair or replace the foundation.

**V Zones:** V Zones are synonymous with High-Hazard Zones.

**Variance:** A grant of relief by a community and the Commonwealth, via the Boards of Appeal, from the terms of the Floodplain Management Regulations.

**Venting** A system designed to allow flood waters to enter an enclosure, usually the interior of foundations walls, so that the rising water does not create a dangerous differential in hydrostatic pressure; usually achieved through openings in the walls. Vents may be installed in garage doors to satisfy this requirement, provided such vents are installed consistent with Appendix G The necessity of human intervention, such as opening garage doors, does not satisfy this requirement.

### **G301 Base Flood Elevation**

**G301.1 Base flood elevation-detail:** The base flood elevation shall be used to define areas prone to flooding, and shall describe, at a minimum, the depth or peak elevation of flooding (including wave height) which has a 1% (100-year flood) or greater chance of occurring in any given year

The 100-year flood elevation shall be determined as follows:

1. In A1-30, AH, AE, V1-30 and VE, the Base Flood Elevation is provided on the community's Flood Insurance Study and the Flood Insurance Rate Map (FIRM).

2. In AO zones, add the depth provided on the Flood Insurance Rate Map to the highest adjacent grade. If no depth is provided, add at least two feet to the highest adjacent grade.

3. In A, A99 and V zones, **where no base flood elevation is provided**, the building official, design professional, or surveyor shall either

**a) obtain, review and reasonably utilize any Base Flood Elevation Data available from a federal, state or other reliable sources, or**

**b) determine the base flood elevation and/or floodway in accordance with accepted hydrologic and hydraulic engineering practices used to define special flood hazard areas.**

**Determinations shall be undertaken by a registered design professional who shall document that the technical methods used reflect currently accepted engineering practice.**

### **G401 Hazard Zones**

**G401.1 Hazard zones-detail:** Areas which have been determined to have a 1 percent or greater chance of flooding in any given year shall be classified as either flood-hazard zones (A Zones) or high-hazard zones (V Zones) in accordance with Appendix G501 and G601.

### **G501 Flood Hazard Zones**

**G501.1 Construction in flood-hazard zones (A Zones):** All areas which have a 1 percent or greater chance of flooding in any given year but are not subject to wave heights in excess of three feet shall be designated as flood-hazard zones. Flood-hazard zones shall include all areas shown as A Zones on the most recent Flood Hazard Boundary Map or FIRM. All buildings and structures as defined in Appendix G201 including new or replacement manufactured homes erected or substantially improved in flood-hazard zones shall be designed and constructed in accordance with Appendix G501.

Plans for the construction or substantial improvement of a building or structure, including a new or replacement manufactured home, in a flood-hazard zone shall be prepared by a qualified

registered professional engineer or architect to ensure the compliance with Appendix G501 inclusive.

Exception: If a substantial improvement consists exclusively of a lateral addition that does not rely on the support of the existing structure, only the lateral addition must be erected in accordance with the applicable provisions of Appendix G501. In that event, the existing structure is not required to come into compliance with Appendix G501.

Note: If located in a coastal dune that is significant to flood control and/or storm damage prevention, a building or structure, including a new or replacement manufactured home, in a flood-hazard zone shall be designed and constructed in accordance with the applicable provisions of Appendix G701, and G801 as well as Appendix G501.

**G501.2 Elevation in a flood-hazard zone:** Except as otherwise provided in G501, all buildings or structures, including new or replacement manufactured homes, erected or substantially improved within a flood-hazard zone shall be elevated so that the lowest floor is located at or above the base flood elevation. All basement/ cellar floor surfaces shall be located at or above the base flood elevations.

**Exceptions:**

1. Floors of occupancy in any use group, other than use group R, below the base flood elevation shall conform to Appendix G501.5.2. Floors of occupancies in any use group, **in an area other than a basement/cellar**, which are utilized solely for structure means of egress, incidental storage garages and parking, and which are located below the base flood elevation, shall conform to Appendix G501.4.

**G501.3 Anchorage in a flood-hazard zone:** The structural systems of all buildings or structures, including new or replacement manufactured homes, shall be designed, connected and anchored to resist flotation, collapse or permanent lateral movement due to structural loads and stresses from flooding equal to the base flood elevation and shall be designed in accordance with **ASCE 7 and ASCE 24**.

**G501.4 Enclosures below base flood elevation in a flood-hazard zone:** Enclosed spaces below the base flood elevation are only permitted **in an area other than a basement/cellar (basements/cellars are not permitted to be constructed below base flood elevation)**. Said spaces shall not be used for human occupancy with the exception of structural means of egress, entrance foyers, stairways and incidental storage. Fully enclosed spaces shall be designed to equalize automatically hydrostatic forces on exterior walls by allowing for the entry and exit of floodwaters. Designs for meeting this requirement shall either be certified by a registered design professional in accordance with Appendix G501.11 through G501.13 or conform to the following minimum criterion: a minimum of two openings having a total net area of not less than one square inch ( $645 \text{ mm}^2$ ) for every one square foot ( $0.1 \text{ m}^2$ ) of enclosed area subject to flooding shall be provided. The bottom of all openings shall not be higher than 12 inches (305 mm) above grade immediately adjacent to the location of the opening. Openings shall not be equipped with screens, louvers, valves or other coverings or devices unless such devices permit the automatic entry and discharge of floodwaters.

**G501.5 Water-resistant construction in a flood-hazard zone:** Occupancies in any use group other than Use Group R may, in lieu of meeting the elevation provisions of Appendix G501.2

be erected with floors usable for human occupancy below the base flood elevation provided that the following conditions are met:

1. All space below the base flood elevation **plus one foot** shall be constructed with walls and floors that are substantially impermeable to the passage of water.
2. All structural components subject to hydrostatic and hydrodynamic loads and stresses during the occurrence of flooding to the base flood elevation shall be capable of resisting such forces, including the effects of buoyancy.
3. All openings below the base flood elevation **plus one foot** shall be provided with water-tight closures and shall have adequate structural capacity to support all flood loads acting upon the closure surfaces.
4. All floor and wall penetrations for plumbing, mechanical and electrical systems shall be made water tight to prevent floodwater seepage through spaces between the penetration and wall construction materials. Sanitary sewer and storm drainage systems that have openings below the base flood elevation **plus one foot** shall be provided with shutoff valves or closure devices to prevent backwater flow during conditions of flooding.

**G501.6 Repair or replacement of existing foundations in a flood-hazard zone:** Existing foundations in a flood-hazard zone may be repaired without further compliance with Appendix G501, unless the work replaces the foundation in total, replaces the foundation so as to constitute new construction or constitutes a substantial repair of a foundation as defined in Appendix G201. In such events, the foundation shall be brought into compliance with the applicable provisions of Appendix G501.

See Note Appendix G501.1.

**G501.7 Protection of mechanical and electrical systems in a flood-hazard zone:** New and replacement electrical, heating, ventilating, air conditioning and other service equipment in a flood-hazard zone shall either be placed above the base flood elevation or protected so as to prevent water from entering or accumulating within the system components during floods up to the base flood elevation in accordance with the mechanical code listed in **780 CMR 100**. Installation of electrical wiring and outlets, switches, junction boxes and panels below the base flood elevation shall conform to the provisions of **527 CMR 12.00 listed in 780 CMR 100** for location of such items in wet locations. Duct insulation subject to water damage shall not be installed below the base flood elevation.

**G501.8 Construction materials, methods, and practices in a flood-hazard zone:** All buildings or structures, including new or replacement manufactured homes, erected in a flood-hazard zone shall be constructed with materials resistant to flood damage and be constructed by methods and practices that minimize flood damage. Construction materials shall be resistant to water damage in accordance with the provisions of **ASCE 24, Chapter 5**.

**G501.9 Recreational vehicles in a flood-hazard zone:** All recreational vehicles placed in a flood-hazard zone and that are not fully licensed and ready for highway use or that are to be placed on a site for more than 180 consecutive days shall comply with the provisions of Appendix G501 applicable to buildings or structures, including new or replacement manufactured homes.

**G501.10 Alterations, renovation and repairs in a flood-hazard zone:** Alterations, renovations and repairs to existing buildings and structures including new or replacement manufactured homes located in a flood-hazard zone shall comply with applicable provisions of 780 CMR. Compliance with Appendix G501 is required whenever such alteration, renovation or repair constitutes a substantial repair of a foundation as defined in Appendix G201, repair or replacement of a foundation that requires compliance with Appendix G501, or a substantial improvement as defined in Appendix G201.

**G501.11 Certifications and Plans for construction in a flood-hazard zone:** Certifications and plans shall be submitted in accordance with Appendix G501.12 and G501.13 for a substantial repair of a foundation as defined in Appendix G201, repair or replacement of a foundation that requires compliance with Appendix G501, a substantial improvement as defined in Appendix G201, or a building or structure as defined in Appendix G201, including a new or replacement manufactured home.

**G501.12 As-built elevation certification for construction in a flood-hazard zone:** For all substantial repairs of a foundation as defined in Appendix G201, all repairs or replacement of a foundation that trigger the requirement to comply with Appendix G501, all substantial improvements as defined in Appendix G201, and all buildings or structures including new and replacement manufactured homes, a licensed land surveyor or registered design professional shall provide the following certifications:

**1. The elevation of the lowest floor, including the basement, as required by the lowest floor elevation inspection in Section 110.3.3.**

**2. For fully enclosed areas below the base flood elevation where provisions to allow for the automatic entry and exit of floodwaters do not meet the minimum requirements in Section 2.6.2.1 of ASCE 24, *construction documents* shall include a statement that the design will provide for equalization of hydrostatic flood forces in accordance with Section 2.6.2.2 of ASCE 24.**

**3. The certification required herein shall be submitted to the building official after the construction of the foundation is complete and before the commencement of any other work on the building or structure or, if there is no other work, the occupancy of the building or structure.**

**G501.13 Documentation -Water resistant construction in a flood-hazard zone:** Where buildings or structures including new or replacement manufactured homes are to be constructed in accordance with Appendix G501.5, the building official shall require that a registered design professional provide construction documents showing proposed details of floor, wall, foundation support components, loading computations, and other essential technical data used in meeting the conditions of Appendix G501.5. The construction documents shall be accompanied by a statement bearing the signature of the registered design professional indicating that the design and proposed methods of construction are in accordance with applicable provisions of Appendix G501.5 **and ASCE 24.**

## **G601 High Hazard Zones**

**G601.1 Construction in high-hazard zones (V Zones):** Areas of tidal influence which have been determined to be subject to wave heights in excess of three feet (914 mm) or subject to high-velocity wave run-up or wave-induced erosion shall be classified as high-hazard zones. High-hazard zones shall include all areas shown as V Zones on the most recent Flood Hazard Boundary Map or FIRM. All buildings or structures as defined in Appendix G201, including new or replacement manufactured homes, erected or substantially improved in a high-hazard zone shall be designed and constructed in accordance with Appendix G601. All lateral additions of a building or structure in a high-hazard zone shall also be designed and constructed in accordance with Appendix G601 whether or not the lateral addition constitutes a substantial improvement. Plans for a building, structure, substantial improvement, or lateral addition in a high-hazard zone shall be prepared by a registered professional engineer or architect to ensure compliance with Appendix G601.

Note: If located in a coastal dune significant to flood control and/or storm damage prevention and a high-hazard zone, a building, structure, including a new or replacement manufactured home, a lateral addition, and a substantial improvement of a building or structure that has suffered substantial damage as a result of flooding or storms shall be designed and constructed in accordance with Appendix G701 and G801 as well as G601.

**G601.1.2 High-hazard zone construction documents requirements:** Where buildings or structures are to be constructed in accordance with Appendix G601, the building official shall require that a registered design professional provide construction documents showing proposed details of foundation support and connection components which are used in meeting the requirements of Appendix G601.4. Where solid walls or partitions are proposed that are less than two feet above the base flood elevations, wall, framing and connection details of such walls shall be provided, including loading computations for the wall and foundation system used in meeting the conditions of Appendix G601.3. The construction documents shall be accompanied by a statement bearing the signature of the registered design professional indicating that the design and proposed methods of construction are in accordance with all applicable provisions of Appendix G601.

**G601.2 Elevation in a high-hazard zone:** All buildings or structures including new and replacement manufactured homes erected or substantially improved within a high-hazard zone shall be elevated so that the bottom of the lowest horizontal structural member supporting the lowest floor, with the exception of mat or raft foundations, piling, pile caps, columns, grade beams and bracing, is located at an elevation that is at least two feet above the base flood elevation. All lateral additions erected in a high-hazard zone shall also be elevated so that the lowest portion of all structural members supporting the lowest floor of the lateral addition with the exception of mat or raft foundations, pilings, pile caps, columns, grade beams and bracing shall also be located at an elevation that is at least two feet above the base flood elevation.

**G601.3 Enclosures below base flood elevation in a high-hazard zone:** All spaces that are less than two feet above the base flood elevation in a high-hazard zone shall not be used for human occupancy and shall be free of obstruction except as permitted herein:

1. Mat or raft foundations, piling, pile caps, bracing, grade beams and columns which provide structural support for the building.



2. Entrances and exits which are necessary for required ingress and means of egress.
3. Incidental storage of portable or mobile items readily moved in the event of a storm.
4. Walls and partitions are permitted to enclose all or part of the space below the elevated floor provided that such walls and partitions are not part of the structural support of the building and are constructed with insect screening, open wood lattice, or nonsupporting walls designed to break away or collapse without causing collapse, displacement or other structural damage to the elevated portion of the building or supporting foundation system due to the effect of wind loads as specified in Appendix 1611.0 and water loads as specified in Appendix 1615.0 acting simultaneously. Any such nonsupporting solid wall shall be certified as specified in Appendix G601.10 and G601.11.

**G601.4 Foundations in a high-hazard zone:** All buildings or structures, including new and replacement manufactured homes, erected or substantially improved in high-hazard zones shall be supported on pilings or columns and shall be adequately anchored to such pilings or columns. All lateral additions in high-hazard zones shall also be supported on pilings or columns and shall be adequately anchored to such pilings or columns. The piling shall have adequate soil penetrations to resist the combined wave and wind loads (lateral and uplift) to which such piles are likely to be subjected during a flood to the base flood elevation. Pile embedment shall include consideration of decreased resistance capacity caused by scour of soil strata surrounding the piling. Pile system design and installation shall also be made in accordance with the provisions of **780 CMR 1808, 1809, 1810, ASCE 7 and ASCE 24**. Mat or raft foundations which support columns shall not be permitted where soil investigations required in accordance with **780 CMR 1803** indicate that soil material under the mat or raft is subject to scour or erosion from wave-velocity flow conditions.

**G601.5 Repair or Replacement of Existing Foundations in a high-hazard zone.** Existing foundations may be repaired in a high-hazard zone without further compliance with Appendix G unless the work replaces the foundation in total, replaces the foundation so as to constitute new construction, or constitutes a substantial repair of a foundation as defined in Appendix G201. In such events, the foundation shall be brought into compliance with the applicable provisions of Appendix G601.

Note: If located in a coastal dune significant to flood control and/or storm damage prevention and a high-hazard zone, a building, structure, including a new or replacement manufactured home, a lateral addition, and a substantial improvement of a building or structure that has suffered substantial damage as a result of flooding or storms shall be designed and constructed in accordance with Appendix G701 and G801 as well as G601.

**G601.6. Protection of mechanical and electrical systems in a high-hazard zone.** New and replacement electrical equipment and heating, ventilating, air conditioning and other service equipment in a high-hazard zone shall be either placed at least two feet above the base flood elevation or protected so as to prevent water from entering or accumulating within the system components during floods in accordance with the mechanical code listed in **780 CMR 100**. Installation of electrical wiring and outlets, switches, junction boxes and panels that are less than two feet above the base flood elevation shall conform to the provisions of **527 CMR 12.00** listed

in **780 CMR 100** for location of such items in wet locations. Duct insulation subject to water damage shall be installed at least two feet above the base flood elevation.

**G601.7. Construction materials, methods and practices in a high-hazard zone:** All buildings or structures including new or replacement manufactured homes erected in high-hazard zones (V Zones) shall be constructed with materials resistant to flood damage and be constructed by methods and practices that minimize flood damage. Construction materials shall be resistant to water damage in accordance with the provisions of **780 CMR 1808, 1809, 1810, ASCE 7 and ASCE 24.**

**G601.8 Recreational vehicles in a high-hazard zone:** Recreational vehicles placed in a high-hazard zone and that are not fully licensed and ready for highway use or that are to be placed on a site for more than 180 consecutive days shall comply with the provisions of Appendix G601 applicable to buildings or structures including new or replacement manufactured homes.

**G601.9 Alterations, renovations and repairs in a high-hazard zone.** Alterations, renovations and repairs to existing buildings, including manufactured homes, located in a high-hazard zone shall comply with all applicable provisions of 780 CMR. Compliance with Appendix G is required whenever such alteration, renovation or repair constitutes substantial repair of a foundation as defined in Appendix G201, the repair or replacement of a foundation that requires compliance with Appendix G601, as set forth in Appendix G601.5, a substantial improvement as defined in Appendix G201, or a lateral addition as defined in Appendix G201.

**G601.10 Certifications and Plans for construction in a high-hazard zone:** Certifications and plans shall be submitted in accordance with Appendix G601.10 and G601.11 for a substantial repair of a foundation as defined in Appendix G201, a repair or replacement of a foundation that requires compliance with Appendix G601, a substantial improvement as defined in Appendix G201, a lateral addition as defined in Appendix G201, or a building, or structure, including a new and replacement manufactured home.

**G601.11 As-built elevation certifications for construction in a high-hazard zone:** For all substantial repairs of a foundation as defined Appendix G201, all repairs or replacements of a foundation that trigger the requirement to comply with Appendix G601, all substantial improvements as defined in Appendix G201, all lateral additions as defined in Appendix G201, and all buildings and structures, including new and replacement manufactured homes, a licensed land surveyor or registered design professional shall provide the following certifications:

**1. The elevation of the bottom of the lowest horizontal structural member as required by the lowest floor elevation inspection in Section 110.3.3.**

**2. Construction documents shall include a statement that the building is designed in accordance with ASCE 24, including that the pile or column foundation and building or structure to be attached thereto is designed to be anchored to resist flotation, collapse and lateral movement due to the effects of wind and flood loads acting simultaneously on all building components, and other load requirements of Chapter 16.**

**3. For breakaway walls designed to resist a nominal load of less than 10 psf (0.48 kN/m<sup>2</sup>) or more than 20 psf (0.96 kN/m<sup>2</sup>), construction documents shall include a statement that the breakaway wall is designed in accordance with ASCE 24.**

**4. The certification required herein shall be submitted to the building official after the construction of the foundation is complete and before the commencement of any other work on the building or structure or, if there is no other work, the occupancy of the building or structure.**

### **G701 Coastal Dunes**

**G701.1 Determination of Coastal Dunes.** To reduce flood damage, ensure the structural integrity of buildings or structures including manufactured homes, located in coastal dunes, to protect the public safety and to eliminate certain conflicts between the coastal dune performance standards set forth in the Wetlands Protection Act Regulations, 310 CMR 10.28, and this Code, Appendix G701 and G801 establish requirements for design and construction in coastal dunes significant to the interests of flood control and/or storm damage prevention identified in the Wetlands Protection Act Regulations, 310 CMR 10.28.

To determine whether a proposed building or structure, including a manufactured home, a lateral addition, work on a foundation that under Appendix G801.6 requires compliance with Appendix G801, or substantial improvement to a building or structure that has incurred substantial damage as a result of flooding and/or storms is located within an area that is a coastal dune significant to the interests of flood control and/or storm damage prevention, the building official shall require the submission of certain construction document in accordance with Appendix G701.1.

**G701.1.1 Submission of construction documents for proposed work in a coastal wetland resource area including the construction of a building or structures including a manufactured home, a lateral addition, certain work to repair or replace a foundation and certain substantial improvements.** For all buildings or structures, including new or replacement manufactured homes, all lateral additions, all work on a foundation that under Appendix G801.6 requires compliance with G801, and all substantial improvements of a building or structure that has incurred substantial damage as a result of flooding and/or storms proposed on a parcel of land that is located wholly or partially within a coastal wetland resource area shown on the map entitled “Map of Coastal Wetland Resources For Building Officials”, the building official shall require submission of one of the construction documents specified in Appendix G701.1.1(a) through (d) along with a notarized statement by the applicant that the Order, Determination or Notice is in effect and is not the subject of any administrative appeals before the Department of Environmental Protection or the Division of Administrative Law Appeals. No building permit shall issue unless and until a construction document that conforms to the requirements of Appendix G701.1 including G701.1(a) through (d) below is submitted.

- (a) An Order of Conditions establishing the boundaries of all coastal wetland resource areas in a plan referenced in and accompanying the Order. The Order together with the plan referenced therein shall identify the boundaries of all coastal wetland resource areas including coastal dunes and determine whether the coastal wetland resource areas are significant to any of the interests identified in the Wetlands Protection Act, M.G.L.c. 131, § 40 including the interests of flood control and storm damage prevention. If the Order of Condition and the plan referenced therein indicate that the proposed construction work is located within a coastal dune that is significant to the interests of flood control and/or storm damage prevention, the Order of Conditions must allow the proposed construction.

- (b) An Order of Resource Area Delineation stating that the proposed construction work is outside the boundaries of all coastal wetland resource areas as shown on a plan referenced in and accompanying the Order.
- (c) A Determination of Applicability stating that the proposed construction work is outside the boundaries of all coastal wetland resource areas as shown on a plan referenced in and accompanying the Determination or will not fill, dredge or alter a coastal wetland resource area.
- (d) A Notice of Non-significance evidencing that the proposed construction work is within a coastal wetland resource area as shown on a plan referenced in and accompanying the Notice and stating that the coastal wetland resource area is not significant to any of the interests identified in the Wetlands Protection Act, M.G.L.c. 131, § 40.

### **G801 Construction in Coastal Dunes**

**G801.1 Requirements for design and construction in coastal dunes:** All buildings and structures including manufactured homes, all lateral additions, all substantial improvements to a building or structure that has incurred substantial damage as a result of flooding and/or storms, and all work on a foundation that under Appendix G801.6 requires compliance with Appendix G801, that are proposed within an area that is a coastal dune significant to the interests of storm damage prevention and/or flood control shall comply with the provisions of Appendix G801, including G801.1 through G801.11. The determination of whether such construction work is proposed to be located within an area that is a coastal dune significant to the interests of storm damage prevention and/or flood control shall be based solely on the construction documents submitted to the building official in accordance with Appendix G701 including G701.1.1(a) through (d). If the proposed construction work is also located in a flood-hazard zone or a high-hazard zone, the construction work shall also comply with applicable provisions of Appendix G501 or G601, as applicable.

Note 1: A lateral addition proposed to be constructed within a coastal dune that is significant to the interests of flood control and/or storm damage prevention shall be constructed in accordance with Appendix G801.1 through G801.11 whether or not the lateral addition is a substantial improvement as defined in Appendix G201.

Note 2: A substantial improvement to a building or structure including a manufactured home, that is located in a coastal dune that is significant to the interests of flood control and/or storm damage prevention and that has not incurred substantial damage as a result of flooding or storms does not trigger the requirement that the existing building or structure be brought into compliance with Appendix G801.1 through G801.11.

Note 3: If located in a flood hazard-zone or a high hazard zone, a substantial improvement to a building or structure, including a manufactured home, in a coastal dune that is significant to flood control and/or storm damage prevention must comply with all applicable provisions of Appendix G501 or G601.

**G801.2 Plans for Construction in a Coastal dune.** All plans for the construction of a building or structure including a new or replacement manufactured home and all plans for a lateral addition as defined in Appendix G201, a substantial improvement of a building or structure that has incurred substantial damage as a result of flooding and/or storms, work on a foundation that under Appendix G801.6 requires compliance with Appendix G as applicable, proposed within an area that is a coastal dune significant to the interests of flood control and/or storm damage

prevention shall be prepared by a registered professional engineer or architect to ensure compliance with G801.3 through G.8.11.

**G801.3 Foundation types in a coastal dune:** All buildings, structures, or lateral additions, and substantial improvements to a building or structure that has incurred substantial damage as a result of storms and/or flooding that are located in a coastal dune significant to the interests of flood control and/or storm damage prevention shall be supported on open pilings without footings to allow the lateral movement of the dune and shall be adequately anchored to such pilings. The pilings shall have adequate soil penetration to resist the combined wave and wind loads (lateral and uplift) to which such piles are likely to be subjected during storm events. Pile embedment shall include consideration of decreased resistance capacity caused by scour of soil strata surrounding the piling. Pile system design and construction shall be made in accordance with the provisions of **780 CMR 1808, 1809, 1810, ASCE 7 and ASCE 24.**

Exception: Where surface or subsurface conditions consist of nonerodible soil that prevents the use of pile foundations, spread footing or mat foundations may be permitted provided they are anchored to prevent sliding, uplift or overturning to nonerodible soil with sufficient strength to withstand forces from the combinations of load.

Note: An Order of Conditions is required for the construction of a new foundation in a coastal dune that is significant to the interests of flood control or storm damage prevention. An Order of Conditions is also required for work on a foundation that under Appendix G8.6 requires compliance with Appendix G801. To allow the lateral movement of the dune, the Order of Conditions may impose additional requirements or restrictions on the use of certain foundation types based on site-specific factors. All foundations in such a coastal dune must also be designed and constructed in accordance with the Order of Conditions.

**G801.4 Elevation in a coastal dune:** Within a coastal dune that is significant to the interests of flood control and/or storm damage prevention, all buildings or structures including new and replacement manufactured homes, all lateral additions as defined in Appendix G201, and all substantial improvements of a building or structure that has incurred substantial damage as a result of flooding or storms shall be erected so that the bottom of the lowest horizontal structural member of the lowest floor with the exception of pilings or pile caps is located at the elevation required by the Order of Conditions.

Note: Orders of Conditions issued by a Conservation Commission may be appealed to the Massachusetts Department of Environmental Protection and the Division of Administrative Law Appeals by following the procedures set forth in 310 CMR 10.05(7).

**G801.5 Recreational vehicles in a coastal dune:** Recreational vehicles placed in a coastal dune that is significant to the interests of flood control and/or storm damage prevention and that either are not fully licensed and ready for highway use or placed on the coastal dune for more than 180 consecutive days shall be designed and constructed in accordance with the requirements of Appendix G801.1 through 801.11 applicable to buildings or structures including new or replacement manufactured homes.

**G801.6 Repair or replacement of existing foundations in a coastal dune:** Except as otherwise provided herein, existing foundations in a coastal dune significant to the interests of flood control and/or storm damage prevention may be repaired without further compliance with Appendix G, as applicable. Existing foundation systems in a coastal dune significant to the interests of flood control and/or storm damage prevention, which are replaced in total, which are replaced so as to constitute new construction, or any substantial repair of a foundation as defined in Appendix

G201 shall trigger the requirement that the foundation be brought into compliance with the applicable provisions of Appendix G801 including Appendix G801.3 and G801.4.

**G801.7 Substantial improvement of a building or structure, including a manufactured home, that is located in a coastal dune and has suffered substantial damage.** All substantial improvements to a building or structure including a manufactured home that is located in a coastal dune that is significant to flood control and/or storm damage prevention, and that has incurred substantial damage as a result of flooding or storms shall be subject to the requirements in Appendix G701 and Appendix G801 applicable to buildings or structures including without limitation the elevation and foundation type requirements of Appendix G801.3 and G801.4.

**G801.8 Protection of mechanical and electrical equipment in a coastal dune:** New and replacement electrical equipment, heating, ventilating, air conditioning and other service equipment in a coastal dune that is significant to the interests of flood control and/or storm damage prevention shall be placed at the elevation required by the Order of Conditions.

**G801.9 Certifications and plans for construction in a coastal dune:** Certifications and plans in accordance with Appendix G801.10 and G801.11 shall be submitted for the following construction work in a coastal dune significant to the interests of flood control and/or storm damage prevention: all work on a foundation that under Appendix G801.6 requires compliance with Appendix G801, all lateral additions as defined in Appendix G201, all buildings or structures, including new and replacement manufactured homes, and all substantial improvements of a building or structure that has incurred substantial damage as a result of flooding and/or storms.

**G801.10 As-built elevation certification for construction in a coastal dune:** After the construction of the foundation is complete and before the commencement of any other work on the building or structure including a new or replacement manufactured home, or if there is no other work, the occupancy of the structure, a licensed land surveyor or registered design professional shall submit certification to the building official that the actual elevation of the lowest horizontal structural member in relation to the elevation of the dune prior to the start of construction meets or exceeds the requirements of Appendix G801.4.

**G801.11 Coastal dune construction documents:** The building official shall require that the registered design professional provide construction documents showing details of foundation support and components, loading computations and other essential data demonstrating compliance with the requirements of Appendix G801 including G801.3 and G801.4 for the following construction work in a coastal dune significant to the interests of flood control and/or storm damage prevention: all work on a foundation that under Appendix G801.6 requires compliance with Appendix G801, all lateral additions as defined in Appendix G201, all buildings or structures as defined in Appendix G201, including new and replacement manufactured homes, and all substantial improvements of a building or structure that has incurred substantial damage as a result of flooding or storms. The construction documents shall be accompanied by a statement bearing the signature of the registered design professional indicating that the design and proposed methods of construction are in accordance with applicable provisions of Appendix G801 including G801.3 through G801.8

## **G901 SITE IMPROVEMENT**

### **G901.1 High Hazard Zones.** In *high hazard zones*:

1. New buildings and buildings that are substantially improved shall only be authorized landward of the reach of mean high tide.
2. The use of fill for structural support of buildings is prohibited.

**G901.2 Sewer facilities.** In addition to complying with the applicable provisions of 310 CMR 15.000, 314 CMR 3.00, 314 CMR 5.00, 314 CMR and 314 CMR 21.00, all new or replaced sanitary sewer facilities, private sewage treatment plants (including all pumping stations and collector systems) and on-site waste disposal systems shall be designed in accordance with Chapter 7 and ASCE 24 to minimize or eliminate infiltration of floodwaters into the facilities and discharge from the facilities into floodwaters, or impairment of the facilities and systems.

**G901.3 Water facilities.** In addition to complying with all applicable provisions of 310 CMR 22.00 and the Department of Environmental Protection's Guidelines for Public Water Systems, all new or replacement water facilities shall be designed in accordance with all applicable provisions of Chapter 7 and ASCE 24 to minimize or eliminate infiltration of floodwaters into the systems.

## **G1001 TANKS**

**G1001.1 Underground tanks.** In addition to complying with all applicable provisions of 527 CMR 9.00, underground tanks in *flood hazard zones and high hazard zones* shall be anchored to prevent flotation, collapse or lateral movement resulting from hydrostatic loads, including the effects of buoyancy, during conditions of the base *flood*.

**G1001.2 Above-ground tanks.** In addition to complying with all applicable provisions of 527 CMR 9.00, above-ground tanks in flood hazard zones and high hazard zones shall be elevated to or above the base *flood* elevation or shall be anchored or otherwise designed and constructed to prevent flotation, collapse or lateral movement resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy, during conditions of the base *flood*.

**G1001.3 Tank inlets and vents.** In *flood hazard zones and high hazard zones*, tank inlets, fill openings, outlets and vents shall be:

1. At or above the base flood elevation or fitted with covers designed to prevent the inflow of floodwater or outflow of the contents of the tanks during conditions of the base *flood*.
2. Anchored to prevent lateral movement resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy, during conditions of the base *flood*.

## **G1101 OTHER BUILDING WORK**

**G1101.1 Detached accessory structures.** Detached accessory structures shall be anchored to prevent flotation, collapse or lateral movement resulting from hydrostatic loads, including the effects of buoyancy, during conditions of the base *flood*. Fully enclosed accessory structures shall have flood openings to allow for the automatic entry and exit of *flood* waters.

## **G1201 TEMPORARY STRUCTURES AND TEMPORARY STORAGE**

**G1201.1 Temporary structures.** Temporary structures shall be erected for a period of less than 180 days. Temporary structures shall be anchored to prevent flotation, collapse or lateral movement resulting from hydrostatic loads, including the effects of buoyancy, during conditions of the base *flood*. Fully enclosed temporary structures shall have flood openings to allow for the automatic entry and exit of floodwaters.

**G1201.2 Temporary storage.** Temporary storage includes storage of goods and materials for a period of less than 180 days. Stored materials shall not include hazardous materials.

## **G1301 UTILITY AND MISCELLANEOUS GROUP U**

**G1301.1 Utility and miscellaneous Group U.** Utility and miscellaneous Group U includes buildings that are accessory in character and miscellaneous structures not classified in any specific occupancy in the *International Building Code*, including, but not limited to, agricultural buildings, aircraft hangars (accessory to a one- or two-family residence), barns, carports, fences more than 6 feet (1829 mm) high, grain silos (accessory to a residential occupancy), greenhouses, livestock shelters, private garages, retaining walls, sheds, stables and towers.

**G1301.2 Flood loads.** Utility and miscellaneous Group U buildings and structures, including substantial improvement of such buildings and structures, shall be anchored to prevent flotation, collapse or lateral movement resulting from flood loads, including the effects of buoyancy, during conditions of the base *flood*.

**G1301.3 Elevation.** Utility and miscellaneous Group U buildings and structures, including substantial improvement of such buildings and structures, shall be elevated such that the lowest floor, including basement, is elevated to or above the base *flood* elevation in accordance with Section 1612 of the *International Building Code*.

**G1301.4 Enclosures below base flood elevation.** Fully enclosed areas below the base flood elevation shall be at or above grade on all sides and conform to the following:

1. In *flood hazard zones*, enclosed areas shall have flood openings to allow for the automatic inflow and outflow of floodwaters.
2. In *high hazard zones*, enclosed areas shall have walls below the base flood elevation that are designed to break away or collapse from a water load less than that which would occur during the base flood, without causing collapse, displacement or other structural damage to the building or structure.

**G1301.5 Flood-damage-resistant materials.** Flood-damage-resistant materials shall be used below the base *flood* elevation.

**G1301.6 Protection of mechanical, plumbing and electrical systems.** Mechanical, plumbing and electrical systems, including plumbing fixtures, shall be elevated to or above the base *flood* elevation.

**Exception:** Electrical systems, equipment and components, and heating, ventilating, air conditioning, and plumbing appliances, plumbing fixtures, duct systems and other service equipment shall be permitted to be located below the base *flood* elevation provided that they are designed and installed to prevent water from entering or accumulating within the components



and to resist hydrostatic and hydrodynamic loads and stresses, including the effects of buoyancy, during the occurrence of flooding to the base flood elevation in compliance with the flood-resistant construction requirements of this code. Electrical wiring systems shall be permitted to be located below the base flood elevation provided they conform to the provisions of NFPA 70.