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Rainwater Harvesting Systems – PUBLIC REVIEW DRAFT 1

Note: This draft is under development and subject to change; it should not be used for reference purposes.

Public comments are requested on this first Public Review Draft beginning September 24, 2015 and are due by ~~November 24, 2015~~ December 7, 2015. Public comments must be submitted on using the CSA Group Public Review site at http://publicreview.csa.ca/Home/Details/1773 Questions regarding the public review process or comment submission process can be directed to the committee secretariats Paul Gulletson (paul.gulletson@csagroup.org), Shawn Martin (smartin@iccsafe.org).

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Preface

This is the first public review edition of CSA/ICC B805-201x, *Rainwater Harvesting Systems*. This draft standard is intended solely for use by CSA Group and ICC joint committee members and to solicit comments on the draft from the public. This draft may not be reproduced or redistributed, in whole or in part, by any means whatsoever without the prior permission of CSA Group and ICC.

Public comments are requested on this first Public Review Draft beginning September 24, 2015 and are due by November 24, 2015. Public comments must be submitted on using the CSA Group Public Review site at http://publicreview.csa.ca/Home/Details/1773 Questions regarding the public review process or comment submission process can be directed to the committee secretariats Paul Gulletson (paul.gulletson@csagroup.org), Shawn Martin (smartin@iccsafe.org).

The Standard was developed through the collaboration from many knowledgeable experts and representatives from Canada and the United States of America.
This Standard was developed by the Joint Technical Committee on Rainwater Harvesting Systems under the jurisdiction of the CSA Strategic Steering Committee on Construction and Civil Infrastructure and the ICC Codes and Standards Committee, and will be formally approved by the Joint Technical Committee.

Notes:

(1) Use of the singular does not exclude the plural (and vice versa) when the sense allows.

(2) Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.

(3) This Standard was developed by consensus, which is defined by CSA Policy governing standardization — Code of good practice for standardization as "substantial agreement. Consensus implies much more than a simple majority, but not necessarily unanimity". It is consistent with this definition that a member may be included in the Technical Committee list and yet not be in full agreement with all sections of this Standard.

(4) To submit a request for interpretation of this Standard, please send the following information to inquiries@csagroup.org and include "Request for interpretation" in the subject line:
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(b) provide an explanation of circumstances surrounding the actual field condition; and
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(a) Standard designation (number);
(b) relevant section, table, and/or figure number;
(c) wording of the proposed change; and
(d) rationale for the change.

0 Introduction

This standard addresses both roof surface rainwater and storm water (i.e., rainwater that has come in contact with the ground) being used as the source water. The term rainwater harvesting is used generically in the document and can include either roof collected rainwater or storm water as the source.

Recognizing that public health risk increases with the number of persons using a treated water system, this standard provides different methods for protecting water quality based on the type of system and the application.

For single family dwelling systems, the Standard does not require sampling and testing of the output rainwater quality to substantiate performance. It recognizes the lower risk to the public and relies on sound treatment system design and verification of the treatment system operation.

In order to ensure the consideration of the wide range of variables associated with each site, location, design, and application, this standard requires a water safety plan be developed for each system. The water safety plan considers the specific challenges and risks presented by the site impact on source water quality, operation of system components and the risk associated with the use. The water safety plan requires the development of a sound method of verifying treatment processes are operating effectively and as intended, including water quality monitoring for systems serving more than 25 people.

Potential uses of rainwater are separated into 4 tiers that consider the potential risk of ingestion, inhalation, and skin contact. These 4 tiers are further separated into two groups; one group for single family residential and a second for multifamily and commercial/public facilities which are reflected in two different tables. Also included is a sub-tier for evaporative cooling systems.

This Standard sets out minimum performance criteria for each tier of water use in consideration of the risk and identifies possible treatment process options to meet the specified performance criteria. While specific treatment technologies are addressed, the use of other treatment processes that meet the required performance criteria is not intended to be restricted by this standard.

Storm water is expected to have a higher likelihood of fecal contamination (including sewage/septic seepage) picked up during overland flow. Therefore, this standard sets out additional stringent treatment process requirements for storm water, and prohibits its use for potable applications

This standard establishes suitable water quality parameters based on the expected source water quality that are used to substantiate that the treatment process is operating as intended to produce safe water for the specified use.

The water quality parameters set out in the standard that are expected of a system and used to substantiate treatment effectiveness differ from typical parameters used in wastewater treatment as the levels of contaminants expected in rainwater and storm water differ from wastewater.

1 Scope

1.1 Inclusions

1.1.1

The provisions of this Standard apply to the design, materials, installation, and operation of rainwater harvesting systems for potable and non-potable applications. Rainwater harvesting systems covered by this Standard include systems used as a source of water for onsite use or stormwater management.

1.1.2

This Standard covers the use of both rainwater and storm water as the source water.

Note: *Rainwater includes all forms of water from natural precipitation including but not limited to rain, snowmelt, etc.*

1.2 Exclusions

This Standard does not apply to

(a) rainwater harvesting systems that provide water for the following applications:

(i) process water systems for industrial or manufacturing purposes;

(ii) water distribution systems for commercial agricultural processes; and

(iii) irrigation of food crops;

and

(b) rain barrels, as defined by the local authority having jurisdiction, not connected to the plumbing system.

1.3 Terminology

In this Standard, “shall” is used to express a requirement, i.e., a provision that the user is obliged to satisfy in order to comply with the standard; “should” is used to express a recommendation or that which is advised but not required; and “may” is used to express an option or that which is permissible within the limits of the standard.

Notes to tables and figures are considered part of the table or figure and may be written as requirements.

Annexes are designated normative (mandatory) or informative (non-mandatory) to define their application.

2 Reference publications

This Standard refers to the following publications, and where such reference is made, it shall be to the edition listed below, including all amendments published thereto.

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M43-2009

Standard Specification for Sizes of Aggregate for Road and Bridge Construction

American Society of Mechanical Engineers (ASME)

ASME B16.5-2013
Pipe Flanges and Flanged Fittings

ASME A112.6.9-2005
Siphonic Roof Drains

American Society of Plumbing Engineers (ASPE)

ASPE 45-2013
Siphonic Roof Drainage Systems

ASTM

ASTM A36-2014
Standard Specification for Carbon Structural Steel

ASTM D413-1998
Standard Test Method for Rubber Property--Adhesion to Flexible Substrate

ASTM D471-2012a
Standard Test Method for Rubber Property—Effect of Liquids

ASTM A592-2010
Standard Specification for High-Strength Quenched and Tempered Low-Alloy Steel Forged Parts for Pressure Vessels

ASTM A675-2014
Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties

ASTM D751-2006
Standard Test Methods for Coated Fabrics

ASTM D1193-1999e1
Standard Specification for Reagent Water

ASTM D1204-2014
Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature

ASTM D1621-2010
Standard Test Method for Compressive Properties of Rigid Cellular Plastics

ASTM D2136-2002
Standard Test Method for Coated Fabrics—Low-Temperature Bend Test

ASTM D2488-2009a
Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)

ASTM D3389-2010
Standard Test Method for Coated Fabrics Abrasion Resistance (Rotary Platform Abrader)

ASTM E2727-2010e1
Standard Practice for Assessment of Rainwater Quality

American Water Works Association (AWWA)

AWWA D100
Welded Carbon Steel Tanks for Water Storage

AWWA D103
Factory-Coated Bolted Carbon Steel Tanks for Water Storage

AWWA D115
Tendon-Pre-stressed Concrete Water Tanks

AWWA D120
Thermosetting Fiberglass-Reinforced Plastic Tanks

AWWA D121
Bolted Aboveground Thermosetting Fiberglass-Reinforced Plastic Panel-Type Tanks for Water Storage

AWWA D107
Composite Elevated Tanks for Water Storage

CSA Group

CAN/CSA-B64.10-11/CAN/CSA-B64.10.1-11
Manual for the selection and installation of backflow prevention devices/Manual for the maintenance and field testing of backflow prevention devices

CSA B126-13

Water cisterns

Federal Test Method
FTM STD. No. 101C (method 2065) Test Method for Puncture Resistance and Elongation Test

Health Canada
Guidelines for Canadian Drinking Water Quality (published by Health Canada on behalf of the Federal-Provincial-Territorial Committee on Drinking Water)

International Association of Plumbing and Mechanical Officials (IAPMO)
IAPMO/ANSI Z1002
Rainwater Harvesting Tanks

International Code Council (ICC)
2015 International Fire Code

2015 International Mechanical Code

2015 International Plumbing Code

2015 International Green Construction Code

National Fire Protection Association (NFPA)

NFPA 13-2013
Standard for the installation of fire sprinkler systems

NFPA 13D-2013
Standard for the installation of sprinkler systems in one and two-family dwellings and manufactured homes

NFPA 13R-2013
Standard for the installation of sprinkler systems in low-rise residential occupancies

NFPA 14-2013
Standard for the installation of standpipe and hose systems

NFPA 20-2013
Standard for the installation of stationary pumps for fire protection

NFPA 22-2013
Standard for water tanks for private fire protection

NFPA 70-2014
National Electrical Code

NFPA 1142-2012
Standard on water supplies for suburban and rural fire fighting

National Research Council (NRC)

National Building Code of Canada 2010

National Plumbing Code of Canada 2010

National Wood Tank Institute (NWTI)

NWTI Technical Bulletin S-82

NSF International

NSF 53-2013
Drinking Water Treatment Units – Health Effects

NSF 55-2014
Ultraviolet Treatment

NSF 60
Drinking Water Treatment Chemicals – Health Effects

NSF 61-2014a
Drinking Water System Components – Health Effects

NSF 372-2011
Drinking Water System Components – Lead Content

NSF P151-1995
Health Effects from Rainwater Catchment Systems Components

NSF 330-2013
Glossary of Drinking Water Treatment Unit Terminology

Underwriters Laboratory (UL)

UL 58
Standard for Steel Underground Tanks for Flammable and Combustible Liquids

UL 142
Steel Aboveground Tanks for Flammable and Combustible Liquids

UL 508
Standard for Industrial Control Equipment

UL 508A
Standard for Industrial Control Panels

UL 1316
Glass-Fiber-Reinforced Plastic Underground Storage Tanks for Petroleum Products, Alcohols, and Alcohol-Gasoline Mixtures

Underwriters Laboratory Canada (ULC)

ULC S601
Shop Fabricated Steel Aboveground Tanks For Flammable and Combustible Liquids

ULC S603
Standard for Steel Underground Tanks for Flammable and Combustible Liquids

3 Effect of other codes

3.1 Coordination with other Codes

Rainwater harvesting systems shall also comply with the requirements adopted by the authority having jurisdiction.

Note: *In the absence of such local requirements, the relevant requirements of the International Building Code, International Plumbing Code, International Mechanical Code, International Fire Code, National Electrical Code (NFPA 70), National Building Code of Canada, National Plumbing Code of Canada, National Fire Code of Canada and Canadian Electrical Code shall apply, as applicable.*

3.2 Conflicts

Where conflicts occur between provisions of this standard and the referenced standards, the provisions of this standard shall apply.

3.3 Superiority of laws

The provisions of this standard shall not be deemed to nullify any provisions of local, state, provincial, territorial, or federal law.

4 Limits of liability

This Standard does not provide or imply any assurance or guarantee about the life expectancy, durability, operating performance, or workmanship of the equipment, materials, or undertaking.

5 Definitions and abbreviations

5.1 Definitions

The following definitions apply in this standard.

Accessible: Fabricated to be exposed for cleaning and inspection using simple tools (screwdriver, pliers, open-end wrench). See "Readily Accessible"

Alarm: A signal indicating a critical component or system failure requiring immediate action.

Alert: A signal or notification indicating a non-critical component or system condition.

Alarm set point: The conditions under which a sensor activates an alarm.

Air gap: The unobstructed vertical distance through the free atmosphere between the outlet of the pipe and the flood level rim of the receptacle into which the pipes is discharging.

Approved: Acceptable to the code official or other authority having jurisdiction.

Backflow: A reversal of flow or flow in the opposite direction to the normal direction of flow.

Backflow preventer: A backflow prevention assembly, a backflow prevention device or other means or method to prevent backflow into the potable water supply.

Backwater valve: A device or valve installed in the building drain or sewer pipe where a sewer is subject to backflow, and prevents drainage or waste from backing up into a lower level or fixtures and causing a flooding condition.

Bypass water. Secondary water supplied to a rainwater system downstream of the storage tank for the purpose of recharging a rainwater system as an emergency backup provision.

Canal: A scupper or drainage structure from a flat or low-sloped roof that allows rainwater to free fall to a catch basin below.

Catch basin: A ground-level rainwater harvesting system inlet designed to capture surface waters or discharge from a canal.

Cistern: See "Storage tank."

Cleanout: An access opening in the drainage system utilized for the removal of obstructions. Types of cleanouts include a removable plug or cap, and a removable fixture or fixture trap.

Clear water wastes: Waste water containing no impurities or contaminants that are harmful to a person's health, plant or animal life or that impair the quality of the natural environment. Examples include, but are not limited to, cooling water and condensate drainage from refrigeration compressors and air-conditioning equipment, water used for equipment chilling purposes and cooled condensate from steam-heating systems or other equipment.

Collection: Open areas that come into contact with rainwater precipitation such as, but not limited roofs and paved areas.

Conveyance: That portion of a rainwater harvesting system that conveys collected rainwater from collection to the point of untreated rainwater storage. This includes, but is not limited to gutters, downspouts, leaders and conductors.

Conveyance pipe: Unpressurized pipe used within the conveyance subsystem that drains rainwater or stormwater to a storage tank by gravity.

Conductor: A pipe inside a building that conveys rainwater or storm water from the roof to a storm or combined building drain. See "Leader."

Contaminant: An undesirable organic or inorganic, or soluble or insoluble substance in water. This definition includes microbiological organisms.

Control: manual or automatic devices and control algorithm designed to regulate the operation of, a mechanical system in a safe and efficient manner.

Corrosion-resistant: Capable of maintaining original surface characteristics under prolonged contact with the intended end use environment and exposure to cleaning or sanitizing procedures according to the manufacturer's recommendation.

Day tank: a temporary holding tank for a limited volume of treated water to be provided for end use. (also known as buffer tank, batch tank)

Disinfection: The act of eliminating disease-causing microorganisms from contaminated water either by physical removal or by killing/inactivating them.

Distribution: Piping systems and components that convey rainwater from the point of treated storage to the point of end use.

Drainage system: Piping within a public or private premise that conveys sewage, rainwater or other liquid waste to a point of disposal. A drainage system does not include the mains of a public sewer system or a private or public sewage treatment or disposal plant.

Drinking water: See "Potable water."

Evaporative cooling system: The equipment and appliances intended or installed for the purpose of environmental cooling by an evaporative cooler from which the conditioned air is distributed through ducts or plenums to the conditioned area.

Effluent: The treated water at the outlet of a unit, system, component, or process.

First-flush diverter: A device or method for removal of sediment and debris from collection surface by diverting initial rainfall from entry into the storage tank.

Irrigation system: A system of pipes, fittings, and valves to distribute irrigation water.

Leader: An exterior drainage pipe for conveying storm water from roof or gutter drains to an approved means of disposal or treatment. See "Conductor."

Makeup water. Secondary water supplied to the rainwater storage tank for the purpose of recharging a rainwater system as an emergency backup provision.

Non-potable water: Water not safe for drinking, personal or culinary utilization.
Note: This means that non-potable water is not destined for human consumption. See Table 6.2.2 and Table 6.2.3.

Non-potable water system: An assembly or portion thereof of pipes, fittings, valves, and appurtenances that collects and distributes non-potable water. A non-potable water system can include storage tanks, pressurization equipment, and treatment systems.

Potable water: Water that meets human consumption quality standards, as established by the authority having jurisdiction.

Rainwater harvesting system: a system intended to collect, convey, store, treat, and distribute rainwater for use. Also known as "rainwater collection system" or "rainwater catchment system."

Rainwater: water from natural precipitation.

Readily accessible: Fabricated to be exposed for cleaning and inspection without using tools.

Rainwater Inlet: The point of discharge from the conveyance piping into the storage tank.

Rainwater Outlet: The point of entrance at the storage tank into the distribution system.

Reclaimed water: Water that has been derived from the treatment of wastewater by a facility or system licensed or permitted to produce water meeting the jurisdiction's water requirements for its intended uses. Also known as "recycled water." [IPC]

Sewer: A pipe that transports liquid and solid materials from a source to a treatment plant

Public sewer: That part of the drainage system of pipes, installed and maintained by a city, township, county, public utility company or other public entity, and located on public property, in the street or in an approved dedicated easement of public or community use.

Slope: The fall (pitch) of a line of pipe or gutter in reference to a horizontal plane. In drainage, the slope is expressed as the fall in units vertical per units horizontal (percent) for a length of pipe or gutter, in ratio format (1 in 50), or in defined units (1 inch in 8 feet).

Storage: That portion of a rainwater harvesting system where collected water is stored, including, but not limited to storage tanks or reservoirs containing untreated rainwater, storage tanks containing treated rainwater for its intended use, and piping systems and components that convey rainwater from untreated storage to treated storage.

Storage tank: a liquid retention tank connected to a plumbing system or irrigation system. Also known as "Cistern"

Stormwater: Overland water flow caused by precipitation or snowmelt events that occur in volumes or rates that exceed the infiltration capacity of the soil or pervious surfaces.

Supports: Devices for supporting and securing pipe, fixtures and equipment.

Surface water: All water naturally open to the atmosphere (rivers, lakes, reservoirs, ponds, streams, impoundments, seas, estuaries, etc.)

Third-party certification agency: An approved agency operating a product or material certification system that incorporates initial product testing, assessment and surveillance of a manufacturer's quality control system.

Third-party certified: Certification obtained by a manufacturer indicating that the function and performance characteristics of a product or material have been determined by testing and ongoing surveillance by an approved third-party certification agency. Assertion of certification is in the form of identification in accordance with the requirements of the third-party certification agency.

Ultra Violet Transmission (UVT): the measure of a UV light's ability to penetrate the water across 1 cm path length.
Note: *This value is a measurement of the water. For example, water from a metal roof after a 350 micron filter might have a UVT of 90%. As water quality changes, the UVT% of said water also changes.*

UV dose: UV dose is measured in mJ/cm2

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 distribution system: An assembly of pipes, fittings, valves, and other equipment that conveys water from its source to its intended point of use or destination.

Water Safety Plan (WSP): A plan to ensure the safety of water used for specified purposes through the application of a comprehensive risk and management approach that encompasses all steps from the source water to end use. A Water Safety Plan includes the concepts of a Hazard Analysis Critical Control Point (HACCP) for the management of water systems.

5.2 Terms not defined

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

5.3 Abbreviations

The abbreviations used in this standard are defined as follows:

A - catchment area
AAR - average annual rainfall
ARY - annual rainwater yield
AOWD - annual output water demand
BOD_5 – 5 day biochemical oxygen demand
C – minimum tank volumetric capacity
C_{abs} - rainfall abstraction associated with absorption and wetting of surfaces
C_w –weighted runoff coefficient
CU – commercial use
cm – centimeters
CMF – Commercial/multi-family
COD – chemical oxygen demand
daN - dekanewton
D – dead storage
dB – decibels
EC – evaporative cooling use
F - efficiency of the pre-storage filter
F_{abs} - rainfall abstraction associated with pre-storage filtration
FR – dedicated fire reserve storage volume
ft - feet
GPM – US gallons per minute
HPC –Heterotrophic plate count
IS – irrigation use
LPM – liters per minute
kPA – kilopascals
L - liters
LPM – liters per minute
Lx - lux
m – meters
mm - millimeters
mj – millijoules
NTU – nephelometric turbidity unit
OW – output water storage volume
OT – Other uses
ORP – oxidation reduction potential
PD – percent dead space
PSI – pounds per square inch
RD – design rainfall depth
RU – residential use

SF – storage loss factor
SFR – Single-family residential
SW – stormwater management storage volume
TSS – total suspended solids
UV - ultraviolet
WSP – water safety plan
HPC – heterotrophic plate count

6 General system requirements

6.1 General objectives and requirements

6.1.1 Output water quality

The system shall be designed to reliably treat and deliver the source water to a quality that is deemed to be safe for the intended use as set out in Section 6.2.

Note: *Rainwater Harvesting Systems should employ multi-barrier or a treatment train design approach to reduce accumulation, introduction, and re-introduction of contaminants into the system.*

6.1.2 Water Safety Plan (WSP)

6.1.2.1 General

A WSP shall be developed for rainwater harvesting systems.

6.1.2.2 Rationale for a WSP

The WSP should reflect regional, local, and site-specific water quality concerns. A WSP is intended to recognize, address, and improve water quality and water quality concerns for rainwater harvesting systems for potable and non-potable uses. It is important to document the full scope of the rainwater harvesting system in order to identify system components, scope of system supply, parties responsible for system maintenance, and operational guidelines for the rainwater harvesting system. Guidance on developing a WSP is included in Annex E.

6.1.2.3 Elements of a WSP

The elements of a WSP shall include the following:
(a) Site assessment and fit for purpose;
(b) Hazard identification and risk prioritization;
(c) System design and identification of control points;
(d) Operational monitoring, system verification, and response;
(e) Supporting programs, measurement procedures, and documentation.

6.1.3 Continuity of supply

Where rainwater harvesting systems serve as a primary supply for a distribution system a secondary water supply shall be provided where required by the authority having jurisdiction. The secondary supply shall comply with Section 7.2.3.7 and applicable plumbing codes.

6.1.4 System sizing

The required storage capacity of the system for the intended system design needs shall be based on:

(a) precipitation data generated by Environment Canada or U.S National Oceanic and Atmospheric Association (NOAA) National Climatic Data Center or other acceptable localized data;
(b) available collection area;
(c) anticipated demand; and
(d) applicable code requirements.

6.1.5 Limit effect on other building systems and structures

Installation of the system shall not compromise the site, structural integrity of the building and related structures, the safety of the building occupants and general public.

6.1.6 Protection of potable water systems

6.1.6.1 General

Rainwater harvesting systems shall be designed, installed, and maintained to prevent contamination of potable water supplies or potable water distribution piping.

6.1.6.2 Backflow prevention

Where a potable water system is connected to a rainwater harvesting system, the potable system and supply shall be protected against backflow by means of
(a) an air gap; or
(b) an approved backflow protection assembly or device for the application, in accordance with the plumbing code.

6.1.7 Protection of harvested water from contamination

Harvested rainwater shall be protected from external contamination in accordance with the requirements of this standard.

6.1.8 Insect and vermin intrusion control

The system shall be protected to prevent the entrance of insects and vermin into storage tanks, vents, and piping systems in accordance with the plumbing code and this standard.

6.1.9 Local conditions

The system design, installation and materials shall be suitable for local conditions which include but are not limited to,
(a) freezing conditions;
(b) excessive heat;
(c) high wind conditions;
(d) seismic events;
(e) potential for extreme rainfall events;

(f) dust or other airborne contaminants that may adversely affect source water quality; and
(g) seismic conditions.

6.1.10 Access

Access to system components shall be restricted to prevent contamination, vandalism, and unauthorized access in accordance with this standard and applicable codes.

6.1.11 System documentation

A manual shall be supplied with all systems and include standard operating procedure under normal operating conditions, such as system start-up and shutdown procedures, as well as contingencies and emergency procedures for system failure, loss of treatment, or other emergency conditions. The manual shall include a system description, detailed system piping and wiring schematics, and locations of all system components as installed, including manufacturer and model numbers. 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.

6.1.12 Permits

6.1.12.1 General

Any owner, or owner's authorized agent who desires to construct, alter, or abandon a rainwater harvesting system shall first make application for required permits, in accordance with the requirements of the authority having jurisdiction. Where the end use of an existing rainwater harvesting system is changed or modified, the system design parameters shall be re-evaluated and all requirements of this Standard shall apply.

6.1.12.2 Construction documents

The following documents shall be provided to the authority having jurisdiction with an application for permit:
(a) System description and design narrative
(b) List of end uses
(c) Site plan
(d) System specification and bill of materials
(e) Piping diagram
(f) Wiring schematics
(g) Water Safety Plan in accordance with Annex E.
(h) Operations and Maintenance manual (where required by the authority having jurisdiction)

6.1.13 Removal from service

6.1.13.1 Abandonment

Where a rainwater harvesting system is permanently removed from service the following shall apply:

(a) All system piping connecting to a secondary water system shall be removed or disabled;
(b) Storage tanks shall be abandoned in accordance with Section 7.2.3.6.4;

(c) Inlet piping shall be disconnected and redirected to approved drain systems;
(d) Vents, inlets and outlets, and related piping shall be sealed;
(e) Electrical, power and control wiring shall be disconnected; and
(f) Local applicable code requirements.

6.1.13.2 Decommissioning

Where a rainwater harvesting system is seasonally or temporarily removed from service, the following shall apply:

(a) All system piping connected to a utility-provided water system shall locked out or disabled;
(b) The storage tank shall be secured from unauthorized access;
(c) Inlet piping shall be redirected to approved drain systems;
(d) Electrical power shall be shut down; and
(e) Local applicable code requirements.

6.2 End use tiers

6.2.1 General

6.2.1.1 End use tier categorization

The water end use tier categorization shall be as given in Table 6.2.2 and Table 6.2.3 for residential and commercial applications, respectively. Each end use tier is categorized based on the following three elements:
(a) potable or non-potable water quality;
(b) End uses; and
(c) Indicative risk for potential for human contact, including ingestion, inhalation, and skin contact

Each end use tier comprises common end use applications and is not intended to be an exhaustive list. Where end uses are not listed, the application shall be categorized based on the criteria given in Clause 6.2.1.2.

6.2.1.2 End uses and indicative risk

The level of indicative risk for human contact through ingestion, inhalation, or skin contact is characterized as low, medium, or high under normal operation for the intended use. A low level of risk applies to end uses where humans rarely come in contact with the treated rainwater due to the nature of the installation that limits direct or indirect contact under normal operation. A medium level of risk applies to end uses where human contact with the treated rainwater is indirect or limited under normal operation. A high level of risk applies to end uses where human contact with the treated rainwater is direct under normal operation.

6.2.2 End use tiers for residential applications

Rainwater collected for use in residential application shall be categorized in accordance with Table 6.2.2.

TABLE 6.2.2

END USE TIERS FOR RESIDENTIAL APPLICATIONS AND RISKS WITHOUT MITIGATION MEASURES

End Use Tier	Category (potable/non-potable)	End Uses (Included but not limited to)	Indicative Risk (Low, Medium, High)			Overall Risk
			Ingestion	Inhalation	Skin Contact	
R1	Non-Potable	• Trap Primers • Irrigation • Fire suppression	Low	Low	Low	Low
R2	Non-Potable	• Toilet/urinal flushing • Clothes washing	Low	Med	Low	Med
R3	Non-Potable	• Hose bibbs • Pressure washing • Decorative fountains • Vehicle washing	Med	High	High	High
R4	Potable	• Human consumption • Oral care • Food preparation • Dishwashing • Bathing/ showering • Pool/hot tubs	High	High	High	High

6.2.3 End use tiers for multi-residential and non-residential applications

Rainwater collected for use in multi-residential and non-residential applications shall be categorized in accordance with Table 6.2.3.

TABLE 6.2.3
END USE TIERS FOR MULTI-RESIDENTIAL AND NON-RESIDENTIAL APPLICATIONS AND RISKS WITHOUT MITIGATION MEASURES

End Use Tier	Category (potable/non-potable)	End Uses (Included but not limited to)	Indicative Risk (Low, Medium, High)			Overall Risk
			Ingestion	Inhalation	Skin Contact	
1	Non-Potable	• Trap Primers • Irrigation • Fire suppression • Ice rinks	Low	Low	Low	Low
2a	Non-Potable	• Toilet/urinal flushing • Clothes washing • Rooftop thermal cooling	Low	Med	Low	Med

2b	Non-Potable	• HVAC evaporative cooling (e.g., cooling tower, evaporative condenser, spray cooler, direct/indirect evaporative cooling)	Low	High	Med	Med
3	Non-Potable	• Hose bibbs • Building/pressure washing • Decorative fountains • Commercial vehicle washing	Med	High	High	High
4	Potable	• Human consumption • Dishwashing • Food preparation • Oral care • Bathing/Showering/Handwashing • Pool/Spas/Hot tubs/Splash pads • Misting stations • Swamp coolers	High	High	High	High

7 System design and installation

7.1 General

7.1.1 Material compatibility

Materials used in rainwater harvesting systems shall be manufactured of material approved for the intended application and compatible with treatment processes used.

7.1.2 Materials for potable systems

Where collected rainwater is to be used for potable water applications, all materials contacting the water shall comply with NSF 61. All materials contacting the water shall have a weighted average lead content of 0.25 percent or less in accordance with NSF 372. Solders and fluxes used in rainwater harvesting systems supplying potable water shall not have a lead content greater than 0.2 percent.

Exceptions:

(a) Collection surfaces;

(b) Conveyance systems (gutters, leaders, downspouts, roof drains);

(c) Collection piping, conductors and components;

7.1.3 Pressure and temperature

Components used in rainwater harvesting systems shall be approved for use at the operating water temperature and rated for the maximum pressure anticipated within the system.

7.1.4 Seismic considerations

Where required by the building code, rainwater harvesting systems and components shall be designed and installed to withstand the anticipated seismic forces in accordance with the building code.

7.1.5 Below ground piping

Buried collection and distribution piping shall maintain the separation distances from potable water piping set out in the requirements of the authority having jurisdiction. Buried collection and distribution piping shall be protected from damage and potential sources of contamination in accordance with the plumbing code.
Exception: Irrigation piping located outside of a building and downstream of the backflow preventer.

7.1.6 Electrical wiring

7.1.6.1 General

Electrical wiring shall be sized and installed in accordance with the electrical code and the manufacturers' instructions.

7.1.6.2 Wiring identification

Control circuit wiring and terminals shall be identified in accordance with the electrical code.

7.1.6.3 Protection of electrical components

Overload and overcurrent protection of electrically operated components shall be consistent with the maximum current rating of the device and the electrical code

7.1.7 Controls

7.1.7.1 General

Controls for rainwater harvesting systems are required to ensure:
(a) Effective and safe operation of the system,
(b) Continuous supply of water as applicable,
(c) Operation is within intended design parameters of the system,
(d) Minimum treated water quality is within design parameters.
(e) Volume and discharge rate are in compliance with stormwater management requirements specified by the authority having jurisdiction.

7.1.7.2 Environmental protection

Controls and associated components shall be suitable for the environment in which they are installed. Wires, connections, sensors, pneumatic lines, hydraulic lines used to transmit control signals shall be protected from corrosion or signal degradation that would compromise system operations.

7.1.7.3 Bypass and override

Safety controls shall not have provision for bypass or override.

7.1.7.4 Access and labeling of controls

Control systems and components shall be labeled and accessible for operation and maintenance in accordance with this standard and applicable codes.

7.1.7.5 Notification

7.1.7.5.1 General

Notification of system operating conditions through alerts or alarms shall comply with Sections 7.1.7.5.2 through 7.1.7.5.4 and applicable codes.

7.1.7.5.2 Alarms

Alarms shall be provided to indicate that the system is operating outside the design parameters potentially causing a hazard to health and safety or by operating in a manner that could damage the system. Conditions requiring alarms shall automatically disable the rainwater harvesting system to allow for corrective action.

7.1.7.5.3 Alerts

Alerts shall be provided to indicate that the system is operating outside design parameters, without causing a hazard to health or safety and without causing damage to the system. Automatic system shutdown shall not be required for conditions requiring alerts.

7.1.7.5.4 Alarm and alert devices

An alarm or alert shall use bell, horn, speaker, light or text display that provides audible, tactile or visible outputs, or any combination thereof. Visual alarms shall continue to operate for the duration of the alarm or alert condition.

Audible and visual alarms and alerts shall be

(a) rated at not less than 85dB at a distance of 3m (10 ft);

(b) readily visible at a distance of 10 ft. in light conditions of 1000 lx (102 ft-candles); and

(c) provided with a reset switch and test switch.

7.1.7.6 Controls for dedicated firefighting reserves

Where rainwater harvesting systems supply water for use in automatic fire sprinkler systems or to standpipes, all associated controls shall comply with the requirements of the fire code.

7.1.7.7 Control panels

Control panels for rainwater harvesting systems utilized in commercial occupancies shall comply with UL 508 or UL 508A, as applicable.

7.2 Subsystem design and installation

7.2.1 Collection surfaces

7.2.1.1 General

Rainwater collection surfaces shall collect and convey rainwater to inlets of the conveyance network with minimal ponding and retention after the precipitation event. Rainwater that is intercepted by roof material and not subject to pedestrian access shall be considered roof runoff. Rainwater that is intercepted by roof material subject to pedestrian access or ground level surfaces including vegetative roofs, pedestrian surfaces, porous pavement, landscape runoff, paved parking, street, freeway and shoulder areas on roadways shall be considered stormwater runoff. Collection surfaces shall comply with Clauses 7.2.1 through 7.2.3.

7.2.1.2 Protection from contamination

Collection surfaces shall be designed to minimize the conveyance of contaminants to the storage tank.

7.2.1.3 Foliage and vegetation

Foliage and vegetation overhanging collection surfaces shall be minimized.

7.2.1.4 Collection surface types for end use tiers

Subject to the assessment of the WSP, specific types of collection surfaces shall only supply water for end use tiers in accordance with Table 7.2.1.4 for residential and commercial applications based on the prescriptive approach. Where a system supplies multiple end uses, the collection surface shall comply with Table 7.2.1.4 for each end use. Water end use tiers are established in accordance with Section 6.2.

Exception: Colder climate regions subject to some degree of snowfall during the year and use of salt for de-icing shall not collect stormwater runoff for reuse without additional treatment consideration to address salt content.

TABLE 7.2.1.4
COLLECTION SURFACES PER WATER END USE TIER FOR THE PRESCRIPTIVE APPROACH

Collection Surface		Residential	Multi-Residential and Non-Residential
Roofing material[b]	Coated steel	R1, R2, R3, R4	1, 2a, 2b, 3, 4
	Stainless steel	R1, R2, R3, R4	1, 2a, 2b, 3, 4
	Tin	R1, R2, R3, R4	1, 2a, 2b, 3, 4
	Copper	R1, R2, R3, R4	1, 2a, 2b, 3, 4
	Asphalt	R1, R2, R3, R4	1, 2a, 2b, 3, 4
	Ceramic	R1, R2, R3, R4	1, 2a, 2b, 3, 4
	Clay	R1, R2, R3, R4	1, 2a, 2b, 3, 4
	Rubber/Butyl /EPDM membrane	R1, R2, R3	1, 2a, 2b, 3
	Polyethylene membrane	R1, R2, R3, R4	1, 2a, 2b, 3, 4
	Bituminous/tar membranes and asphalt felt	R1, R2, R3	1, 2a, 2b, 3
	Polymer and acrylic	R1, R2, R3	1, 2a, 2b, 3
	Untreated wood	R1, R2, R3	1, 2a, 2b, 3
	Treated wood	R1, R2, R3	1, 2a, 2b, 3
	Asbestos cement	None	None
	Concrete	R1, R2, R3, R4	1, 2a, 2b, 3, 4
	Fiberglass	R1, R2, R3, R4	1, 2a, 2b, 3, 4
	Glass	R1, R2, R3, R4	1, 2a, 2b, 3, 4
	Lead	R1, R2, R3	1, 2a, 2b, 3
Public Pedestrian Accessible Roof		R1, R2	1, 2a, 2b
Vegetated roofs		R1, R2	1, 2a

Pedestrian and Parking Surfaces (e.g. sidewalks, courtyard, driveways, parking areas, pervious surfaces)	R1, R2	1, 2a
Landscaped runoff	R1, R2	1, 2a
Street, Freeway, shoulder areas, paved parking	None	None
Subsurface collection[a] (onsite bioswales, foundation drain, rain garden, etc.)	R1, R2	1, 2a, 2b
Surface waters and stormwater detention ponds	None	None

a: *Subsurface water shall not be collected from sites which contain contaminated soils.*

b: *Roofing products used within rainwater harvesting systems collecting water for use as drinking water can be third-party certified to NSF P151-1995 Health Effects from Rainwater Catchment System Components.*

7.2.1.5 Paints and coatings on potable collection surfaces

Lead, chromium or zinc-based paints and coatings are not permitted on rainwater collection surfaces used for collection of rainwater for potable applications. Paints or coatings applied to collection surfaces used for potable applications shall be third-party certified for drinking water contact, and shall be installed in accordance with manufacturer's installation instructions.

7.2.1.6 Equipment and appliances mounted on collection surfaces

Equipment or appliances mounted on collection or runoff surfaces where liquid discharge may occur shall be installed to prevent the introduction of contaminants into the rainwater harvesting system. Equipment or appliances containing toxic fluids shall not be installed on collection surfaces.

Exceptions:

Containment of discharge from equipment or appliances mounted on collection or runoff surfaces shall not be required where:

(a) Potential discharge is limited to potable water,

(b) Clear water waste is discharged and the collection surface supplies rainwater harvesting systems utilized exclusively for R1, R2, 1, or 2a applications.

7.2.2 Conveyance subsystem

7.2.2.1 General

Conveyance subsystems and components shall be designed and installed to facilitate the transport of collected rainwater with minimal loss and contamination and without degradation of any associated structure.

7.2.2.2 Roof drains

Where rainwater harvesting conveyance systems serve as all or a portion of the primary roof drainage for a structure, the system shall be sized, designed and installed in accordance with the building code and the plumbing code, as applicable. Secondary roof drains and roof drains that connect to a combined primary and secondary roof drainage system shall not discharge to a rainwater harvesting conveyance system.

7.2.2.3 Stormwater management

Where rainwater harvesting conveyance systems also function as elements of stormwater management systems for the site, they shall be designed and installed in accordance with requirements of the authority having jurisdiction.

7.2.2.4 Materials

Conveyance systems shall be constructed of material fit for use. Collection devices shall be constructed of materials that are compatible with the collection surface, anticipated rainwater quality and the treated water quality required for the desired end use.

7.2.2.5 Joints

Joints between components in the conveyance system shall be water tight.

7.2.2.6 Cleanouts

Cleanouts shall be provided in the water conveyance system to allow cleaning and clearing of blockages in pipes, leaders and downspouts.

7.2.2.7 Access

Inlets, debris excluders, filters, first flush diverter, cleanouts, and any conveyance system component requiring service shall be accessible.

7.2.2.8 Vermin

Conveyance systems and inlets shall be protected to prevent the entrance of insects and vermin in accordance with Section 6.1.8.

7.2.2.9 Slope

Gutters and collection piping using gravity to produce flow shall have a slope along their entire length, and shall not permit the collection or pooling of water at any point. Siphonic roof drain systems shall not be required to be sloped and shall be installed in accordance with Section 7.2.2.12.

7.2.2.10 Conveyance system inlets

7.2.2.10.1 General

Inlets receiving water from collection surfaces for introduction to rainwater harvesting system conveyance systems shall comply with Section 7.2.2.10.2 and 7.2.2.10.3.

7.2.2.10.2 Conveyance inlet sizing

Where inlets to rainwater harvesting conveyance systems also serve as primary or secondary roof drains or stormwater management systems, they shall comply with the minimum size requirements of the authority having jurisdiction.

7.2.2.10.3 Pre-filtration

Inlets accepting water from collection surfaces shall be protected with a debris excluder or equivalent device to prevent the entry of large contaminants and debris into the conveyance system. Debris to be excluded include, but are not limited to leaves, sticks, pine needles, tree fruit, bark and moss.

7.2.2.11 First-flush diverters

Where a first flush diverter is installed, it shall operate automatically and not rely on manually operated valves or devices. Diverted rainwater shall be discharged in a manner consistent with the storm water runoff requirements of the jurisdiction and shall not drain onto rainwater collection surfaces.

7.2.2.12 Gutters

Where roof gutters are used to convey captured rainwater, they shall be installed, and sized in accordance with the requirements of the authority having jurisdiction. In the absence of such requirements, installation and sizing shall be in accordance with the applicable code.

7.2.2.13 Roof drain systems

Where roof drain systems are utilized for the collection of rainwater, the collection and conveyance of rainwater shall not adversely impact the function of the roof drain system. Roof drain systems shall be designed and installed in accordance with the requirements of the applicable codes and manufacturers' requirements. Siphonic roof drains and drainage systems shall be designed in accordance with ASME A112.6.9 and ASPE 45.

7.2.2.14 Vertical conveyance

7.2.2.14.1 General

Leaders, vertical conductors and other devices conducting captured rainwater from elevated collection surfaces shall be designed, sized and installed in accordance with the requirements of the applicable code.

7.2.2.14.2 Canales and catch basins

Where canals are used with elevated collection surfaces, they shall be designed to permit the free fall of water to a catch basin without obstructions in the path of travel. Canales and catch basins shall be designed to prevent water from splashing the exterior of the structure. Catch basins used in conjunction with canals shall comply with Section 7.2.2.

7.2.2.14.3 Rain chains

Rain chains used to convey water from elevated collection surfaces shall be designed to convey captured water to a lower receptacle without splashing the exterior of the structure. Receptacles used in conjunction with rain chains shall comply with Section 7.2.2.

7.2.2.15 Conveyance piping

7.2.2.15.1 General

Rainwater harvesting systems shall utilize drainage piping approved for use within plumbing drainage systems to convey captured rainwater. Collection materials shall comply with the requirements of the authority having jurisdiction.

7.2.2.15.2 Design and installation of conveyance piping

Collection piping conveying captured rainwater shall be designed, sized and installed in accordance with the requirements of the authority having jurisdiction. The size of a drainage pipe shall not be reduced in the direction of flow.

7.2.3 Storage

7.2.3.1 General Design

Storage systems shall be constructed in accordance with Section 7.2.3.1 through 7.2.3.13.
Tanks shall conform to the applicable requirements of one the standards listed in Table 7.3, or the applicable requirements in Annex C *Prescriptive Tank Requirements*. Tanks used for fire suppression shall comply with the applicable fire code. Tanks shall comply with applicable code requirements, including but not limited to fire, wind, seismic and lightning protection.

TABLE 7.3
RAINWATER STORAGE TANKS

Designation	Title
NFPA 22	Standard for Water Tanks for Private Fire Protection
IAPMO/ANSI Z1002	Rainwater Harvesting Tanks
CSA B126	Water Cisterns
AWWA D100	Welded Carbon Steel Tanks for Water Storage
AWWA D103	Factory-Coated Bolted Carbon Steel Tanks for Water Storage
AWWA D115	Tendon-Pre-stressed Concrete Water Tanks
AWWA D120	Thermosetting Fiberglass-Reinforced Plastic Tanks
AWWA D121	Bolted Aboveground Thermosetting Fiberglass-Reinforced Plastic Panel-Type Tanks for Water Storage
AWWA D107	Composite Elevated Tanks for Water Storage
UL 58	Standard for Steel Underground Tanks for Flammable and Combustible Liquids
UL 142	Steel Aboveground Tanks for Flammable and Combustible Liquids
UL 1316	Glass-Fiber-Reinforced Plastic Underground Storage Tanks for Petroleum Products, Alcohols, and Alcohol-Gasoline Mixtures
ULC S601	Shop Fabricated Steel Aboveground Tanks For Flammable and Combustible Liquids
ULC S603	Standard for Steel Underground Tanks for Flammable and Combustible Liquids
ASTM C1227	Standard Specification for Precast Concrete Septic Tanks

7.2.3.2 Sizing

The minimum holding capacity of the rainwater storage tank shall be sized in accordance with the requirements of the authority having jurisdiction, taking into consideration output water demand, dedicated fire reserve storage volume, stormwater management storage or detention volume and storage loss factors.

Note: *Tanks sizing methodologies and calculations are provided in Appendix D.*

7.2.3.3 Materials

7.2.3.3.1 General

Tanks, liners, coatings, associated pipes and pipe fittings, and appurtenances shall be constructed of durable, non-absorbent materials. Storage tank materials shall be compatible with disinfection agents or processes that come in contact with the tank, the water to be stored and the intended end use. Seams and joints shall be water-tight.

7.2.3.3.2 Material compatibility for potable end use

Storage tanks, liners, coatings, associated pipes and pipe fittings, and appurtenances contacting collected rainwater intended for potable end uses shall comply with NSF 61 and NSF 372.

7.2.3.3.3 Environmental compatibility

Storage tanks and materials shall be constructed to withstand local environmental conditions. Storage tanks pipes and pipe fittings and appurtenances designed to be installed in a location subject to ultraviolet (UV) light shall be constructed from a material designed to be stable under the UV light exposure anticipated during the life of the system.

7.2.3.4 Storage tank foundation and supports

7.2.3.4.1 General

Storage tanks shall be properly supported on a base capable of withstanding the weight of the storage tank when filled to capacity. Storage tanks shall be supported and restrained to prevent lateral movement. Support and restraint devices shall be placed in a manner that will not obstruct access for testing and maintenance. Support and restraint shall be in accordance with the building code, the manufacturer's installation instructions and any applicable standards related to the end use.

7.2.3.4.2 Tanks subject to buoyancy uplift conditions

Tanks shall be ballasted or otherwise secured to prevent the tank from floating or moving and shall be designed to withstand structural stresses caused by hydrostatic pressure and buoyancy. Where: high ground water conditions or risk of flooding at the location and elevation where the tank is to be installed.

7.2.3.4.3 Underground structural support

7.2.3.4.3.1 General

Buried or partially buried tank design shall take into account the external loads on the tank including the weight of the backfill together with hydrostatic, overburden, and live loads. The tank design shall include consideration of tank loading when in both the full and empty conditions for the soil type at the site.

7.2.3.4.3.2 Surface loads

Underground tanks subject to vehicular traffic shall withstand anticipated loads (as defined by American Association of State Highway and Transportation Officials (AASHTO)) when properly installed according to tank manufacturer's installation requirements and applicable codes and standards.

7.2.3.5 Storage tank location

7.2.3.5.1 Restricted locations

Storage tanks and their access openings shall not be located directly under sanitary, waste and storm drainage piping, or any potential source of contamination. Storage tanks shall not be installed above onsite sewage disposal systems.

7.2.3.5.2 Protection of water from direct sunlight

Water contained within storage tanks shall be protected from direct sunlight by any of the following:
(a) Opaque, UV-resistant materials; or
(b) Installation in locations not subject to direct sunlight.

7.2.3.6 Access

7.2.3.6.1 General

Access openings shall be located to facilitate the pumping and cleaning of tanks and the servicing and inspection of inlets and outlets. At least one access opening shall be provided to allow inspection and cleaning of the interior of each tank. Access openings shall be secured to prevent unauthorized access. All openings shall be constructed to be watertight and weatherproof, prevent vermin and insects, and prevent entry of foreign materials and substances.

7.2.3.6.2 Manholes

Openings intended for human access shall have a minimum dimension of 20 inches and a minimum area of at least 0.20 m^2 (314 in^2). Manholes shall extend a minimum of 4 inches (102 mm) above ground or shall be designed to prevent water infiltration. Finished grade shall be sloped away from the manhole to divert surface water. Manhole covers shall be secured to prevent unauthorized access.

7.2.3.6.3 Covers

Covers shall be installed over service ports and manholes. Penetrations for wiring or piping shall not be installed on covers.

7.2.3.6.4 Tank abandonment

Where a storage tank is permanently removed from service the following shall apply:
(a) Underground storage tanks shall be removed or filled with inert material; and
(b) Aboveground tanks shall be removed or secured to prevent unauthorized access.

7.2.3.7 Secondary water supply

7.2.3.7.1 General

Where an uninterrupted water supply is required for the intended application, a secondary source shall be provided. When installed, secondary water may be supplied by means of a makeup water system to refill the storage tank(s) or a bypass system that provides water directly to the distribution system. Secondary water systems shall comply with Sections 7.2.3.7.1 through 7.2.3.7.6.

7.2.3.7.2 Availability and minimum quality

Secondary sources of water supply shall have sufficient capacity to meet the anticipated demand supplied by the rainwater harvesting system. Secondary sources of water shall meet the minimum quality for the intended use as required in Section 8. Where rainwater harvesting systems supply potable end uses, secondary water supplies shall be potable.

7.2.3.7.3 Protection against backflow

The secondary water supply shall be protected against backflow in accordance with the plumbing code.

7.2.3.7.4 Pipes, valves, and fittings

All valves shall be accessible for inspection and maintenance. A full-open manual valve shall be installed on secondary water supply lines upstream of automatic level control or diverter valves for servicing and maintenance. Secondary water piping, joints, fittings and valves shall be designed and installed in accordance with the plumbing code for the intended end use.

7.2.3.7.5 Makeup water supply systems

Where makeup water is utilized, it shall be provided to rainwater harvesting systems to maintain minimum water levels within the storage tank. Makeup water supply systems shall use automatic level control valves to maintain the minimum water level in the tank for uninterrupted operation. The automatic level controls shall limit the makeup water level below the tank overflow. Makeup water shall be supplied at a flow rate no less than the maximum demand of the end use. For tanks using a makeup water system, an alarm shall be activated in accordance with Section 7.1.7.5 in the event that the water level drops below the minimum operating level in the storage tank.

7.2.3.7.6 Bypass water systems

Where bypass water is utilized, it shall be provided to rainwater harvesting systems to maintain water supply and sized to meet the maximum anticipated demand of the end use. Where an automatic bypass system is utilized, an alert shall be provided in accordance with Section 7.1.7.5 indicating when the bypass water system is in operation.

7.2.3.8 Tank overflow

7.2.3.8.1 General

Storage tanks shall be equipped with an overflow having an aggregate area not less than that shown for the piping in Table 7.2.3.8, and not less than the capacity of the inlet(s). No single overflow pipe shall be less than 2 inches (50 mm) in diameter.

7.2.3.8.2 Insects and vermin intrusion control

Tank overflow pipes shall be protected from insects or vermin in accordance with Section 6.1.8.

7.2.3.8.3 Distance and direction

Tank overflow pipes shall discharge directed away from the tank and in accordance with the local applicable code. Drainage from tank overflow pipes shall be directed to prevent a hazardous condition.

7.2.3.8.4 Shutoff valves

Shutoff valves shall be prohibited to be installed in tank overflow piping.

7.2.3.8.5 Cleanouts

Cleanout shall be provided on each tank overflow pipe in accordance with the plumbing code.

7.2.3.8.6 Backwater valves

Where tank overflows are directly connected to sanitary or storm drainage systems a backwater valve shall be installed on each tank overflow.

TABLE 7.2.3.8
OVERFLOW PIPE SIZES FOR WATER SUPPLY TANKS

MAXIMUM CAPACITY OF WATER SUPPLY LINE TO TANK (GPM)	DIAMETER OF OVERFLOW PIPE (INCHES)	DIAMETER OF OVERFLOW PIPE (mm)
0 – 200	3	75
200 – 400	4	100
400 – 700	5	125
700 – 1,000	6	150
Over 1,000	8	200

7.2.3.9 Tank connections and penetrations

7.2.3.9.1 General

All inlets and outlets on storage tanks shall be installed and supported in accordance with manufacturers' instructions. Where utilized flanged connections shall be a minimum Class 150 as specified in ASME B16.5.

7.2.3.9.2 Rainwater inlet pipe

Rainwater inlets shall be constructed and arranged to minimize turbulence and disturbance of sediment within the storage tank

7.2.3.9.3 Rainwateroutlets

Rainwater outlets and pump suction shall be located at least 4 inches (102 mm) above the bottom of the storage tank and shall not skim water from the surface. Where a floating outlet(s) is used it shall be

tethered to the top of the tank to prevent the intake from coming within 4 inches (102 mm) of the bottom of the tank with changes to the water level.

7.2.3.9.4 Controlled flow outlets

Where rainwater harvesting systems are used for stormwater management and detention a controlled flow outlet shall be provided utilizing an orifice or flow restrictor sized to control the release rate from the rainwater harvesting system in accordance with the applicable code. Controlled flow outlet shall not supersede overflow requirement in section 7.2.3.8.

7.2.3.9.5 Pipe penetrations

Pipe penetrations through the tank wall shall be watertight and shall conform to the applicable code. Piping penetrations shall not impede access to the tank.

7.2.3.9.6 Interconnection of multiple tanks

Where tanks are interconnected, piping connections shall be made with approved fittings and installed in a manner that provides adequate flexibility to allow for settlement or movement that may result from unevenly distributed weight or movement of the liquid content within the tank.

7.2.3.9.7 Electrical penetrations

Electrical penetrations through the tank wall shall be installed above the highest water level in the tank permitted by the overflow system. Electrical penetrations through the tank wall shall be watertight and shall conform to the electrical code. Electrical penetrations shall not impede access to the tank.

7.2.3.10 Venting

Tanks shall be vented through vent or overflow piping to prevent airlocking.
Storage tanks shall be vented directly to the atmosphere. Vent pipes 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 6 inches (154 mm) above grade or as necessary to prevent surface water from entering the storage tank. Vent openings shall be protected against the entrance of vermin and insects in accordance with the requirements of Section 6.1.8. Air admittance valves shall not be installed on vent pipes.

7.2.3.11 Draining of tanks

All tanks shall be provided with a means to drain or empty the tank utilizing a gravity drain or pump. Where tanks are provided with a gravity drain, tank drain pipe(s) shall discharge as required for the overflow pipe(s). The gravity drain or pump discharge shall not be less than 2 inches (50 mm) in diameter.

7.2.3.12 Tank marking and signage

Each water storage tank shall be labeled with its rated capacity. Where the tank contains non-potable water, the contents shall be identified with the words "CAUTION: NON-POTABLE WATER - DO NOT DRINK." 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 exterior tank wall

or on a tag or sign constructed of corrosion-resistant waterproof material that is mounted on the tank in a visible location. The letters of the words shall be not less than 0.5 inch (12.7 mm) in height and shall be of a color in contrast with the background on which they are applied. At each entry point, a warning sign indicating the need for procedures for safe entry into confined spaces shall be posted. Entry points shall be secured against unauthorized entry and vandalism.

7.2.3.13 Ladders, balconies, and platforms

Where installed, interior and exterior ladders, platforms and balconies on tanks shall conform to the requirements of NFPA 22.

7.2.4 Treatment and disinfection subsystem

Potable water systems shall be equipped with a fail-safe mechanism that will trigger an alarm in accordance with Section 7.1.7.5 and turn the supply off should the treatment system malfunction.

7.2.4.1 Sampling ports

Sampling ports shall be installed to verify the operation of each filtration and disinfection process.

7.2.4.1 Filtration systems

Collected rainwater shall be filtered as required for the intended end use as established in Section 8. Filters shall be installed in accordance with the applicable code and shall be accessible for inspection and maintenance. Filters shall utilize a pressure gauge 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.

7.2.4.2 Disinfection systems

Where the intended end use requires disinfection, rainwater shall be disinfected to ensure that the required water quality is delivered at the point of use, as established in Section 8. Disinfection systems shall be designed and installed in accordance with manufacturers' instructions and the applicable code.

7.2.4.2.1 UV disinfection systems

Where Rainwater harvesting systems utilize UV disinfection systems to treat water for distribution, disinfection shall occur downstream of the storage tank and prior to the point of end use.
Exception: Where systems employ day tanks, UV disinfection shall be permitted to be applied upstream of the day tank, provided measures are taken to maintain the required water quality.

7.2.4.2.1.1 UV Disinfection system sizing

UV disinfection systems shall be sized based upon the design flow and minimum UVT required for disinfection specified for the end uses.

7.2.4.2.1.2 Filtration for UV systems

Filtration of 5 microns or less shall be installed upstream of the UV disinfection system.

7.2.4.3 Chemical disinfection systems

Where rainwater harvesting systems utilize chemical disinfection they shall produce treatment levels in accordance with the requirements established in Chapter 8. Chemical feed and dosing systems shall be installed in accordance with the manufacturer's specifications. Chemical disinfection system shall comply with Sections 7.4.3.2.1 through 7.4.3.2.2.

7.2.4.3.1 Filtration for chemical disinfection systems

Filtration shall be installed upstream of the chemical disinfection system in accordance with Section 7.2.4.1 and the disinfection system's installation requirements.

7.2.4.3.2 Measurement and control for chemical disinfection systems

Chemical disinfection systems must have means to measure and control the disinfection and oxidation concentrations within the treated water to maintain the minimum treatment levels set in Section 8. Chemical feed pumps shall be controlled to prevent operation unless there is flow through the system.

7.2.4.3.3 Chlorine disinfection systems

Chemicals used in chlorine disinfection systems shall comply with the requirements of NSF 60. Chlorine residuals in the distribution system shall be maintained within the parameters specified in Section 8 for the end use.

7.2.4.3.4 Microfiltration and ultrafiltration systems

Where rainwater harvesting systems utilize microfiltration or ultrafiltration to meet the performance criteria set out in Section 8, it shall be installed between the storage tank and the point of end use. Microfiltration and ultrafiltration systems shall be sized based upon the design flow. Microfiltration and ultrafiltration systems shall be installed in accordance with the requirements of Section 7.2.4.1 and the manufacturer's installation instructions.

7.2.5 Distribution system

Distribution systems shall be designed and installed in accordance with the plumbing code for the intended application. Non-potable piping in rainwater harvesting shall be identified and marked in accordance with the plumbing code.

Exception: Distribution piping serving irrigation systems.

7.2.5.1 Water pressure-reducing valve or regulator

Where the water pressure supplied by the pumping system exceeds 80 psi (550 kPa) static, a pressure-reducing valve shall be installed to reduce the pressure in the rainwater distribution system piping to 80 psi (550 kPa) static or less. Pressure-reducing valves shall be specified and installed in accordance with the plumbing code.

7.2.5.2 Piping materials and design requirements

7.2.5.2.1 Materials, joints and connections

Distribution piping, fittings, joints and connections shall conform to the standards and requirements specified in accordance with the plumbing code.

7.2.5.2.2 Markings

Distribution piping for non-potable water systems shall be clearly identified in accordance with Section 6.1.5.2.

7.2.5.3 Pumps

Where pumps are utilized in distribution systems, they shall be sized for the maximum anticipated end use demand and in accordance with the requirements of the applicable code. Pumps used to supply water for potable applications shall comply with NSF 61.

7.2.5.3.1 Pump controls

The pump controller shall be designed to ensure that pumps shall not operate when there is a low water level or low suction pressure condition. Where a pump failure alarm or alert is provided, it shall be activated in accordance with Section 7.1.7.5.

7.3 Point of use signage and identification

7.3.1 Point of use signage for non-potable water

Signage shall be provided at the point of use where non-potable water is used and dispensed in accordance with the requirements of this standard and the plumbing code.

7.3.1.1 Non-potable water outlets

Non-potable water outlets, such as hose bibbs, open ended pipes and faucets shall be identified at the point of use for each outlet in accordance with the requirements of the plumbing code. Where no such requirements exist, they shall be identified with signage that reads as follows: “Non-potable 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 inch (12.7 mm) 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 7.3.1.1 shall appear on the required signage.

FIGURE 7.3.1.1
POINT OF USE SIGNAGE

8 Water quality

8.1 General water quality treatment requirements

8.1.1 Minimum performance criteria

Rainwater harvesting system treatment shall meet the minimum performance criteria in Table 8(1), 8(2), 8(3) or 8(4) as required for the end use and source. Treatment options shall include one of the three listed within the applicable table or another method acceptable to the authority having jurisdiction. All equipment used to meet the performance criteria shall be validated to meet the minimum performance criteria.

8.1.2 Multiple end uses

Where multiple end uses are supplied from a single treatment system, the most restrictive performance criteria shall be met for each end use.

8.1.3 Multiple sources

Where the water source for a rainwater harvesting system is derived from both rooftop and stormwater runoff and combined, Table 8(2) or 8(4) shall be followed as applicable.

8.1.4 Water storage temperatures

Water stored at temperatures between 25 °C (77 °F) and 55°C (131 °F) for periods exceeding 3 weeks shall not be used for tiers 2, 3 or 4 due to potential for growth of opportunistic pathogens (e.g., *Legionella*, *Pseudomonas aeruginosa*, *Mycobacterium avian* complex) unless a chlorine residual of 0.5 mg/L is maintained. Where water is supplied to multi-residential or commercial facilities for tier 2, 3 or 4 applications, the system shall be equipped with water temperature monitors.

8.1.5 Treatment for multi-residential and non-residential applications

Rainwater Harvesting Systems delivering water to a facility other than a single-family home and likely to supply water to more than 25 persons per day shall employ a multi barrier or treatment train design approach to reduce accumulation, introduction, and re-introduction of contaminants into the system.

TABLE 8(1)

ROOF RUNOFF WATER TREATMENT REQUIREMENTS FOR SINGLE FAMILY RESIDENTIAL APPLICATIONS

Application				Minimum Performance Criteria				Minimum Prescriptive Requirements				
				Log Reduction (% reduction)				Options for post-storage treatment before end use				
								UV		Chlorine		
End Use Tier	Category (potable/ non-potable)	Potential for Human Contact (Low, Medium, High)	Uses (Included but not limited to)	Viruses	Bacteria[e]	Protozoa	pH	Filtration	Disinfection	Filtration	Disinfection	Microfiltration or Ultrafiltration
R1	Non-Potable	Low	• Trap Primers • Irrigation • Fire suppression	0	0	0	-	None[d]				
R2	Non-Potable	Medium	• Toilet/urinal flushing • Clothes washing	0[a]	2 (99%)	2 (99%)	-	5 µm	16 mJ/cm^2	NR[b,e]	NR[b,e]	0.5 µm[c]
R3	Non-Potable	High	• Hose bibbs • Pressure washing • Decorative fountains • Vehicle washing	0[a]	3 (99.9%)	3 (99.9%)	-	5 µm	30 mJ/cm^2	NR[b,e]	NR[b,e]	0.5 µm[c]
R4	Potable	High	• Human consumption • Oral care • Food preparation • Dishwashing • Bathing/ showering • Pool/hot tubs	0[a]	6 (99.9999%)	4 (99.99%)	7-10	5 µm	40 mJ/cm^2 and third-party certified to NSF 55 Class A	NR[b,e]	NR[b,e]	0.2 µm[c] third-party certified to NSF 53

Note: *A figure depicting the particle size spectrum for filtration is included in Annex A.*

NR: *Not recommended*

a: *It is unlikely that human infectious viruses are present in harvested rainwater sourced from elevated surfaces. If below-ground tanks are used where there is a potential for sewage contamination, a 4 log reduction shall be required in accordance with the WSP.*

b: *Due to complexity of operation and design for single-family dwellings, chlorine-based disinfection is not recommended.*

c: *pre-filtration of 5-100 µm is recommended to extend the life of the filter.*

d: *For operational purposes only, it is recommended to use <= 500 µm filtration, or for drip irrigation only, to use <= 100 µm.*

e: *Due to potential for growth of opportunistic pathogens in plumbing systems (e.g., Legionella, Pseudomonas aeruginosa, Mycobacterium avian complex), water stored at temperatures above 25 °C (77 °F) for extended periods shall not be used for tiers R2, R3, and R4 unless a chlorine residual of 0.5*

mg/L is maintained for these end uses. If chlorine is used, consideration should be given to the potential formation of disinfection by-products.

TABLE 8(2)
STORMWATER RUNOFF TREATMENT REQUIREMENTS FOR SINGLE FAMILY RESIDENTIAL APPLICATIONS

Application				Minimum Performance Criteria				Minimum Prescriptive Requirements				
				Log Reduction (% reduction)				Options for post-storage treatment before end use				
								UV		Chlorine		
End Use Tier	Category (potable/ non-potable)	Potential for Human Contact (Low, Medium, High)	Uses (Included but not limited to)	Viruses	Bacteria[e]	Protozoa	pH	Filtration	Disinfection	Filtration	Disinfection	Microfiltration or Ultrafiltration
R1	Non-Potable	Low	• Trap Primers • Irrigation • Fire suppression	0	0	0	-	None[d]				
R2	Non-Potable	Medium	• Toilet/urinal flushing • Clothes washing	4[a]	2 (99%)	2 (99%)	-	5 µm	16 mJ/cm^2	NR[b,e]	NR[b,e]	0.5 µm[c]
R3	Non-Potable	High	• Hose bibbs • Pressure washing • Decorative fountains • Vehicle washing	4[a]	3 (99.9%)	3 (99.9%)	-	5 µm	30 mJ/cm^2	NR[b,e]	NR[b,e]	0.5 µm[c]
R4	Potable	High	• Human consumption • Oral care • Food preparation • Dishwashing • Bathing/ showering Pool/hot tubs	Not Permitted								

Note: *A figure depicting the particle size spectrum for filtration is included in Annex A.*

NR: *Not recommended*

a: *It is unlikely that human infectious viruses are present in harvested rainwater. For below-ground tanks where there is a potential for sewage contamination, a 4 log reduction shall be required in accordance with the WSP.*

b: *Due to complexity of operation and design for single-family dwellings, chlorine-based disinfection is not recommended.*

c: *pre-filtration of 5-100 µm is recommended to extend the life of the filter.*

d: *For operational purposes only, it is recommended to use <= 500 µm filtration, or for drip irrigation only, to use <= 100 µm.*

e: *Due to potential for growth of opportunistic pathogens in plumbing systems (e.g., Legionella, Pseudomonas aeruginosa, Mycobacterium avian complex), water stored at temperatures above 25 °C (77 °F) for extended periods shall not be used for tiers R2, R3, and R4 unless a chlorine residual of 0.5 mg/L is maintained for these end uses. If chlorine is used, consideration should be given to the potential formation of disinfection by-products.*

TABLE 8(3)
ROOF RUNOFF WATER TREATMENT REQUIREMENTS FOR MULTI-RESIDENTIAL AND NON-RESIDENTIAL APPLICATIONS

Application				Minimum Performance Criteria				Minimum Prescriptive Requirements				
				Log Reduction (% reduction)				Options for post-storage treatment before end use				
								UV		Chlorine		
End Use Tier	Category (potable/ non-potable)	Potential for Human Contact (Low, Medium, High)	Uses (Included but not limited to)	Viruses	Bacteria[e]	Protozoa	pH	Filtration	Disinfection	Filtration	Disinfection	Microfiltration or Ultrafiltration
1	Non-Potable	Low	• Trap Primers • Irrigation • Fire suppression • Ice rinks	0	0	0	-	None[d]				
2a	Non-Potable	Medium	• Toilet/urinal flushing • Clothes washing • Rooftop thermal cooling	0[a]	2 (99%)	2 (99%)	-	5 µm	16 mJ/cm^2	1 µm absolute[e]	CT for 2 Log reduction for bacteria and minimum 0.5 mg/L chlorine residual[e]	0.5 µm[c] with minimum 0.5 mg/L chlorine residual

2b	Non-Potable	Medium	• HVAC evaporative cooling (e.g., cooling tower, evaporative condenser, spray cooler, direct/indirect evaporative cooling)	Treatment shall consider equipment manufacturer water quality requirements and designed in accordance to ANSI/ASHRAE 188-2015 addressing Legionellosis Risk Management for Building Water Systems									
3	Non-Potable	High	• Hose bibbs • Building/pressure washing • Decorative fountains • Commercial vehicle washing	0[a]	3 (99.9%)	3 (99.9%)	-	5 µm	30 mJ/cm^2 with minimum 0.5 mg/L chlorine residual	1 µm absolute[e]	CT for 3 Log reduction for bacteria and minimum 0.5 mg/L chlorine residual[e]	0.5 µm[c] with minimum 0.5 mg/L chlorine residual
4[f]	Potable	High	• Human consumption • Dishwashing • Food preparation • Oral care • Bathing/Showering/Handwashing • Pool/Spas/Hot tubs/Splash pads • Misting stations • Swamp coolers	0[a]	6 (99.9999%)	4 (99.99%)	7-10	5 µm	40 mJ/cm^2 and third-party certified to NSF 55 Class A or validated to US EPA UVDGM or DVGW-W294 with minimum 0.5 mg/L chlorine residual	1 µm absolute[e]	CT for 6 Log reduction for bacteria[b] and minimum 0.5 mg/L chlorine residual[e]	0.2 µm[c] third-party certified to NSF 53 with minimum 0.5 mg/L chlorine residual

Note: *A figure depicting the particle size spectrum for filtration is included in Annex A.*

CT: *Concentration of disinfectant (C) x contact time (T)*

a: *It is unlikely that human infectious viruses are present in harvested rainwater. For below-ground tanks where there is a potential for sewage contamination, a 4 log reduction shall be required in accordance with the WSP.*

b: *Depending on source water quality, consideration should be given to the potential formation of disinfection by-products.*

c: *pre-filtration of 5-100 µm is recommended to extend the life of the filter.*

d: *For operational purposes only, it is recommended to use <= 500 µm filtration, or for drip irrigation only, to use <= 100 µm.*

e: *Due to potential for growth of opportunistic pathogens in plumbing systems (e.g., Legionella, Pseudomonas aeruginosa, Mycobacterium avian complex), a minimum 0.5 mg/L chlorine residual shall be maintained.*

f: *The authority having jurisdiction may specify additional requirements for public drinking water supplies.*

UVDGM: *Ultraviolet Disinfection Guidance Manual*

DVGW: *German Technical and Scientific Association for Gas and Water*

TABLE 8(4)
STORMWATER RUNOFF TREATMENT REQUIREMENTS FOR MULTI-RESIDENTIAL AND NON-RESIDENTIAL APPLICATIONS

Application				Minimum Performance Criteria				Minimum Prescriptive Requirements				
				Log Reduction (% reduction)				Options for post-storage treatment before end use				
								UV		Chlorine		
End Use Tier	Category (potable/ non-potable)	Potential for Human Contact (Low, Medium, High)	Uses (Included but not limited to)	Viruses	Bacteria[e]	Protozoa	pH	Filtration	Disinfection	Filtration	Disinfection	Microfiltration or Ultrafiltration
1	Non-Potable	Low	• Trap Primers • Irrigation • Fire suppression • Ice rinks	0	0	0	-	None[d]				
2a	Non-Potable	Medium	• Toilet/urinal flushing • Clothes washing • Rooftop thermal cooling	4 (99.99%)	4 (99.99%)	3 (99.9%)	-	5 µm	40 mJ/cm^2 and third-party certified to NSF 55 Class A or validated to US EPA VDGM or DVGW-W294 with minimum 0.5 mg/L chlorine residual	1 µm absolute[e]	CT for 4 Log reduction for bacteria and minimum 0.5 mg/L chlorine residual[e]	0.5 µm[c] with minimum 0.5 mg/L chlorine residual
2b	Non-Potable	Medium	• HVAC evaporative cooling (e.g., cooling tower, evaporative condenser, spray cooler, direct/indirect evaporative cooling)	Treatment shall consider equipment manufacturer water quality requirements and designed in accordance to ANSI/ASHRAE 188-2015 addressing Legionellosis Risk Management for Building Water Systems								

3	Non-Potable	High	• Hose bibbs • Building/pressure washing • Decorative fountains • Commercial vehicle washing	4 (99.99%)	4 (99.99%)	3 (99.9%)	-	5 µm	40 mJ/cm^2 and third-party certified to NSF 55 Class A or validated to US EPA UVDGM or DVGW-W294 with minimum 0.5 mg/L chlorine residual	1 µm absolute[e]	CT for 4 Log reduction for bacteria and minimum 0.5 mg/L chlorine residual[e]	0.5 µm[c] with minimum 0.5 mg/L chlorine residual
4	Potable	High	• Human consumption • Dishwashing • Food preparation • Oral care • Bathing/Showering/Handwashing • Pool/Spas/Hot tubs/Splash pads • Misting stations • Swamp coolers	Not Permitted								

Notes:

(1) *A figure depicting the particle size spectrum for filtration is included in Annex A.*

(2) *The source water (see Table 7.2.1.4) for tier 2 is of poorer quality that that for tier 3 (i.e. higher likelihood of human sewage contamination). Therefore, the log reductions are the same for these two tiers so as to produce an equivalent level of safety.*

CT: *Concentration of disinfectant (C) x contact time (T)*

c: *pre-filtration of 5-100 µm is recommended to extend the life of the filter.*

d: *For operational purposes only, it is recommended to use <= 500 µm filtration, or for drip irrigation only, to use <= 100 µm.*

e: *Due to potential for growth of opportunistic pathogens in plumbing systems (e.g., Legionella, Pseudomonas aeruginosa, Mycobacterium avian complex), a minimum 0.5 mg/L chlorine residual shall be maintained.*

UVDGM: *Ultraviolet Disinfection Guidance Manual*

DVGW: *German Technical and Scientific Association for Gas and Water*

8.2 Water quality verification and substantiation

8.2.1 Purpose

To ensure system equipment is operating effectively and as intended to meet the minimum performance criteria specified in Table 8(3) or Table 8(4), a water quality verification and substantiation program shall be implemented as required by the WSP (see Clause 6.1.2). The elements of the water quality verification and substantiation program shall include but not be limited to:

(a) inspection and monitoring of equipment, processes, and controls to verify effective system operation;
(b) inspection, monitoring, and cleaning of collection surfaces, conveyance piping, equipment, and storage tanks; and
(c) for commercial and multi-family residential, a water quality monitoring program.

8.2.2 Single-family residential applications

Any filter, UV lamp, or other consumable shall be replaced as per manufacturer's recommendations. If output water changes in clarity or odour, filters should be replaced and any sediment in the storage tank should be flushed or pumped out.

8.2.3 Multi-family residential applications

Any filter, UV lamp or other consumable shall be replaced as per manufacturer's recommendations. Water quality monitoring shall include weekly turbidity and UV transmittance leaving the treatment system, chlorine residual at the point of use and, for systems serving 500 or more persons, grab samples for HPC and culturable enterococci, to ensure treatment processes are operating within control limits. Where treatment process are not operating within control limits, corrective action shall be taken.

8.2.4 Commercial applications

Any filter, UV lamp, or other consumable shall be replaced as per manufacturer's recommendations. Water quality monitoring shall include weekly turbidity and UV transmittance leaving the treatment system, chlorine residual at the point of use and grab samples for HPC, and culturable enterococci to ensure treatment processes are operating within control limits. Where treatment process are not operating within control limits, corrective action shall be taken.

8.2.5 Water quality substantiation

Water quality results that meet the limits outlined in Table 8(5) or Table 8(6), as required by the end use and source, shall substantiate that hazards are being effectively controlled. Corrective action shall be taken if output water quality requirements are not met.

The values in Tables 8(5) or 8(6) are provided only as suitable indicator parameters to substantiate system performance and shall not be used as the only or primary criteria for the design of a treatment system.

TABLE 8(5)
OUTPUT WATER QUALITY REQUIREMENT FOR APPLICATIONS USING WATER SOURCED FROM ROOF COLLECTION SURFACES

Tier	Parameter	Turbidity (NTU)	HPC (CFU/100 mL)	Enterococci (CFU/100 mL)	pH[a]	Chlorine[b]	
						CMF[c]	SFR[d]

						(mg/L)	(mg/L)
1	Median		NT	<			-
	Maximum		-		-		-
2a	Median	<1	< 500[b]	≤ 5		0.5 – 2[b]	
	Maximum	5	-	< 15			-
2b	Median	-	< 500[b]	NT	7-8.2		-
	Maximum	-	-	-	-		-
3	Median	≤1	< 500[b]	< 5		0.5 – 2	
	Maximum	5	-	< 15	-		-
4	-	Refer to drinking water standards and guidelines applicable from the authority having jurisdiction					

Notes:

(1) *For systems serving a single-family dwelling, there is no requirement to undertake microbiological testing, however the system must be physically examined upon installation and periodically thereafter.*

(2) *Methods are to follow APHA Standard Methods for Water and Wastewater Analysis or EPA-approved methods.*

a: *A pH of below 7 can be a concern for piping, fittings, and other equipment but a required value is not set for most uses.*

b: *For systems supplying water to < 25 people, UV disinfection can be used instead of chlorine.*

c: *CMF = Commercial/multi-family.*

d: *SFR = Single-family residential.*

TABLE 8(6)
OUTPUT WATER QUALITY REQUIREMENT FOR APPLICATIONS USING WATER SOURCED FROM GROUND LEVEL COLLECTION SURFACES

Tier	Parameter	Turbidity (NTU)	HPC (CFU/100 mL)	*E. coli* (CFU/100 mL)	Enterococci (CFU/100 mL)	*Bacteroides* HF183 & HumM2 Markers (GE/100 mL)	pH	Chlorine	
								CMF[a] (mg/L)	SFR[b] (mg/L)
1	Median	-	-					-	-
	Maximum		-				-	-	-
2a	Median	≤2	< 500	≤ 10	≤ 5	< 60		0.5 – 2	0.5 – 2
	Maximum	5	-	< 200	< 70	< 100		-	-
2b	Test Ave.	-	< 500	NT	NT	NT	7-8.2	-	-
	Maximum	-	-	-	-	-	-	-	-
3	Test Ave.	≤1	< 500	< 100	< 35	< 60		0.5 - 2	0.5 - 2
	Maximum	5	-	< 200	< 100	< 100	-	-	-
4	-	Not permitted							

a: *CMF = Commercial/multi-family.*
b: *SFR = Single-family residential.*

9 Rainwater System Tests and Inspections

9.1 Testing for non-potable water distribution system cross-connection

Where potable water is supplied to a rainwater harvesting system, the water distribution systems shall be tested for cross-connections in accordance with Section 9.1.1 through 9.1.2 upon construction and after any modifications.

9.1.1 Cross-connection testing for water distribution systems

Water distribution systems shall be tested for cross-connection following the procedures as follows:
(a) Fill the water storage tank with sufficient potable water to conduct the test.
(b) Ensure the water supply from the storage tank remains active.
(c) Deactivate and drain the water in the potable water system.
(d) Confirm that potable water is no longer supplied after the system has been drained.
Note: *If a potable outlet keeps running, then it may not be connected to the correct water supply system and the plumbing system must be reconfigured.*
(d) Activate the non-potable water system outlets and confirm water from the storage tank is provided continuously.

Note: *If a non-potable outlet does not flow, then it may not be connected to the proper water supply system and the plumbing systems must be reconfigured.*

9.1.2 Post-test reconnection

After conducting cross connection testing in Section 9.1.1,
(a) close all potable and non-potable outlets;
(b) restore the water system back to normal operation; and
(c) purge any air trapped in the water systems.

9.2 First-flush diversion test

First-flush diverters shall be inspected and tested by introducing water into the device. Proper diversion of the first quantity of water shall be verified.

9.3 Collection pipe and vent test

Drain, waste, and vent piping used for rainwater collection and conveyance systems shall be tested in accordance with the applicable code.

9.4 Tank test

Storage tanks shall be tested in accordance with the following procedure conducted in sequence:
(a) Tanks shall be filled with water to the overflow outlet prior to and during inspection. All seams and joints shall be left exposed and the tank shall remain water tight without leakage for a minimum of 24 hours before completing subsequent tests;
(b) Overflow systems shall be inspected for proper operation. Additional water shall be introduced for a period of 15 minutes at a rate similar to the anticipated influent flow to verify proper drainage through the overflow system without leaks;
(c) Tank drains shall be inspected and tested for proper operation;
(d) Where makeup water systems are provided, they shall be inspected and tested for proper operation of the automatic control valves, level controls and alarms.

9.5 Water supply system test

The testing of makeup water supply piping and distribution piping shall be conducted in accordance with the applicable code.

9.6 Inspection and testing of backflow prevention assemblies

The testing of backflow preventers and backwater valves shall be conducted in accordance with the applicable code.

9.7 Inspection of vermin and insect protection

Inlets and vents to the system shall be inspected to verify each is protected to prevent the entrance of insects and vermin into the storage tank and piping systems in accordance with Section 6.1.8.

9.8 Water quality

Water supplied to an end use shall be verified to meet the minimum water quality requirements for the intended application as specified in Section 8. If there are multiple end uses supplied by a single treatment system, the water supply shall meet the most stringent requirements for the end use applications as specified in Section 8. The quality of the water for the intended application shall be verified at the point of use in accordance with the requirements of this standard and applicable codes.

Annex A

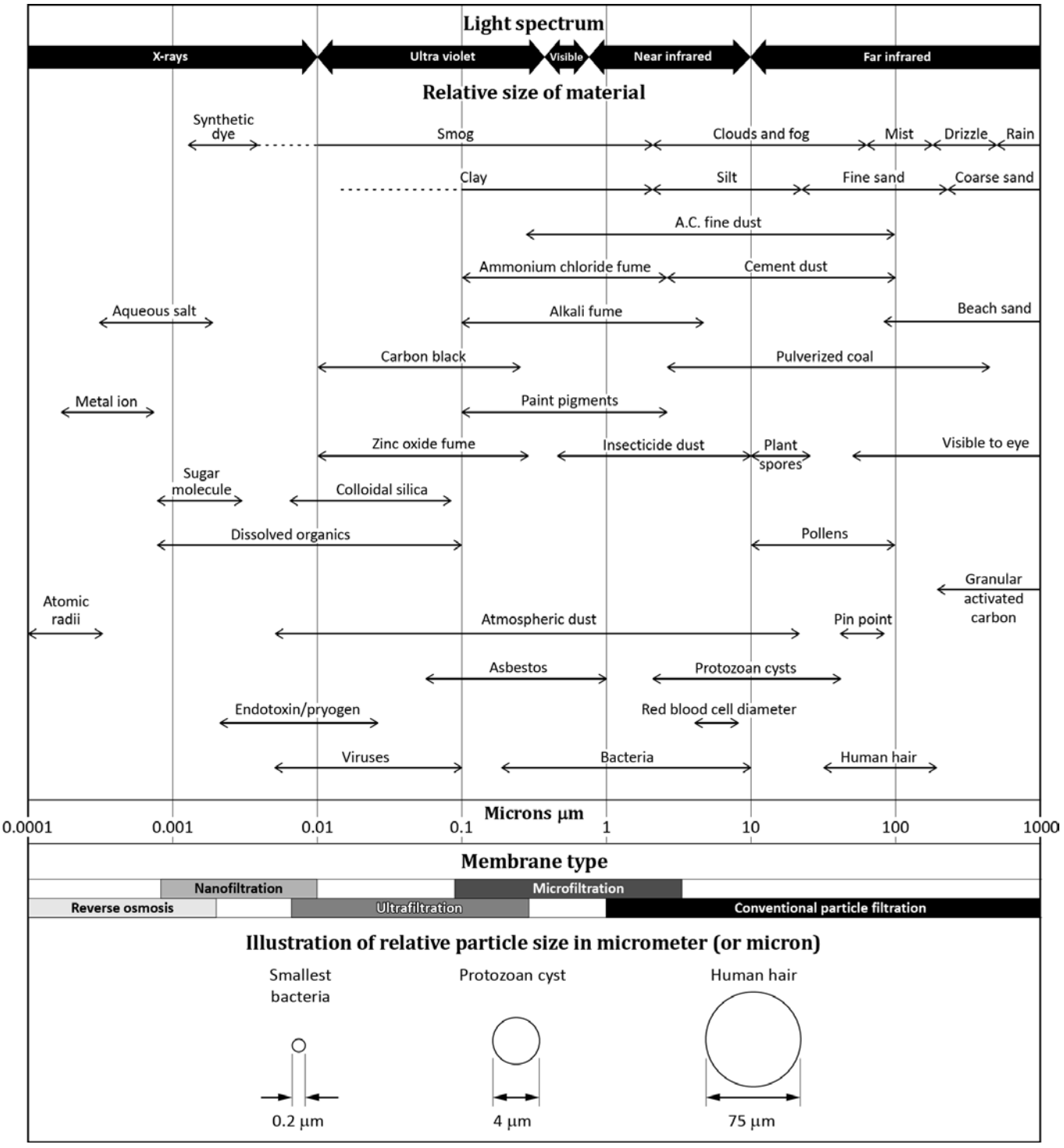
Particle Size Spectrum

Note: *This Annex is an informative (non-mandatory) part of this Standard.*

A.1 Particle size spectrum for filtration

Figure A.1 gives a comparison of particle sizes for different substances.

FIGURE A.1
PARTICLE SIZE SPECTRUM


Light spectrum
X-rays
Ultra violet
Visible
Near infrared
Far infrared
Relative size of material
Synthetic dye
Smog
Clouds and fog
Mist
Drizzle
Rain
Clay
Silt
Fine sand
Coarse sand
A.C. fine dust
Ammonium chloride fume
Cement dust
Aqueous salt
Alkali fume
Beach sand
Carbon black
Pulverized coal
Metal ion
Paint pigments
Zinc oxide fume
Insecticide dust
Plant spores
Visible to eye
Sugar molecule
Colloidal silica
Dissolved organics
Pollens
Granular activated carbon
Atomic radii
Atmospheric dust
Pin point
Asbestos
Protozoan cysts
Endotoxin/pryogen
Red blood cell diameter
Viruses
Bacteria
Human hair
Microns µm
0.0001
0.001
0.01
0.1
1
10
100
1000
Membrane type
Nanofiltration
Microfiltration
Reverse osmosis
Ultrafiltration
Conventional particle filtration
Illustration of relative particle size in micrometer (or micron)
Smallest bacteria
Protozoan cyst
Human hair
0.2 µm
4 µm
75 µm

Annex B

Suggested Evaporative Cooling Water Quality Control Levels

Note: *This Annex is an informative (non-mandatory) part of this Standard.*

B.1 General

The suggested evaporative cooling water quality control levels are given in Table B.1. Where an evaporative cooling equipment manufacturer specifies a differing water quality control level, it shall take precedence over the suggested water quality control levels provided in Table B.1

TABLE B.1
SUGGESTED EVAPORATIVE COOLING WATER QUALITY CONTROL LEVELS

Measure	Unit	Suggested Limits
BOD5	mg/L	< 50
TSS	mg/L	<25
Alkalinity	as $CaCo_3$ ppm	75-400
Total Hardness	as $CaCo_3$ ppm	<1000
Chlorides	ppm	<250
Silica	ppm	<150
Copper	ppm	<10
Iron	ppm	<3
TDS	ppm	<3000
Specific Conductivity	micro-mhos/cm	<3000
pH	--	7-8.8
Total Coliform	#/100 mL	<10000

Annex C

Prescriptive Tank Requirements

Note: *This Annex is a normative (mandatory) part of this Standard.*

C.1 Precast Concrete tank requirements

C.1.1 Materials

C.1.1.1 Freeze-thaw

Where exposed to freeze-thaw conditions concrete tanks shall be constructed with 4%-7% entrained air.

C.1.1.2 Sulphate soils

Where exposed to moderate or greater sulphate soils, the concrete shall be rated for appropriate resistance to sulphate exposure.

C.1.1.3 Potable applications

Tanks for potable water use shall require sealants and fittings complying with applicable requirements of NSF 61. Non-toxic form release agents shall be used in the production of all molded components installed on tanks to be used in potable applications.

C.1.2 Field testing

Field testing shall be in accordance with methods specified by manufacturer.

C.2 Modular plastic tanks

C.2.1 Materials

Potable and non-potable tanks shall be manufactured with recycled or virgin polymers complying with the applicable requirements of NSF 61 or ASTM D1193-99e1. Injection molded products shall use polymer material tested in accordance with ASTM D1621.

C.2.2 Design life

The design life of a polymer tank should be determined in accordance with the life expectancy of the specific project.

C.2.2 Below ground requirements

Where water is introduced into the tank through infiltration, the soil mix and plant material shall be selected to provide required infiltration rates and shall not contain contaminants.

C.3 Flexible Material Pillow Tanks

C.3.1 Materials

Panels shall be tested in accordance with the test methods specified in Table C.3.1 and shall comply with performance criteria set in Table C.3.1 as applicable for the type and minimum total material weight.

TABLE C.3.1

PILLOW TANK PANEL MATERIAL TEST CRITERIA

Test	Criteria	Test Method Reference
Tear strength	30/30 lbs (133/133 N) minimum	ASTM D751 Trap Tear
Breaking yield strength	250/200 lbs. (1,110/890 N) minimum	ASTM D751 Grab tensile
Hydrostatic resistance	300 psi (2.07 MPa) minimum	ASTM D751, Procedure A
Low temperature resistance	Pass -25 F (-32 C)	ASTM D2136, 1/8 in mandrel-4 hr
Dimensional stability	5% each direction, maximum	ASTM D1204, 100 C-1hr
Bursting strength	350 lbs. (1557 N) minimum	ASTM D751, Ball Tip
Blocking resistance	#2 Rating, maximum	ASTM D751, 180 F (82 C)
Adhesion-ply	12 lbs/in (10 daN/5 cm) minimum	ASTM D413, Type A
Abrasion resistance	2,000 cycles, minimum before fabric exposure and 50 mg/100 cycles weight loss, maximum	ASTM D3389, H-18 Wheel, 1 kg load
Water absorption	0.05 kg/m^2 @ 70 F (21 C) and 0.28 kg/m^2 @ 212 F(100 C) maximum	ASTM D471, Section 12-7 days
Wicking	1/8 in (0.3 cm) maximum	ASTM D751
Puncture resistance	50 lb (225 N) minimum	ASTM D4833
	OR	
	205 lb (912 N) minimum	FTMS 101C, Method 2031

C.3.1.2 Seams

Seams shall be made water-tight using radio frequency, heat bonding or equivalent methods and shall comply with the performance criteria set in Table C.3.2 as applicable for the fabric and seam type.

TABLE C.3.2
PILLOW TANK SEAM TEST CRITERIA

Test	Criteria	Test Method Reference
Adhesion heat welded seam	10 lbs/in (9.0 daN/5 cm) minimum	ASTM D751, Dielectric Seam
Dead load seam strength	Pass 100 lb/in @ 70 F (445 N @ 21 C) and Pass 50 lb/in @ 160 F (220 N @ 70 C)	ASTM D751
Bonded seam strength	250 lb (1,112 N) minimum	ASTM D751, Grab Test Method Procedure A,

C.3.2 Fittings

C.3.2.1 Reinforcement patch
All fitting ports areas shall contain a re-enforcement patch of the same material that is used in the manufacture of the bladder tank. Patches are to be thermally welded to the bladder tank.

C.3.2.2 Location
All fittings shall be located a minimum of 8 inches (20.3 cm) from seams.

C.3.2.3 Bulk-head fittings
Where bulk-head fittings are used, they shall be bolt-on type.

C.3.2.5 Flexible piping or tubing
All side and top fittings shall be connected to a section of flexible pipe or tubing that is sufficiently long enough to compensate for bladder tank flexing without imparting excessive stress on the piping or tank.

C.3.3 Installation
Bladder tanks shall be installed on a level and smooth surface.

C.4 Wooden Tanks
C.4.1 Materials
Lumber for wood bottoms and wood staves for the manufacturing of wooden tanks shall be of decay resistant species, untreated, and as specified in the USDA Wood Handbook, (NWTI) National Wood Tank Institute Technical Bulletin S-82. Acceptable lumber species are as follows:
(a) Western Red Cedar,
(b) Alaskan Yellow Cedar,
(c) Atlantic White Cedar,
(d) Coast- Type Douglas Fir,
(e) White Oak,
(f) Red Cypress,
(g) Other wood species, including imported species may be acceptable provided they comply with the requirements of NWTI Bulletin S-82.

C.4.1.1 Binding materials
Binding material, including, but not limited to hoops, lugs and nuts, shall meet the strength requirements of ASTM A36, ASTM A592 or ASTM A675, as applicable, and shall be of ductile iron, mild steel, hot dipped galvanized steel, or stainless steel. Different materials are acceptable when they comply with the ultimate strength design for the application.

C.4.1.2 Liners

Wooden tanks subject to prolonged periods without water shall utilize a flexible liner appropriate for the application. Where the tank supplies water for use in potable applications, the liner shall comply with NSF 61.

C.4.2 Installation

Wooden tanks shall be installed aboveground and rest on timbers a minimum of 4" x 6" (100 x 150 mm) in a structural or dense grade adequate to support the weight of the tank when full. The timbers (dunnage) shall provide at least a ¾" (19mm) high air space below the bottom of the staves and the ground to provide air circulation under the tank. Wooden tanks shall not be used for underground applications.

C.4.3 Testing

Wooden tanks shall be tested with water and verified to be watertight for a period of at least 48 hours without adjustments. The tank shall be allowed to continue swelling for an additional six (6) days. Moisture on the outside surface of a wood tank which disappears or evaporates without forming a drip shall not be considered a leak.

Annex D

Tank Sizing and Capacity Calculation Methodologies

Note: *This Annex is an informative (non-mandatory) part of this Standard.*

This annex is under development.

Annex E
Water Safety Plan

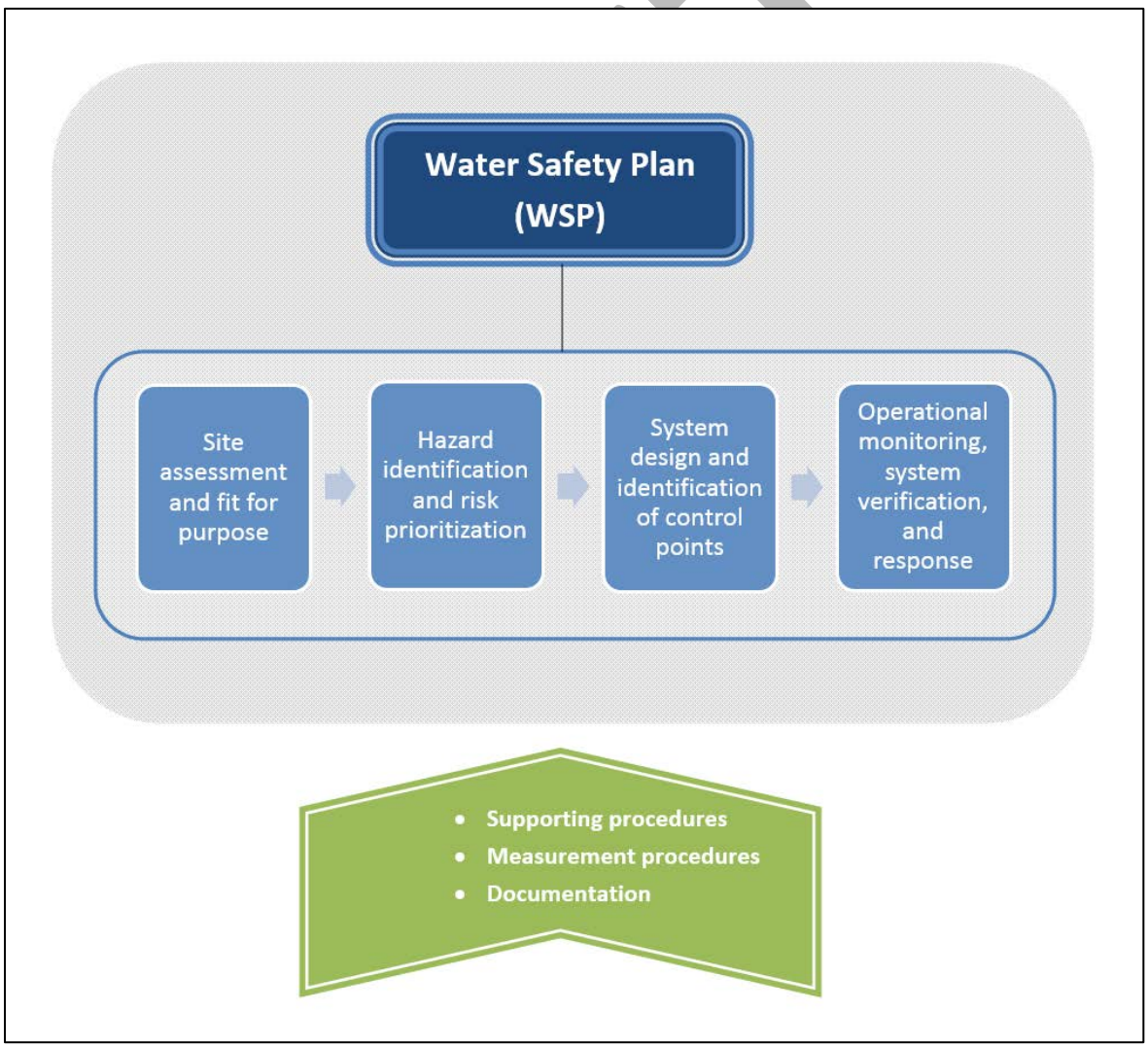
Note: *This Annex is an informative (non-mandatory) part of this Standard.*

E.1 General

E.1.1 Elements of the Water Safety Plan (WSP)

An overview of the WSP is illustrated in Figure E.1.1.

Figure E.1.1
Overview of the Water Safety Plan



E.1.2 Scope of water supply

The WSP is intended to recognize, address, and improve water quality and water quality concerns for rainwater harvesting systems for potable and non-potable uses. This WSP only applies to rainwater harvesting systems using roofs of residential or commercial structures as the catchment area. It is important to document the full scope of your rainwater harvesting system in order to identify system components, scope of system supply, parties necessary for system maintenance, and operational guidelines for the rainwater harvesting system. The Rainwater Harvesting System Information Document should be completed in accordance with Section E.5.

E.1.3 Water testing

A preliminary water test should be performed to establish the baseline water quality and identify possible contaminants. Subsequent water quality tests should be performed periodically for water quality compliance monitoring. All relevant water quality standards for the authority having jurisdiction for the end water use should be adhered to.

E.2 Site assessment and fit for purpose

All rainwater harvesting systems except those installed on single-family homes using rainwater collected exclusively from a rooftop should be assessed for suitability in accordance with ASTM E2727 or equivalent as required by the authority having jurisdiction.

E.3 Risk identification and risk prioritization

E.3.1

A rainwater harvesting system design "map" or drawing may be needed in order to identify what component in the rainwater harvesting system is most likely to encounter a specific risk. The WSP should recognize risks that could adversely impact water quality in a rainwater harvesting system. An evaluation of the entire rainwater harvesting system or system design should be performed to assess which water quality risks are most prevalent. Risks may include, but not be limited to, the following:

(a) Fecal contamination from animals/humans;
(b) Chemical contamination from roofing materials;
(c) Organic contamination from plant debris;
(d) Contamination from air pollution in urban, industrialized, and/or farming areas;
(e) Algae growth in the collection tank;
(f) Stagnation of water in the collection tank;
(g) Mosquito growth;
(h) Contamination of conveyance and/or distribution piping;
(i) High turbidity in the stored rainwater;
(j) Groundwater entering storage tank (primarily in below ground storage tank systems).

E.3.2

Where stormwater is to be used as a source for the rainwater harvesting system, the assessment should take into account the likelihood of contaminants from current or past uses, in particular the presence of microbiologicals, heavy metals, petroleum products, pesticides, and radioactive materials. Sites that have the likelihood of such contaminants may include

(a) Dog parks, livestock pens, animal holding yards;
(b) Agricultural property;
(c) Transportation facilities such as rail yards, truck parks, airports;
(d) Landfills;
(e) Transportation corridors;
(f) Mining;
(g) Oil and gas production and processing sites; and
(h) Brownfields.

E.4 Incremental Improvement Plan

E.4.1 General

An essential component of the incremental improvement plan is to ask questions such as the following related to each identified risk:
(a) What is the risk? (e.g., fecal contamination on the catchment area);
(b) How is the risk identified? (e.g., visual inspection, testing etc.);
(c) When is the system inspected for each identified risk? (e.g., weekly, monthly, etc.);
(d) What system component does the risk impact? (e.g., catchment surface);
(e) Where does the risk occur? (e.g., northern ¼ of catchment area);
(f) Who is responsible for inspections and/or monitoring the risk?; and
(g) What corrective action is needed? (e.g., clean roof area monthly, implement a first flush system for a portion of the roof, etc.).

E.4.2 Control measures

Control measures should be taken to minimize the risk of adversely impacting water quality for each identified risk (see Section E.3). The system owner or person(s) responsible for maintaining the rainwater harvesting system is the party responsible for implementing necessary control measures. Once the proper control measures are identified and implemented it is essential to then perform periodic operational monitoring checks to ensure the control measures are operational and performing as expected.

E.5 Rainwater harvesting system general information document

E.5.1 General

A general information document should be created to record information about the rainwater harvesting system. Any design drawings, specification sheets, warranties, and operational guidelines should be included. The following information should be included:
(a) Date;
(b) System Name;
(c) Emergency contact information;
(d) Person(s) responsible for system maintenance and operation;
(e) Scope of system supply? (e.g., potable, irrigation, laundry);
(f) Number of people served by the system;
(g) Number and type of fixtures served by the system;
(h) Whether all fixtures that the system serves are labeled accordingly;

(i) Volume of water supplied by the system (e.g., gallons/year or liters/year);
(j) Details of any auxiliary water supply;
(k) Details of any system design drawings (e.g., whether they are on file with local health departments and/or permitting offices);
(l) Water testing data, if available;
(m) Whether seasonal weather patterns can impact water quality;
(n) Any risks that apply to the system (e.g., based on the risks identified in E.3);
(o) Control measures to mitigate identified risks;
(p) Details of any regular operational inspections performed on the system to ensure identified risks are properly mitigated and new risks identified; and
(q) Inspection schedule.

E.5.2 System technical information

The rainwater harvesting system general information document should include the following system technical information:
(a) Catchment area size (e.g., in ft^2 or m^2);
(b) Roofing material;
(c) Gutter/downspout material;
(d) Conveyance piping material;
(e) Storage tank information, including
    (i) Tank volume (e.g., in gallons or liters);
    (ii) Tank dimensions:
    (iii) Tank construction materials;
    (iv) Location (e.g., above or below ground);
(f) Tank pre-filtration system information, including
    (i) Type of pre-filter(s);
    (ii) Quantity of pre-filters;
    (iii) Filtration particle size;
(g) Pump system information, including
    (i) Brand, make, and model of pump;
    (ii) Pump power requirement;
    (iii) Pump horsepower;
(h) Water treatment system information, including
    (i) Type of filtration/disinfection: (e.g., sediment, UV, chlorine, etc.);
    (ii) Water treatment components brand, make, model;
    (iii) Age of equipment;
(i) Distribution piping information, including
    (i) Distribution pipe material;
    (ii) Approximate length of distribution pipe system.

E.5.3 System water quality information

The rainwater harvesting system general information document should include the following system water quality information:

(a) Frequency of water quality tests and other monitoring activities;

(b) The microbial, chemical, and physical parameters that are tested for and monitored;

(c) Location or facility where the water tested;

(d) Any water quality problems that have been found;

(e) Any waterborne illnesses that have originated from water in the system;

(f) Any water test results.

Public comments are requested on this first Public Review Draft beginning September 24, 2015 and are due by ~~November 24, 2015~~ December 7, 2015. Public comments must be submitted on using the CSA Group Public Review site at http://publicreview.csa.ca/Home/Details/1773 Questions regarding the public review process or comment submission process can be directed to the committee secretariats Paul Gulletson (paul.gulletson@csagroup.org), Shawn Martin (smartin@iccsafe.org).