

# ICC 805-201X, Rough Draft Standard for Rainwater Collection System Design and Installation

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## **RAINWATER COLLECTION AND DISTRIBUTION SYSTEMS**

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## CHAPTER 1 SCOPE

**101.1 Scope.** The provisions of this standard shall apply to the design, installation and equipment used for rainwater collection systems intended to collect, store, treat, distribute, and utilize rainwater for potable and nonpotable applications. This standard is intended to apply to new rainwater collection installations as well as alterations, additions, maintenance, relocations, replacement and repair to existing installations. Includes systems designed for residential, commercial, industrial, and agricultural applications on buildings, structures and sites.

## CHAPTER 2 DEFINITIONS

### SECTION 201 GENERAL

201.1 Scope. Unless otherwise expressly stated, the following words and terms shall, for the purposes of this code, have the meanings shown in this chapter.

201.2 Interchangeability. Words used in the present tense include the future; words stated in the masculine gender include the feminine and neuter; the singular number includes the plural and the plural, the singular.

201.3 Terms defined in other codes. Where terms are not defined in this code and are defined in the International Building Code® (IBC®), International Energy Conservation Code® (IECC®), International Fire Code® (IFC®), International Fuel Gas Code® (IFGC®), International Mechanical Code® (IMC®), International Plumbing Code® (IPC®) or International Residential Code® (IRC®), such terms shall have the meanings ascribed to them as in those codes.

201.4 Terms not defined. Where terms are not defined through the methods authorized by this section, such terms shall have ordinarily accepted meanings such as the context implies.

### SECTION 202 DEFINITIONS

**95th-PERCENTILE RAINFALL EVENT.** The rainfall event having a precipitation total greater than or equal to 95 percent of all rainfall events during a 24-hour period on an annual basis.

**ALTERNATE ON-SITE NONPOTABLE WATER.** Nonpotable water from other than public utilities, onsite surface sources and subsurface natural freshwater

sources. Examples of such water are gray water, onsite reclaimed water, collected rainwater, captured condensate, and rejected water from reverse osmosis systems.

**APPROVED AGENCY.** An established and recognized agency regularly engaged in conducting tests or furnishing inspection services or commissioning services, where such agency has been *approved*.

**APPROVED SOURCE.** An independent person, firm or corporation, *approved* by the *code official*, who is competent and experienced in the application of engineering principles to materials, methods or systems analyses.

**AUTOMATIC.** Self-acting, operating by its own mechanism when actuated by some impersonal influence, such as a change in current strength, pressure, temperature or mechanical configuration (see “Manual”).

**BACKWATER VALVE.** A device or valve installed in the system drain piping which prevents drainage or waste from backing up into the system and causing contamination or flooding.

**CATCHMENT AREA.** The aggregate area over which precipitation is collected on collection surfaces and devices.

**CODE OFFICIAL.** The officer or other designated authority charged with the administration and enforcement of this code, or a duly authorized representative.

**COLLECTION PIPING.** Unpressurized piping used within the collection system that drains rainwater to the storage tank by gravity.

**COLLECTION DEVICES.**

- Collection Surface

**CONSTRUCTION DOCUMENTS.** Written, graphic and pictorial documents prepared or assembled for describing the design, location and physical characteristics of the elements of a project necessary for obtaining a building permit.

**CONTROL.** A specialized automatic or manual device or system used to regulate the operation of equipment or systems.

**CONVEYANCE SYSTEM.** System designed to collect water from catchment systems and devices and convey it to storage tanks or intermediate sumps by means of gravity-driven flow.

**DISTRIBUTION PIPE.** Pressurized or nonpressure piping used within the plumbing system.

**FIRST FLUSH DEVICE.** See roof washer.

**LABEL.** An identification applied on a product by the manufacturer that contains the name of the manufacturer, the function and performance characteristics of the product or material, and the name and identification of an approved agency and that indicates that the representative sample of the product or material has been tested and evaluated by an approved agency.

**LABELED.** Equipment, materials or products to which has been affixed a label, seal, symbol or other identifying mark of a nationally recognized testing laboratory, inspection agency or other organization concerned with product evaluation that maintains periodic inspection of the production of the above labeled items and whose labeling indicates either that the equipment, material or product meets identified standards or has been tested and found suitable for a specified purpose.

**LISTED.** Equipment, materials, products or services included in a list published by an organization acceptable to the *code official* and concerned with evaluation of products or services that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services and whose listing states either that the equipment, material, product or service meets identified standards or has been tested and found suitable for a specified purpose.

**LOT.** A portion or parcel of land considered as a unit.

**LOT LINE.** A line dividing one lot from another, or from a street or any public place.

**METER.** A measuring device used to collect data and indicate usage.

**NONPOTABLE WATER.** Water not safe for drinking, personal or culinary utilization.

**OUTDOOR ORNAMENTAL FOUNTAIN.** An outdoor fixture whose dominant use is aesthetic consisting of a catch basin, reservoir or chamber from which one or more jets or streams of water is emitted.

**PERMIT.** An official document or certificate issued by the jurisdiction which authorizes performance of a specified activity.

**POTABLE WATER.** Water free from impurities present in amounts sufficient to cause disease or harmful physiological effects and conforming to the bacteriological and chemical quality requirements of the Public Health Service Drinking Water Standards or the regulations of the public health authority having jurisdiction.

**RAIN BARREL.**

**RAIN CHAIN.**

**RAINWATER.** Water from natural precipitation.

**RAINWATER COLLECTION AND CONVEYANCE SYSTEM.** Rainwater collection system components extending between the collection surface and the storage tank that convey collected rainwater, usually through a gravity system.

**REGISTERED DESIGN PROFESSIONAL.** An individual who is registered or licensed to practice their respective design profession as defined by the statutory requirements of the professional registration laws of the state or jurisdiction in which the project is to be constructed.

**ROOF WASHER.** A device or method for removal of sediment and debris from collection surface by diverting initial rainfall from entry into the storage tank. Also referred to as a First Flush Device.

**STORAGE TANK.** A fixed container for holding water at atmospheric pressure for subsequent use as part of a plumbing or irrigation system.

**USEFUL VOLUME.** The portion of the total tank volume that is available for beneficial use.

**VEGETATIVE ROOF.** An assembly of interacting components designed to waterproof and normally insulate a building's top surface that includes, by design, vegetation and related landscaping elements.

**WATER FEATURE.** An outdoor open water installation or natural open water way within a built landscape to retain water supplied from source other than rainwater naturally flowing into the feature.

**YIELD COEFFICIENT.** Ratio of the volume of rainwater collected by a rainwater collection system to the total volume precipitation delivered to a collection surface during a rainfall event or over a specified period of time.

## CHAPTER 3 GENERAL REQUIREMENTS

### Administration

**Appendices.** Provisions in the appendices shall not apply unless specifically adopted.

**Intent.** This standard is intended to safeguard public health, safety and general welfare through the establishment of minimum requirements for rainwater collection systems. This standard is not intended to abridge or supersede safety, health or environmental requirements under other applicable codes or ordinances. Where there is a conflict between a general requirement and a specific requirement of this standard, the specific requirement shall be applicable.

**Other laws.** The provisions of this standard shall not be deemed to nullify any provisions of local, state or federal law.

**Application of references.** References to chapter or section numbers, or to provisions not specifically identified by number, shall be construed to refer to such chapter, section or provision of this standard.

**Partial invalidity.** In the event that any part or provision of this standard is held to be illegal or void, this shall not have the effect of making void or illegal any of the other parts or provisions.

**Permits.** Any owner or authorized agent intending to construct, enlarge, alter, repair, move, demolish or change a rainwater collection system in accordance with this standard shall first obtain all permits required by the authority having jurisdiction.

**Exception:** Unless otherwise specified by the authority having jurisdiction, permits shall not be required for the construction, alteration, change or removal of rain barrels under 350 gallons in size and requiring no electrical power for their operation.

**Used materials, products and equipment.** The use of used materials, products and equipment that meet the requirements of this standard for new materials is permitted unless otherwise specified in this standard.

**Exception:** Used, recycled or repurposed materials shall not be utilized for any system or portion of a system in contact with potable water, which is intended to deliver water for potable uses.



## Codes. (Reserved)

## Water rights. (Reserved)

## Source quality of rainwater. (Reserved).

**Backflow protection.** Where a potable system is connected to a rainwater collection and conveyance system, the potable water supply shall be protected against backflow in accordance with Section 608 of the *International Plumbing Code*.

**Protection from contamination.** Rainwater collection and conveyance systems shall be designed to minimize contamination of collected waters. The system shall be designed to prevent the entrance of water to the system at any point except approved sources entering through collection devices and makeup water systems.

**Insect and vermin control.** The system shall be protected to prevent the entrance of insects and vermin into storage tanks and piping systems. Screen materials shall be compatible with contacting system components and shall not accelerate corrosion of system components.

## Lightning protection (reserved).

**Approved components and materials.** Piping, plumbing components, and materials used in the collection and conveyance systems shall be manufactured of material approved for the intended application and compatible with any disinfection and treatment systems used.

**Nonpotable water quality.** Nonpotable water shall meet the minimum water quality requirements at each point of use as established for the intended application by the laws, rules and ordinances applicable in the jurisdiction. Where nonpotable water from different sources is combined in a system, the system shall comply with the most stringent of the requirements of this code that are applicable to such sources.

**Potable water quality.** Potable water shall conform to the bacteriological and chemical quality requirements of the Public Health Service Drinking Water Standards, or the regulations of the public health authority having jurisdiction.

## Multiple use tanks (reserved).

- Thermal storage and cooling
- Emergency fire suppression

**Sources.** Rainwater shall be collected from above-ground impervious roofing surfaces and collection devices constructed from approved materials. Where systems are used exclusively for nonpotable applications, water from other approved nonpotable sources including swimming pool backwash operations, air conditioner condensate, rainwater, cooling tower blow-down water, foundation drain water, steam system condensate, fluid cooler discharge water, food steamer discharge water, combination oven discharge water, industrial process water, and fire pump test water shall also be permitted to be collected for reuse, as approved by the code official and as appropriate for the intended application.

**Pedestrian and Parking Surfaces.** Collection of water from vehicular parking or pedestrian surfaces shall be prohibited, except where the water is used exclusively for landscape irrigation.

**Bioswales.** Collection of water from bioswales shall be prohibited, except where the water is used exclusively for landscape irrigation.

**Vegetative Roofs.** Collection of water from vegetative roofs shall be prohibited, except where the water is used exclusively for landscape irrigation.

**Roof-Mounted Appliances.** Collection of water from overflow and bleed-off pipes from roof-mounted appliances shall be prohibited.

**Prohibited Sources.**

Wastewater containing urine or fecal matter shall not be diverted to rainwater collection and conveyance systems and shall discharge to the sanitary drainage system of the building or premises in accordance with plumbing code of the jurisdiction. Water from reverse osmosis system reject water, water softener discharge water, kitchen sink wastewater, dishwasher wastewater, and wastewater discharged from wet-hood scrubbers shall not be collected for reuse within rainwater harvesting systems. Floor drains shall not be connected to rainwater collection systems.

**Marking and signage.**

**Nonpotable Water Outlets.**

Nonpotable water outlets such as hose connections, open ended pipes, and faucets shall be identified at the point of use for each outlet with signage that reads as follows: “Nonpotable water is utilized for [application name]. Caution: Nonpotable water. DO NOT DRINK.” The words shall be

legibly and indelibly printed on a tag or sign constructed of corrosion-resistant waterproof material or shall be indelibly printed on the fixture. The letters of the words shall be not less than 0.5 inches in height and in colors in contrast to the background on which they are applied. In addition to the required wordage, the pictograph shown in Figure \*\* shall appear on the signage required by this section.



**FIGURE \*\***  
**PICTOGRAPH-DO NOT DRINK**

#### **Tanks.**

**General.** Each water storage tank shall be labeled with its rated capacity. Where an opening is provided that could allow the entry of personnel, the opening shall be marked with the words, “DANGER – CONFINED SPACE.” Markings shall be indelibly printed on the tank or on a tag or sign constructed of corrosion-resistant waterproof material that is mounted on the tank. The letters of the words shall be not less than 0.5 inches in height and shall be of a color in contrast with the background on which they are applied.

**Nonpotable Tanks.** The contents of nonpotable storage tanks shall be identified with the words “CAUTION: NONPOTABLE WATER – DO NOT DRINK.”

#### **Piping.**

**Collection Piping.** Additional marking of collection piping conveying untreated rainwater for reuse shall not be required beyond that required for sanitary drainage, waste, and vent piping by the plumbing code of jurisdiction.

**Distribution Piping.** Nonpotable rainwater distribution piping shall be of the color purple and shall be embossed or integrally stamped or marked with the words: “CAUTION: NONPOTABLE WATER – DO NOT DRINK” or shall be installed with a purple identification tape or wrap. Identification tape shall be not less than 3 inches (76 mm)

wide and have white or black lettering on purple field stating “CAUTION: NONPOTABLE WATER – DO NOT DRINK.” Identification tape shall be installed on top of nonpotable rainwater distribution pipes, fastened not greater than every 10 feet (3048 mm) to each pipe length and run continuously the entire length of the pipe. Lettering shall be readily observable within the room or space where the piping is located.

Exception: Piping located outside of the building and downstream of the backflow preventer is not required to be purple where rainwater is used for outdoor applications.

### **Metering.**

All water delivered from rainwater collection systems for use shall be metered. Meters shall be installed in accordance with the requirements of the plumbing code of the jurisdiction. Potable and nonpotable makeup water supply lines shall be metered. Each meter shall be capable of communicating water consumption data remotely and at a minimum, be capable of providing daily data with electronic data storage and reporting capability that can produce reports that show daily, monthly, and annual water consumption.

### **Insect and vermin control.**

Systems shall be protected to prevent the entrance of insects and vermin into storage tanks and piping systems. Where used, screen materials shall be compatible with contacting system components and shall not accelerate corrosion of system components.

### **Electrical system design and installation.**

Electrical systems, equipment components and all related wiring shall be specified, designed and installed in accordance with the applicable requirements of NFPA 70.

### **Drainage.**

Discharge from devices including but not limited to filters, first flush diverters, debris excluders and tank overflows and drains shall not be drained to the sanitary sewer and shall be disposed of in a manner consistent with the storm water runoff requirements of the jurisdiction. Such water shall be diverted from the storage tank and discharge in a location that will not cause erosion or damage to property in accordance with the International Building Code.

Discharge shall be drained at a sufficient distance from tanks to avoid damaging tank foundations. Drainage shall not discharge into a street, alley or other areas so as to cause a nuisance.

### **Freeze protection.**

Where sustained freezing temperatures occur, provisions shall be made to keep storage tanks and the related system piping and conveyances from freezing.

### ***Trenching requirements for potable water piping.***

Potable water distribution and makeup supply piping shall be located and installed in accordance with the requirements of plumbing code of the jurisdiction.

### **Trenching requirements for nonpotable water piping.**

Nonpotable water collection and distribution piping and reclaimed water piping shall be separated from the building sewer and potable water piping underground by 5 feet (1524 mm) of undisturbed or compacted earth. Nonpotable water collection and distribution piping shall not be located in, under or above cesspools, septic tanks, septic tank drainage fields or seepage pits. Buried nonpotable water piping shall comply with the requirements of Section 306.

Exceptions:

1. The required separation distance shall not apply where the bottom of the nonpotable water pipe within 5 feet (1524 mm) of the sewer is not less than 12 inches (305 mm) above the top of the highest point of the sewer and the pipe materials conforms to Table 702.3.
2. The required separation distance shall not apply where the bottom of the potable water service pipe within 5 feet (1524 mm) of the nonpotable water pipe is a minimum of 12 inches (305 mm) above the top of the highest point of the nonpotable water pipe and the pipe materials comply with the requirements of Table 605.4
3. Nonpotable water pipe is permitted to be located in the same trench with a building sewer, provided that such sewer is constructed of materials that comply with the requirements of Table 702.2.
4. The required separation distance shall not apply where a nonpotable water pipe crosses a sewer pipe provided that the pipe is sleeved to at least 5 feet (1524 mm) horizontally from the sewer pipe centerline on both sides of such crossing with pipe materials that comply with Table 702.2.

5. The required separation distance shall not apply where a potable water service pipe crosses a nonpotable water pipe provided that the potable water service pipe is sleeved for a distance of at least 5 feet (1524 mm) horizontally from the centerline of the nonpotable pipe on both sides of such crossing with pipe materials that comply with Table 702.2.
6. Irrigation piping located outside of a building and downstream of the backflow preventer is not required to meet the trenching requirements where nonpotable water is used for outdoor applications.

### Location.

Storage tanks shall be located with a minimum horizontal distance between various elements as indicated in Table \*\*.

**TABLE \*\***  
**LOCATION OF NONPOTABLE WATER REUSE STORAGE TANKS**

ELEMENT	MINIMUM HORIZONTAL DISTANCE FROM STORAGE TANK (FEET)
Critical root zone (CRZ) of protected trees	2
Lot line adjoining private lots	5
Seepage pits	5
Septic tanks	5
Water wells	50
Streams and lakes	50
Water service	5
Public water main	10

For SI: 1 foot = 304.8 mm

### Enclosures and Sumps(Reserved).

#### Collection and use across sites

Rainwater captured by a rainwater collection and conveyance system on a landowner's property for use on a different landowner's property shall be permitted if approved by the jurisdiction and if all of the following conditions are met:

- 1) The rainwater is captured and used exclusively within the jurisdiction that is authorizing the capture and conveyance of the rainwater.
- 2) The rainwater is provided at no cost to the user of the rainwater.
- 3) The rainwater is used only for approved outdoor nonpotable applications.
- 4) The rainwater is treated and used in a manner approved by the local department of public health.
- 5) All pipes designed to carry rainwater are colored and marked in accordance with Section \*\*.

6) All points of use are clearly marked in accordance with Section \*\*.

## **Occupational health and safety (HB230)**

- 1) **General**
- 2) **Lifting of tanks**
- 3) **Trenching and excavations**
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## **CHAPTER 4 DESIGN AND INSTALLATION**

### **General**

#### **Collection surfaces and devices**

##### **Size and Location**

The size location of collection surfaces and devices shall be specified in accordance with:

- 1) Available collection area
- 2) Quality of collection area
- 3) Proximity to storage devices
- 4) Proximity to sources of contamination
- 5) Volume and quality of water required for end use applications

### **Materials**

#### **General.**

Collection surfaces shall be constructed using *approved* non-toxic, impervious materials. Collection of water from any surfaces containing asbestos shall be prohibited.

Exception: Where rainwater is collected from parking, and pedestrian surfaces, bioswales, and vegetative roofs for exclusive outdoor use in accordance with Section \*\*, collection from pervious and impervious materials including but not limited to pavers, gravel, growing media and concrete shall be permitted.

### **Potable Applications.**

Collection surfaces to be utilized for potable applications shall comply with Section \*\*, and the following:

- 1) The use of wood shake, materials treated with biocides, and containing asbestos or lead materials are prohibited.
- 2) Paint and coatings utilized on collection surfaces shall be approved for contact with drinking water and shall not be lead, chromium or zinc-based.
- 3) Flat roofing products shall be certified to NSF P151.
- 4) Collection of rainwater from parking and pedestrian surfaces, bioswales and vegetative roofs collecting water for potable applications shall be prohibited.

### **Debris Excluders and strainers**

Water collected from collection surfaces and devices shall pass through a debris excluder, strainer or equivalent device upstream of all filtration devices to prevent the contamination of collected rainwater with leaves, sticks, pine needles and similar material prior to introduction into the storage tank. Debris excluders shall prevent the passage of debris equal to or greater than ¼” (6.4 mm) in any dimension. Where debris excluders produce a discharge stream, the drainage shall be disposed of in accordance with Section \*\* and shall not be drained to the sanitary sewer. Debris excluders, strainers or equivalent devices shall be accessible for maintenance and cleaning in accordance with manufacturer’s instructions.

### **Dedicated structures (reserved)**

### **Sidewall collection (reserved)**

### **Fog collection nets (reserved)**

### **Rooftop appliances.**

Overflow and bleed-off pipes from roof-mounted appliances including but not limited to evaporative coolers, water heaters, and solar water heaters shall not discharge onto rainwater collection surfaces or devices supplying water to potable or nonpotable end uses.



## Conveyance system.

### General.

Conveyance system components, including but not limited to gutters, downspouts, and roof drains shall be constructed of materials that are compatible with the collection surface and the rainwater quality for the desired end use. Where the collected water is to be utilized for potable applications, all wetted materials shall comply with NSF 61. All joints between conveyance system components shall be water-tight. Conveyance systems shall be protected to prevent the entrance of insects and vermin into storage tanks and closed piping systems in accordance with Section \*\*.

### Slope.

Gravity-fed conveyance components including but not limited to roof gutters, leaders, and rainwater collection piping shall slope continuously toward collection inlets with slope of not less than 1/8 inch per foot along their entire length, and shall not permit the collection or pooling of water at any point.

**Exception:** Siphonic drainage systems installed in accordance with the manufacturer's installation instructions shall not be required to have slope.

### Size.

Conveyance components, including but not limited to downspouts and gutters, shall be installed and sized in accordance with local codes and rainfall rates.

### Cleanouts.

Cleanouts shall be provided in the water conveyance system so as to allow access to all filters, flushes, pipes and downspouts.

### Canales, scuppers and catchbasins.

Canales or scuppers may be used in lieu of gutters and downspouts to conduct collected water to catchbasins where permitted. Canales and scuppers shall conduct water a sufficient distance away from the structure to prevent contact with walls and foundations. Catchbasins shall contain impervious material and structures to minimize splash and erosion and shall be lined to contain collected water. Catchbasins shall be sized to encompass all areas receiving water falling from canales and scuppers. Canales and scuppers shall be sized in accordance with local codes and located in accordance with the requirements of Section 1503.4 of the *International Building Code*.

### Roof drains.

Roof drains shall conform to ASME A112.6.4 or ASME A112.3.1. The connection between roofs and roof drains which pass through the roof and into the interior of the building shall be made water-tight by the use of approved flashing material. The inside opening for the roof drain shall not be obstructed by the roofing membrane material.

### ***Siphonic roof drains.***

Siphonic roof drains and drainage systems connected to rainwater collection systems shall be designed in accordance with ASME A112.6.9 and ASPE 45.

### ***Secondary roof drains. (reserved)***

### ***Rain chains.***

The use of rain chains to conduct collected water from the collection surface to catch basins shall be permitted. Rain chains shall be constructed of approved materials, and shall be installed in such a way as to prevent contact with the structure walls or foundations. Rain chains shall be secured at the bottom to ensure alignment with the catchbasin. Rain chains shall be sized and installed in accordance with manufacturers instructions.

### ***Spillways and french drains (Reserved).***

### ***Collection pipe.***

Rainwater collection and conveyance systems shall utilize drainage piping approved for use within storm drainage systems to collect and convey captured rainwater.

***Materials.*** Collection pipe shall comply with local code requirements for sanitary drainage pipe and pipe fittings.

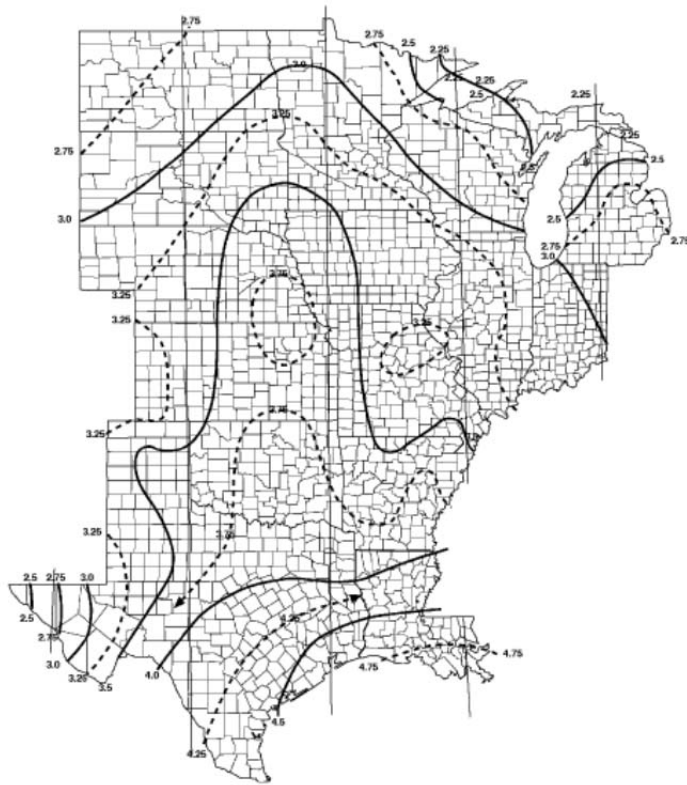
***Size.*** Horizontal collection piping and vertical conductors and leaders conveying captured rainwater shall be sized in accordance with 100 year hourly rainfall rates or on other rainfall rates determined from approved local weather data in accordance with Tables \*\*.

***Bypass valve.*** One three-way diverter valve listed and labeled to NSF 50 or other approved device shall be installed on collection piping upstream of each storage tank, or drainfield, as applicable, to divert collected rainwater to drainage and disposal in accordance with local stormwater requirements to allow servicing and inspection of the system. Bypass valves shall be marked to indicate the direction of flow, connection and storage tank. Bypass valves shall be installed in accessible locations. Two shutoff valves shall not be installed to serve as a bypass valve.



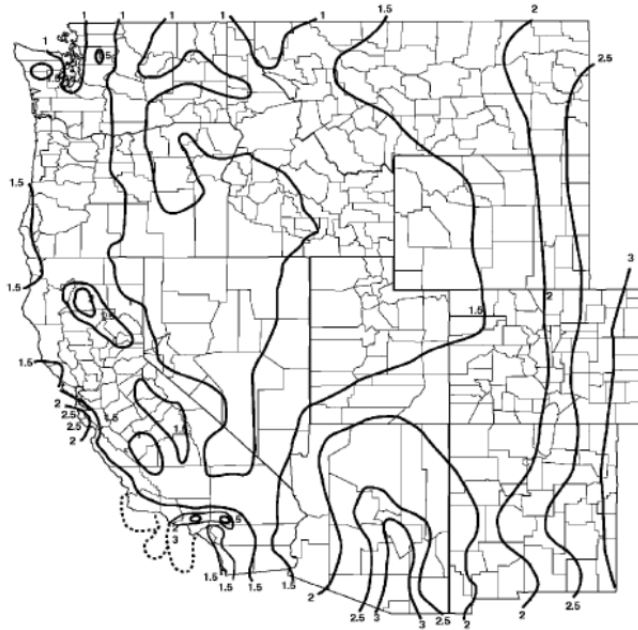
For SI: 1 inch = 25.4 mm.  
Source: National Weather Service, National Oceanic and Atmospheric Administration, Washington D.C.

FIGURE 108-1  
100-YEAR, 1-HOUR RAINFALL (INCHES) EASTERN UNITED STATES



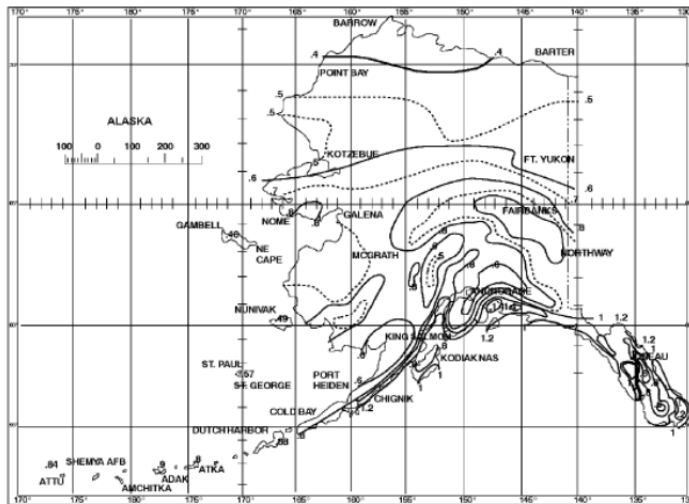
For SE: 1 inch = 25.4 mm.  
 Source: National Weather Service, National Oceanic and Atmospheric Administration, Washington D.C.

**FIGURE 1106.1—continued**  
**100-YEAR, 1-HOUR RAINFALL (INCHES) CENTRAL UNITED STATES**



For SI: 1 inch = 25.4 mm.  
 Source: National Weather Service, National Oceanic and Atmospheric Administration, Washington D.C.

FIGURE 1106.1—continued  
 100-YEAR, 1-HOUR RAINFALL (INCHES) WESTERN UNITED STATES



For SI: 1 inch = 25.4 mm.  
 Source: National Weather Service, National Oceanic and Atmospheric Administration, Washington D.C.

FIGURE 1106.1—continued  
 100-YEAR, 1-HOUR RAINFALL (INCHES) ALASKA

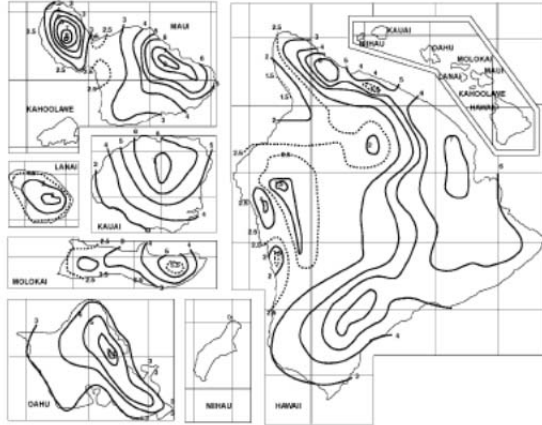


FIG. 11-1 (cont.) 11-4 (cont.)  
 Source: National Weather Service, National Oceanic and Atmospheric Administration, Washington, DC.

**100-YEAR 24-HOUR RAINFALL RATES, HAWAII**

**TABLE 1106.2(1)**  
**SIZE OF CIRCULAR VERTICAL CONDUCTORS AND LEADERS**

DIAMETER OF LEADER (inches) <sup>a</sup>	HORIZONTALLY PROJECTED ROOF AREA (square feet)											
	Rainfall rate (inches per hour)											
	1	2	3	4	5	6	7	8	9	10	11	12
2	2,880	1,440	960	720	575	480	410	360	320	290	260	240
3	8,800	4,400	2,930	2,200	1,760	1,470	1,260	1,100	980	880	800	730
4	18,400	9,200	6,130	4,600	3,680	3,070	2,630	2,300	2,045	1,840	1,675	1,530
5	34,600	17,300	11,530	8,650	6,920	5,765	4,945	4,325	3,845	3,460	3,145	2,880
6	54,000	27,000	17,995	13,500	10,800	9,000	7,715	6,750	6,000	5,400	4,910	4,500
8	116,000	58,000	38,680	29,000	23,200	19,315	16,570	14,500	12,890	11,600	10,545	9,600

For SI: 1 inch = 25.4 mm; 1 square foot = 0.0929 m<sup>2</sup>.

a. Sizes indicated are the diameter of circular piping. This table is applicable to piping of other shapes, provided the cross-sectional shape fully encloses a circle of the diameter indicated in this table. For rectangular leaders, see Table 1106.2(2). Interpolation is permitted for pipe sizes that fall between those listed in this table.

**TABLE 1106.2(2)**  
**SIZE OF RECTANGULAR VERTICAL CONDUCTORS AND LEADERS**

DIMENSIONS OF COMMON LEADER SIZES width x length (inches) <sup>a</sup>	HORIZONTALLY PROJECTED ROOF AREA (square feet)											
	Rainfall rate (inches per hour)											
	1	2	3	4	5	6	7	8	9	10	11	12
1½" x 2½"	3,410	1,700	1,130	850	680	560	480	420	370	340	310	280
2 x 3	5,540	2,770	1,840	1,380	1,100	920	790	690	610	550	500	460
2½" x 4½"	12,830	6,410	4,270	3,200	2,560	2,130	1,830	1,600	1,420	1,280	1,160	1,060
3 x 4	13,210	6,600	4,400	3,300	2,640	2,200	1,880	1,650	1,460	1,320	1,200	1,100
3½" x 4	15,900	7,950	5,300	3,970	3,180	2,650	2,270	1,980	1,760	1,590	1,440	1,320
3½" x 5	21,310	10,650	7,100	5,320	4,260	3,550	3,040	2,660	2,360	2,130	1,930	1,770
3½" x 4½"	21,960	10,980	7,320	5,490	4,390	3,660	3,130	2,740	2,440	2,190	1,990	1,830
3½" x 5½"	25,520	12,760	8,500	6,380	5,100	4,250	3,640	3,190	2,830	2,550	2,320	2,120
3½" x 6	27,790	13,890	9,260	6,940	5,550	4,630	3,970	3,470	3,080	2,770	2,520	2,310
4 x 6	32,980	16,490	10,990	8,240	6,590	5,490	4,710	4,120	3,660	3,290	2,990	2,740
5½" x 5½"	44,300	22,150	14,760	11,070	8,860	7,380	6,320	5,530	4,920	4,430	4,020	3,690
7½" x 7½"	100,500	50,250	33,500	25,120	20,100	16,750	14,350	12,560	11,160	10,050	9,130	8,370

a. Sizes indicated are nominal width x length of the opening for rectangular piping.

b. For shapes not included in this table, Equation 11-1 shall be used to determine the equivalent circular diameter,  $D_e$ , of rectangular piping for use in interpolation using the data from Table 1106.2(1).

$$D_e = (\text{width} \times \text{length})^{0.5} \text{ (Equation 11-1)}$$

where:

$D_e$  = equivalent circular diameter and  $D_e$ , width and length are in inches.

TABLE 1106.3  
SIZE OF HORIZONTAL STORM DRAINAGE PIPING

SIZE OF HORIZONTAL PIPING (inches)	HORIZONTALLY PROJECTED ROOF AREA (square feet)					
	Rainfall rate (inches per hour)					
	1	2	3	4	5	6
	% unit vertical in 12 units horizontal (1-percent slope)					
3	3,288	1,644	1,096	822	657	548
4	7,520	3,760	2,506	1,800	1,504	1,253
5	13,360	6,680	4,453	3,340	2,672	2,227
6	21,400	10,700	7,133	5,350	4,380	3,566
8	46,000	23,000	15,330	11,500	9,300	7,600
10	82,800	41,400	27,600	20,700	16,580	13,800
12	133,200	66,600	44,400	33,300	26,650	22,200
15	218,000	109,000	72,800	59,500	47,600	39,650
	% unit vertical in 12 units horizontal (2-percent slope)					
3	4,640	2,320	1,546	1,160	928	773
4	10,600	5,300	3,533	2,650	2,120	1,766
5	18,880	9,440	6,293	4,720	3,776	3,146
6	30,200	15,100	10,066	7,550	6,040	5,033
8	65,200	32,600	21,733	16,300	13,040	10,866
10	116,800	58,400	38,950	29,200	23,350	19,450
12	188,000	94,000	62,600	47,000	37,600	31,350
15	336,000	168,000	112,000	84,000	67,250	56,000
	% unit vertical in 12 units horizontal (4-percent slope)					
3	6,576	3,288	2,205	1,644	1,310	1,086
4	15,040	7,520	5,010	3,760	3,010	2,500
5	26,720	13,360	8,900	6,680	5,320	4,450
6	42,800	21,400	13,700	10,700	8,580	7,140
8	92,000	46,000	30,650	23,000	18,400	15,320
10	171,600	85,800	55,200	41,400	33,150	27,600
12	266,400	133,200	88,800	66,600	53,200	44,400
15	476,000	238,000	158,800	119,000	95,300	79,250

Note: 1 inch = 25.4 mm, 1 square foot = 0.0929 m<sup>2</sup>.

TABLE 1106.6  
SIZE OF SEMICIRCULAR ROOF GUTTERS

DIAMETER OF GUTTERS (inches)	HORIZONTALLY PROJECTED ROOF AREA (square feet)					
	Rainfall rate (inches per hour)					
	1	2	3	4	5	6
	% unit vertical in 12 units horizontal (0.5-percent slope)					
3	680	340	226	170	136	113
4	1,440	720	480	360	288	240
5	2,500	1,250	834	625	500	416
6	3,840	1,920	1,280	960	768	640
7	5,520	2,760	1,840	1,380	1,100	918
8	7,960	3,980	2,655	1,990	1,590	1,325
10	14,400	7,200	4,800	3,600	2,880	2,400
	% unit vertical in 12 units horizontal (1-percent slope)					
3	960	480	320	240	192	160
4	2,040	1,020	680	510	408	340
5	3,520	1,760	1,172	880	704	587
6	5,440	2,720	1,815	1,360	1,085	905
7	7,800	3,900	2,600	1,950	1,560	1,300
8	11,200	5,600	3,740	2,800	2,240	1,870
10	20,400	10,200	6,800	5,100	4,080	3,400
	% unit vertical in 12 units horizontal (2-percent slope)					
3	1,360	680	454	340	272	226
4	2,880	1,440	960	720	576	480
5	5,000	2,500	1,668	1,250	1,000	834
6	7,680	3,840	2,560	1,920	1,536	1,280
7	11,040	5,520	3,640	2,760	2,205	1,840
8	15,920	7,960	5,310	3,980	3,180	2,655
10	28,800	14,400	9,600	7,200	5,750	4,800
	% unit vertical in 12 units horizontal (4-percent slope)					
3	1,920	960	640	480	384	320
4	4,080	2,040	1,360	1,020	816	680
5	7,080	3,540	2,360	1,770	1,415	1,180
6	11,080	5,540	3,695	2,770	2,220	1,850
7	15,600	7,800	5,200	3,900	3,120	2,600
8	22,400	11,200	7,460	5,600	4,480	3,730
10	40,000	20,000	13,330	10,000	8,000	6,660

Note: 1 inch = 25.4 mm, 1 square foot = 0.0929 m<sup>2</sup>.

**Installation.** Collection piping conveying captured rainwater shall be installed in accordance with local plumbing code requirements for above-ground sanitary drainage pipe.

**Marking.** Additional marking of collection piping conveying untreated rainwater for reuse shall not be required beyond that required for sanitary drainage, waste, and vent piping by the plumbing code of jurisdiction.

### Filters.

Collected rainwater shall be filtered as required for the intended end use. Filters shall be accessible for inspection and maintenance. Filters shall utilize a pressure gage or other approved method to provide indication when a filter

requires servicing or replacement. Filters shall be installed with shutoff valves installed immediately upstream and downstream to allow for isolation during maintenance.

**Filtration required.** Rainwater utilized for water closet and urinal flushing applications shall be filtered by a 100 micron or finer filter. Rainwater utilized for surface or drip landscape irrigation applications shall be filtered by a 100 micron or finer filter. Where filters are backwashed, the discharge shall be disposed of in accordance with Section \*\* and local codes.

**Hydrodynamic separators (Reserved).**

## Treatment and Disinfection Equipment

### General.

Where the intended application for rainwater requires disinfection or other treatment or both, it shall be disinfected as needed to ensure that the required water quality is delivered at the point of use. Disinfection and treatment equipment shall be accessible for inspection and maintenance. Collected rainwater shall be filtered in accordance with manufacturers specifications for disinfection and treatment systems specified.

**Chlorine.** Where chlorine is used for disinfection or treatment, treated rainwater shall be tested for residual chlorine in accordance with ASTM D1253 at the point of use. Treated rainwater shall contain not more than 4 mg/L of chloramines or free chlorine when tested in accordance with ASTM D1253.

**Ozone.** Where ozone is used for disinfection or treatment, treated rainwater shall not contain gas bubbles having elevated levels of ozone at the point of use. Offgassing of ozone shall be controlled to ensure compliance with OSHA recommended exposure limits as applicable to the facility. Materials in contact with ozone shall be ozone resistant.

Ozone destructors (Reserved).

### Ultraviolet light.

Ultraviolet light disinfection systems shall be installed with an audible and visual alarm indicating lamp failure. Ultraviolet light systems shall be installed with a properly sized pre-filter to remove sediment in accordance with the ultraviolet light system manufacturers specifications.

### Membrane and nanofiltration

### Clariflocculation (Reserved)



### Storage tanks.

**Design and construction.** Storage tanks shall be designed and constructed in accordance with Chapters 16 through 22 of the International Building Code. Rainwater storage tanks shall be watertight and have smooth interior surfaces. Partitions, baffles, or similar structural features shall be constructed of nonabsorbent, easily cleanable materials free of spalls, cracks or crevices which may entrap unwanted matter. Rainwater storage tanks shall be completely covered with a tight-fitting, solid, material and constructed in such a way that they will not allow water to pond or collect on the surface. All opening and entrances to tanks shall be protected to prevent the entrance of insects and vermin into storage tanks and piping systems in accordance with Section \*\*.

### *Building integrated tanks.(Reserved)*

### Location.

Storage tanks shall be installed above or below grade. Storage tanks and their manholes shall not be located directly under soil piping, waste piping or any source of contamination. Storage tanks shall be located with a minimum horizontal distance between various elements as indicated in Table \*\*. Where installed below grade, tanks shall be set at adequate depth to prevent frost heave.

### Flood Hazard Areas (Reserved).

**TABLE \*\***  
**LOCATION OF NONPOTABLE WATER REUSE STORAGE TANKS**

<b>ELEMENT</b>	<b>MINIMUM HORIZONTAL DISTANCE FROM STORAGE TANK (FEET)</b>
Critical root zone (CRZ) of protected trees	2
Lot line adjoining private lots	5
Seepage pits	5
Septic tanks	5
Water wells	50
Streams and lakes	50
Water service	5
Public water main	10
Animal stables and habitats	50*
Application sites of treated wastewater	50*

For SI: 1 foot = 304.8 mm

\*Texas Rainwater Harvesting Manual, 3<sup>rd</sup> Edition

**Algae mitigation.** No portion of storage tanks shall be exposed to direct sunlight in order to prevent algae growth, using one or more or a combination of the following methods:

- 1) Construction from opaque, UV-resistant materials.
- 2) Applied paint or coatings.
- 3) Underground installation.
- 4) Specially constructed sun barriers.
- 5) Shaded locations including but not limited to installation in garages, basements, crawlspaces, or sheds.

### Capacity.

The holding capacity of storage tanks shall be sized in accordance with the anticipated demand, rainfall rates and patterns and collection system efficiency.

### *Useful volume. (Reserved)*

### *Minimum storage volume. (Reserved)*

### *Fire suppression reserve. (Reserved)*

### Foundation and structural.

Storage tanks shall be supported on a firm base capable of withstanding the weight of the storage tank when filled to capacity. Storage tanks shall be supported in accordance with the International Building Code and manufacturers installation instructions to prevent tipping and withstand seismic forces. The foundation shall be flat and shall be designed to support the weight of the storage tank when full, consistent with the bearing capability of adjacent soil. Where installed below grade, storage tank installations shall be designed to withstand earth and surface structural loads without damage and with minimal deformation when empty or filled with water.

### *Subslab piping and wiring protection (Reserved).*

***Underground hydrostatic lift*** Where the soil can become saturated, underground storage tanks shall be secured to prevent the tank from floating out of the ground when empty.

#### Ballast.

Where ballast is utilized to counteract hydrostatic lift, the combined weight of the tank and hold down ballast shall meet or exceed the buoyancy force of the tank.

#### Hold-downs. (Reserved)

### ***Surface loads.***

Where installed below grade, storage tank installations shall be designed to withstand earth and surface structural loads without damage and with minimal deformation when empty or filled with water. Where tanks are to be installed below parking and roadway areas subject to vehicle traffic, they shall be designed to withstand surface AASHTO H-20 axle loads.

**Materials.**

Storage tanks shall be constructed of approved, durable, nonabsorbent and corrosion-resistant materials compatible with any disinfection systems used to treat water upstream of the tank and with any systems used to maintain water quality within the tank. Wooden storage tanks that are not equipped with a makeup water source shall be provided with a flexible liner. Storage tanks shall comply with one or more of the following standards as applicable for the material of the storage tank:

**TABLE \*\*  
STORAGE TANK STANDARDS**

MATERIAL	STANDARD
Welded carbon steel	AWWA D100, CSA B126
Bolted carbon steel, coated	AWWA D103
Tendon prestressed-concrete	AWWA D115
Thermosetting fiberglass-reinforced plastic	AWWA D120, CSA B126, ASTM D3299
Precast Concrete	ASTM C913, CSA B66, CSA B126, AWWA D110
Polyethylene	CSA B126, ASTM D1998

**Wooden Tanks.**

Wooden storage tanks that are not equipped with a makeup water source shall be provided with a flexible liner complying with Section \*\*.

**Bladders.**

**Ferrocement.**

**Cellular structures.**

**Potable Applications.** Storage tanks delivering water for potable use shall comply with NSF 61.

**Corrosion and oxidation.**

Carbon steel, fiberglass reinforced plastic, polyurethane, polyurea, high density polyethylene and high density polyethylene tanks installed underground shall comply with the corrosion protection provisions in UL 1746 as applicable to the material. Where active or passive corrosion or oxidation mitigation devices and elements are used, they shall be accessible for service and replacement.

**Liners and coatings.**

Liners and coatings used within rainwater storage tanks shall comply with NSF P151, as applicable.

#### Fittings and couplings.

Fittings and couplings which extend through the walls of cover of storage tanks shall be cast in place by the manufacturer. Couplings shall be made of either cast brass, fiberglass, galvanized cast iron, or flexible pipe to manway connectors conforming to ASTM C-923 or shall be two piece friction clamps or longitudinally ribbed plastic so as to prevent turning in place and the entry of contamination or loss of stored water.

#### Wiring bulkhead fittings. (Reserved).

#### Joints, connections and seams.

All joints, connections and other seams between components shall be sealed with nontoxic waterproof material to prevent the loss or contamination of stored water.

#### Access.

Not less than one access opening shall be provided to allow inspection and cleaning of rigid tank interiors. Access openings shall have an approved locking device or other approved method of securing access. Below grade storage tanks, located outside of the building, shall be provided with either a manway not less than 22 inches (559 mm) square or a manway with an inside diameter not less than 22 inches (559 mm) . Manways shall extend not less than 4 inches above ground in non-traffic areas. In traffic areas, manways shall be equipped with a traffic-rated cover designed to prevent water infiltration and shall installed flush with finished roadway. Finished grade shall be sloped away from the manhole to divert surface water from the manhole. Manway covers shall be secured to prevent unauthorized access. Service ports in manway covers shall be not less than 8 inches (203 mm) in diameter and shall be not less than 4 inches (102 mm) above the finished grade level. Service ports shall be secured to prevent unauthorized access. A patio or deck may be located over an underground cistern provided that proper access is maintained for filling, service and inspections.

**Exception:** Storage tanks less than 800 gallons (3028 L) in volume and installed below grade shall not be required to be equipped with a manway, but shall have a service port not less than 8 inches (203 mm) in diameter.

#### Tank interconnection (Reserved).

#### Ladders.

Where ladders are permanently installed on the exterior or interior of tanks, they shall...

#### Lift Points. (Reserved)

## Accessory components.

*Overflow.* The storage tank shall be equipped with an overflow pipe having a diameter not less than that shown in Table \*\*. The overflow pipe shall be protected from insects or vermin and shall discharge in a manner consistent with storm water runoff requirements of the jurisdiction. The overflow pipe shall discharge at a sufficient distance from the tank to avoid damaging the tank foundation or the adjacent property. Drainage from overflow pipes shall be directed so as not to freeze on roof walkways. The overflow drain shall not be equipped with a shutoff valve. A cleanout shall be provided on each overflow pipe in accordance with Section 708.

### *Level indicators.*

Level indicators shall be provided for all tanks.

### *Makeup water systems.*

Where an uninterrupted supply is required for the intended application, potable or reclaimed water shall be provided as a source of makeup water for the storage tank. The makeup water supply shall be protected against backflow in accordance with local plumbing. A full-open valve located on the makeup water supply line to the storage tank shall be provided. Inlets to storage tank shall be controlled by fill valves or other automatic supply valves installed so as to prevent the tank from overflowing and to prevent the water level from dropping below a predetermined point. Where makeup water is provided, the water level shall not be permitted to drop below the source water inlet or the intake of any attached pump.

### *Venting.*

Storage tanks shall be provided with a vent sized in accordance with local plumbing codes and based on the aggregate diameter of all tank influent pipes. The reservoir vent shall not be connected to sanitary drainage system vents. Vents shall be protected from contamination by means of an approved cap or U-bend installed with the opening directed downward. Vent outlets shall extend not less than 4 inches (102 mm) above grade or as necessary to prevent surface water from entering the storage tank.

### *Tank Drains.*

Where tanks require draining for service or cleaning, tanks shall be drained by using a pump or by one or more drains located at the lowest point in the tank. The tank drain pipes shall discharge in accordance with Section \*\* and shall not be smaller in size than specified in Table \*\*. Not less than one cleanout shall be provided on each drain pipe in accordance with plumbing code requirements. The discharge from draining the tank shall be disposed of in a manner consistent with the storm water runoff requirements of the jurisdiction and at a sufficient distance from the tank to avoid damaging the tank foundation.

Table \*\*  
MINIMUM SIZE OF DRAIN PIPES FOR STORAGE TANKS

TANK CAPACITY (GALLONS)	MINIMUM DRAIN PIPE SIZE (INCHES, NOMINAL)
Up to 750	1
751-1,500	1 ½
1,501-3,000	2
3,001-5,000	2 ½
5,001-7,500	3
Over 7,500	4

**Outlets.** Outlets shall be located at least 6 inches (152 mm) above the bottom of the storage tank or shall be attached to a flotation device and be located a minimum of four inches below the surface of the water. Submersible pumps may be used as the water intake and shall not be required to be attached to a flotation device. Outlets shall not skim water from the surface of the stored water.

**Inlets.** Storage tank inlets shall be designed to introduce collected rainwater into the tank with minimum turbulence, and shall be located and designed to avoid agitating the contents of the storage tank.

**Fire department connections.**

Where fire department connections are installed on rainwater storage tanks they shall be in accordance with the NFPA standard applicable to the system design and shall comply with Sections \*\* to \*\*.

**Location.** With respect to hydrants, driveways, buildings and landscaping, fire department connections shall be so located that fire apparatus and hose connected to supply the system will not obstruct access to the buildings for other fire apparatus. The location of fire department connections shall be *approved* by the fire chief. Fire department connections shall be located on the street side of buildings, fully visible and recognizable from the street or nearest point of fire department vehicle access or as otherwise approved by the fire chief.

**Existing buildings.** On existing buildings, wherever the fire department connection is not visible to approaching fire apparatus, the fire department connection shall be indicated by an *approved* sign mounted on the street front or on the side of the building. Such sign shall have the letters "FDC" at least 6 inches (152 mm) high and words in letters at least 2 inches (51 mm) high or an arrow to indicate the location.

All such signs shall be subject to the approval of the *fire code official*.

**Access.** Immediate access to fire department connections shall be maintained at all times and without obstruction by fences, bushes, trees, walls or any other fixed or moveable object. Access to fire department connections shall be *approved* by the fire chief.

**Exception:** Fences, where provided with an access gate equipped with a sign complying with the legend requirements of the International Fire Code and a means of emergency operation. The gate and the means of emergency operation shall be *approved* by the fire chief and maintained operational at all times.

**Locking fire department connection caps.** The *fire code official* is authorized to require locking caps on fire department connections for water-based *fire protection systems* where the responding fire department carries appropriate key wrenches for removal.

**Clear space around connections.** A working space of not less than 36 inches (762 mm) in width, 36 inches (914 mm) in depth and 78 inches (1981 mm) in height shall be provided and maintained in front of and to the sides of wall-mounted fire department connections and around the circumference of free-standing fire department connections, except as otherwise required or *approved* by the fire chief.

**Physical protection.** Where fire department connections are subject to impact by a motor vehicle, vehicle impact protection shall be provided in accordance with International Fire Code.

**Signs.** A metal sign with raised letters at least 1 inch (25 mm) in size shall be mounted on all fire department connections serving automatic sprinklers, standpipes or fire pump connections. Such signs shall read: AUTOMATIC SPRINKLERS or STANDPIPES or TEST CONNECTION or a combination thereof as applicable. Where the fire department connection does not serve the entire building, a sign shall be provided indicating the portions of the building served.

**Backflow protection.** Where rainwater tanks provide water for potable uses, the water supply to automatic sprinkler and standpipe systems shall be protected against backflow as required by the local plumbing code.

**Backwater valve.** Backwater valves shall be installed on each overflow and tank drain pipe in accordance with local plumbing codes.

**Roof washer.** Where a roofwasher is used or required, a sufficient amount of rainwater shall be diverted at the beginning of each rain event, and not allowed to enter the storage tank, to wash accumulated debris from the collection surface. The amount of rainfall to be diverted shall be field adjustable as necessary to minimize storage tank water contamination. The roof washer shall not rely on

manually operated valves or devices, and shall operate automatically. Diverted rainwater shall not be drained to the roof surface, and shall be discharged in a manner consistent with the storm water runoff requirements of the jurisdiction. Roof washers shall be accessible for maintenance and service.

## **Delivery systems.**

### **Water-pressure-reducing valve or regulator.**

Where the water pressure supplied by the delivery system exceeds 80 psi (552 kPa) static, a pressure-reducing valve shall be installed to reduce the pressure in the rainwater distribution system piping to 80 psi (552 kPa) static or less. Pressure-reducing valves shall be specified and installed in accordance with the local plumbing code.

### **Gages. (Reserved)**

### **Gravity feed system (HB230).**

Where water is distributed to the point of use by means of gravity feed system, the minimum flow rate and flow pressure delivered shall be appropriate for the application and in accordance with local plumbing codes.

### **Pump feed system.**

Mechanical equipment, designed to deliver water to the point of use, including pumps, valves and filters shall be easily accessible and removable in order to perform repair, maintenance and cleaning. Where used, the minimum flow rate and flow pressure delivered by the pumping system shall be appropriate for the application and in accordance with local plumbing codes. Where collected rainwater is to be treated to potable water standards, the pump and all other pump components shall be listed, labeled and approved for use with potable water systems.



**Location. (Reserved).**

**Noise (Reserved).**

**Wiring and pump controls (Reserved).**

**Submerged pumps (Reserved).**

**Pressure tanks (Reserved).**

**Check valves (Reserved).**

**Pressure switches (Reserved).**

**Priming (Reserved).**

**Distribution pipe.**

Distribution piping utilized in rainwater collection and conveyance systems shall comply with Sections \*\*through\*\*.

**Exception:** Irrigation piping located outside of the building and downstream of a backflow preventer.

**Materials, joints and connections.**

Distribution piping and joints shall conform to the standards and requirements specified in the local plumbing code for nonpotable water.

**Design.**

Distribution piping systems shall be designed and sized in accordance with the local plumbing code for the intended application.

**Marking.**

Nonpotable rainwater distribution piping shall be of the color purple and shall be embossed or integrally stamped or marked with the words: "CAUTION: NONPOTABLE WATER – DO NOT DRINK" or shall be installed with a purple identification tape or wrap. Identification tape shall be not less than 3 inches (76 mm) wide and have white or black lettering on purple field stating "CAUTION: NONPOTABLE WATER – DO NOT DRINK." Identification tape shall be installed on top of nonpotable rainwater distribution pipes, fastened not greater than every 10 feet (3048 mm) to each pipe length and run continuously the entire length of the pipe. Lettering shall be readily observable within the room or space where the piping is located.

**Exception:** Piping located outside of the building and downstream of the backflow preventer is not required to be purple

**Information.** Pipe identification shall be repeated at intervals not exceeding 25 feet (7620 mm) and at each point where the piping passes through a wall, floor or

roof. Lettering shall be readily observable within the room or space where the piping is located.

**Size.** The size of the background color field and lettering shall comply with Table \*\*.

**TABLE 608.8.3**  
**SIZE OF PIPE IDENTIFICATION**

PIPE DIAMETER (inches)	LENGTH BACKGROUND COLOR FIELD (inches)	SIZE OF LETTERS (inches)
$\frac{3}{4}$ to $1\frac{1}{4}$	8	0.5
$1\frac{1}{2}$ to 2	8	0.75
$2\frac{1}{2}$ to 6	12	1.25
8 to 10	24	2.5
over 10	32	3.5

For SI 1 inch = 25.4 mm.

## CHAPTER 5 NON-POTABLE COLLECTED RAINWATER UTILIZATION (Reserved)

## CHAPTER 6 POTABLE COLLECTED RAINWATER UTILIZATION (Reserved)

## CHAPTER 7 TESTS AND INSPECTIONS

### **Collection pipe and vent test.**

Drain, waste and vent piping used for onsite water reuse systems shall be tested in accordance with local plumbing codes.

**Storage tank tests.** Storage tanks shall be tested in accordance with local plumbing codes and the following:

- 1) Storage tanks shall be filled with water to the overflow line prior to and during inspection. All seams and joints shall be left exposed and the tank shall remain water tight without leakage for a period of 24 hours.
- 2) After 24 hours, supplemental water shall be introduced for a period of 15 minutes to verify proper drainage of the overflow system and verify that there are no leaks.
- 3) The tank drain shall be observed for proper operation.
- 4) The makeup water system shall be observed for proper operation and successful automatic shutoff of the system at the refill threshold shall be verified.

**Inspection and testing of backflow prevention assemblies.** The testing of backflow preventers and backwater valves shall be conducted in accordance with local plumbing codes.

**Inspection vermin and insect protection.** Inlets and vents to the system shall be inspected to verify that each is protected to prevent the entrance of insects and vermin into the storage tank and piping systems in accordance with Section \*\*.

**Water quality test.** The quality of the water for the intended application shall be verified at the point of use in accordance with the requirements of the jurisdiction.

### **Roof gutter inspection and test.**

Roof gutters shall be inspected to verify that the installation and slope is in accordance with Section 1303.5.1. Gutters shall be tested by pouring a minimum of one gallon (3.8 l) of water into the end of the gutter opposite the collection point. The gutter being tested shall not leak and shall not retain standing water.

### **Roofwasher test.**

Roofwashers shall be tested by introducing water into the gutters. Proper diversion of the first quantity of water in accordance with the requirements of Section 1303.4 shall be verified.

### **Collection pipe and vent test.**

Drain, waste and vent piping used for rainwater collection and conveyance systems shall be tested in accordance with local plumbing codes.

**Water supply system test.** The testing of makeup water supply piping and distribution piping shall be conducted in accordance with local plumbing codes.

**Fire department connection inspection, testing and maintenance.** All fire department connections shall be periodically inspected, tested and maintained in accordance with NFPA 25.

### **Potable water testing.**

Collected rainwater to be utilized for approved potable applications shall be tested. Accumulated water to be tested shall be the result of not less than two rainfall events. Testing shall be in accordance with Sections \*\* and \*\*.

**Test methods.** Water quality testing shall be performed in accordance with the latest edition of *APHA—Standard Methods for the Examination of Water and Wastewater* and in accordance with Sections \*\* and \*\*.

**Annual tests required.** Accumulated rainwater used for approved potable applications shall be tested prior to initial use and annually thereafter for *Escherichia coli*, total coliform, heterotrophic bacteria and cryptosporidium.

**Quarterly tests required.** Accumulated rainwater used for approved potable applications shall be tested prior to initial use and quarterly thereafter for pH, filterable solids, residual chlorine if disinfection is used, and turbidity. The pH shall be tested in accordance with ASTM D 5464; filterable solids shall be tested in accordance with ASTM D 5907; residual chlorine shall be tested in accordance with ASTM D 1253 and turbidity shall be tested in accordance with ASTM D 6698.

**Test records.** Test records shall be retained for not less than two years.

## **CHAPTER 8 OPERATION AND MAINTENANCE**

**Operation and maintenance manuals.** Operations and maintenance materials shall be supplied with rainwater collection and conveyance systems in accordance with Sections \*\* through \*\*.

**Manual.** A detailed operations and maintenance manual shall be supplied in hardcopy form with all systems.

**Schematics.** The manual shall include a detailed system schematic, locations of all system components, and a list of all system components including manufacturer and model number.

**Maintenance procedures.** The manual shall provide a maintenance schedule and procedures for all system components requiring periodic maintenance. Consumable parts including filters shall be noted along with part numbers.

**Operations procedures.** The manual shall include system startup and shutdown procedures. The manual shall include detailed operating procedures for the system.

- a) Test records

### **Sediment disposal.**

Tank sediment shall be disposed of in accordance with local requirements according to the level of hazard associated with the waste.

### **System commissioning and startup.**

The following procedures for initial and periodic disinfection shall apply to storage tanks:

- 1) All loose debris, sediment, mineral encrustation and biofilm shall be removed from the storage tank prior to disinfection.
- 2) A solution of 250 mg/L of chlorine shall be prepared in a storage container. The quantity of solution prepared shall be of sufficient volume to disinfect the entire cistern and all related storage or pressure tanks, existing plumbing and attached plumbing fixtures.
- 3) The solution shall be used to thoroughly rinse all sides of the storage tank and discharged. A second chlorine solution of 250 mg/L of chlorine shall then be circulated through the water supply system and distribution lines.

## **CHAPTER 9 SYSTEM ABANDONMENT**

### **Permanent system abandonment.**

If the owner of a rainwater collection and conveyance system elects to cease use of, or fails to properly maintain such system, the system shall be permanently abandoned and shall comply with the following:

1. System piping connecting to a utility-provided water system shall be removed or disabled.
2. The rainwater distribution piping system shall be replaced with an *approved* potable water supply piping system. Where an existing potable pipe system is already in place, the fixtures shall be connected to the existing system.
3. The storage tank shall be secured from accidental access by sealing or locking tank inlets and access points, or filling with sand or equivalent.

### **Temporary closure.(Reserved)**

If the rainwater collection and conveyance system is shutdown temporarily for a period exceeding \* days for purposes of maintenance, facility renovations, etc....

## System restart.(Reserved)

## Appendix A: Rainwater Collection Estimation

The volume of rainwater collected from a rainwater collection system can be estimated for a given precipitation event or a specified period of time using past precipitation data. The equation for estimating the volume of rainwater collected for a specified time period is provided in Equation \*\*.

$$Q(\text{gal}) = \varepsilon(0.623)A(\text{ft}^2)y(\text{in})$$

$$Q(\text{L}) = \varepsilon A(\text{m}^2)y(\text{mm})$$

where:

Q = Collected volume of rainwater.

$\varepsilon$  = Yield coefficient.

A = Catchment area of the rainwater collection surface.

y = Depth of precipitation over the specified time period.

gal = Gallons

$\text{ft}^2$  = Square feet

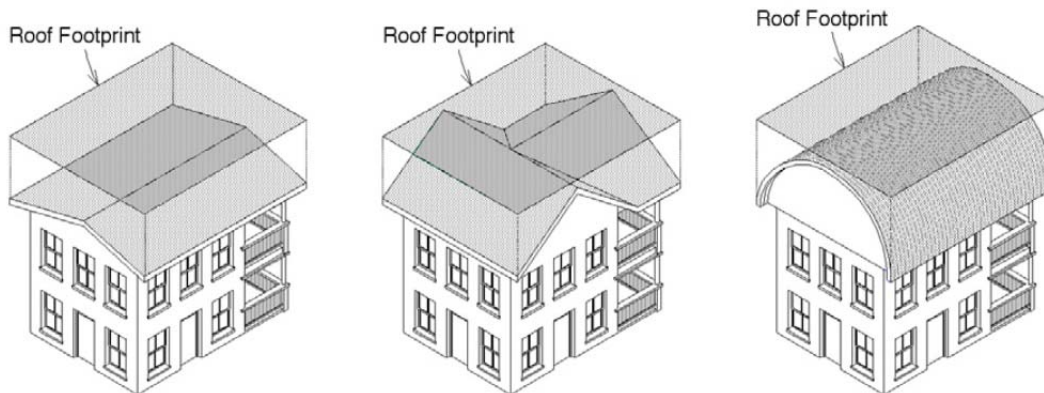
in = Inches

L = Liters

$\text{m}^2$  = Square meters

mm = millimeters

The catchment area of rooftop rainwater collection surfaces can be calculated using the horizontal equivalent or the “roof footprint” as shown in Figure \*\*.



The yield coefficient of the system is a measure of the incident rainwater lost to evaporation, absorption, deflection, leaks, and edge runoff. It is a function of several variables, including precipitation intensity and angle, roofing material (roughness and absorbency), roof slope, roof orientation, temperature and relative humidity. Common estimates of yield coefficient for various types of roofing materials are provided in Table \*\*. Further modification of these values may be necessary for systems with above average leakage or deflection losses.

**TABLE \***  
**COMMON YIELD COEFFICIENTS FOR VARIOUS TYPES OF ROOFING**

ROOFING TYPE	YIELD COEFFICIENT ( $\epsilon$ )
Sheet Metal	0.8-0.85
Cement Tile	0.62-0.69
Clay tile	0.24-0.39

[FROM DIN 1989 – FOR REFERENCE ONLY]

**Table 3 — Yield Coefficients**

Composition	Yield Coefficient % e
Slanted hard roof <sup>a</sup>	0.8
Flat roof, without gravel	0.8
Flat roof, with gravel	0.6
Green roof, intensive	0.3
Green roof, extensive	0.5
Paved surface/compound paved surface	0.5
Asphalt covering	0.8
<sup>a</sup> Deviations depending on the absorbency and roughness	

## Appendix B: Water Demand Estimation Method

### Plumbing Fixture Consumption

**PLUMBING FIXTURE WATER CONSUMPTION  
To Estimate Nonpotable Water Consumption**

Plumbing Fixture or Supply Fitting	Average Flow Rate or Volume <sup>b</sup>	Duration	Daily Uses Per Occupant	Occupants <sup>h</sup>	Daily Volume Gallon per day
Urinal	1.0 gpc <sup>f</sup>	1 cycle	2/male		
Water closet in other than dwelling units and guest rooms	1.6 gpc <sup>f</sup>	1 cycle	1/male <sup>g</sup>	males	
			3/female	females	
Water closet in dwelling units and guest rooms <sup>i</sup>	1.6 gpc <sup>f</sup>	1 cycle	6/male	males	
			6/female	females	
				Total Reference Water Use (R) (gal/day)	
For SI: 1 gallon = 3.785 L, 1 gallon per minute = 3.785 L/m, 1 pound per square inch = 6.895 kPa.					

b. Consumption tolerances shall be determined from referenced standards.

c. For shower heads, the number of occupants shall be based upon the anticipated number of shower users. Residential and hotels shall presume 1 shower per occupant per day. Residential occupancy as regulated by the code in accordance with Section 101.2.

d. Flow at 60 psi

e. Flow at 80 psi

f. Gallons per cycle (gpc)

g. The daily use per male occupant shall be 3 where urinals are not installed



- h. The number of occupants shall be that number used to determine the required number of plumbing fixtures in accordance with the International Plumbing Code.

## HVAC Consumption

## Irrigation Consumption

## Appendix D: Tank Sizing Methods

### Dry Period Demand

- Longest average time period without significant rainfall x use/day

### Simple Tabular Method

- Data over one year used (use worst year where several available – lowest annual rainfall or longest dry period).

### Graphical Method

### Mass Curve Analysis

### Dimensionless Constant Analysis

## Appendix F: Rainwater Uses

- 1) Non-potable collected rainwater utilization
  - a) Landscape irrigation
  - b) Water features and ornamental fountains
  - c) Swimming pools and spas
  - d) Toilet and urinal flushing
  - e) Automatic fire suppression systems
  - f) Fire pump testing
  - g) Trap priming
  - h) Clotheswashing
  - i) Cooling tower makeup
  - j) Industrial processes
  - k) Hose bibbs
  - l) Carwashes
  - m) Roof cooling
  - n) Agricultural cooling cells
  - o) Evaporative coolers
  - p) Subsurface infiltration and groundwater recharge
- 2) Potable collected rainwater utilization

- a) Drinking and cooking
- b) Bathing
- c) Dishwashing
- d) Animal watering
- e) Swimming pools and spas