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3.5

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3.5 Potable Water Systems

3.5.1 Introduction

The water supply system in a structure located in a flood-prone area must be designed so that floodwaters do not contaminate the potable water systems and create a health hazard.

A building's potable water system can be arranged into two components:

1. Water Supply Systems
2. Distribution Components

Water Supply Systems generally include a source of potable water and transport of the water to the property or the surface of the ground. Water supply systems are typically one of two types:

1. Public utility system, which is fed from a public utility water supply main. *Figures 3.5.1A* and *3.5.1B* show typical public utility water supply systems in non-velocity and velocity flow areas, respectively.
2. On-site system, which is fed from an on-site well. *Figure 3.5.1C* show a typical on-site well water system in a non-velocity flow area.

Distribution Components generally include a usage meter, a service feed pipe, water heater and a distribution system.

NOTE:
This manual excludes discussion of public water mains, public service lines, and public water supply plants which lie beyond the usage meter.

In a public water system, the public utility provides water supply through a water main and service line to the edge of the public right-of-way, where the water usage meter is located. The service feed pipe from the structure then connects to the usage meter. For structures connected to public water supply, only the service feed pipe and the on-site distribution system are covered in this manual.

In an on-site water supply system, the source of water is a private on-site well, and the owner is responsible for the operation and maintenance of the well. The water service feed pipe is the main pipeline that connects the on-site water well to the distribution system within a structure. The distribution

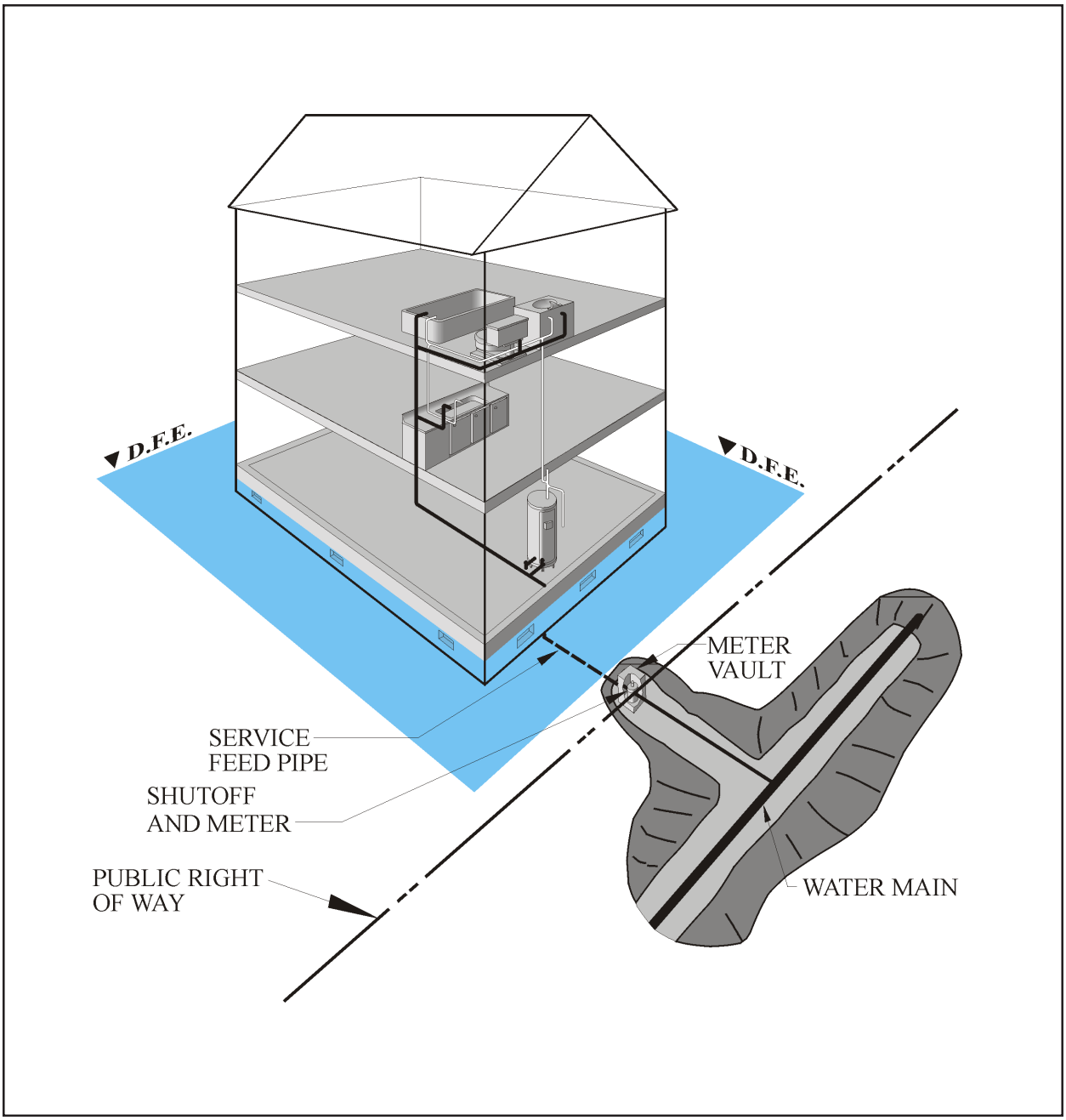

Figure 3.5.1A: Components of a public potable water supply system in a non-velocity flow area

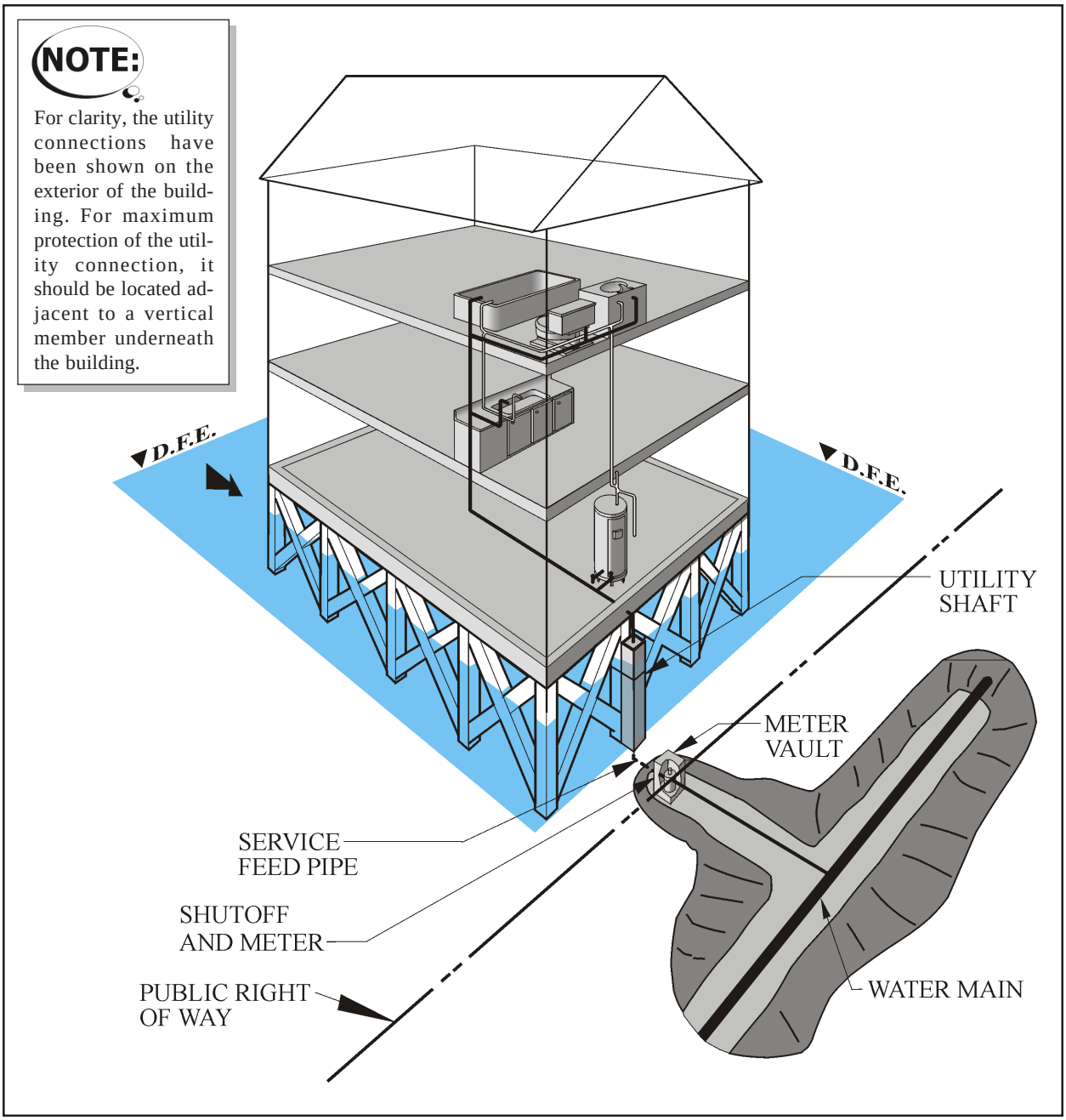

Figure 3.5.1B: Components of a public potable water supply system in a velocity flow area

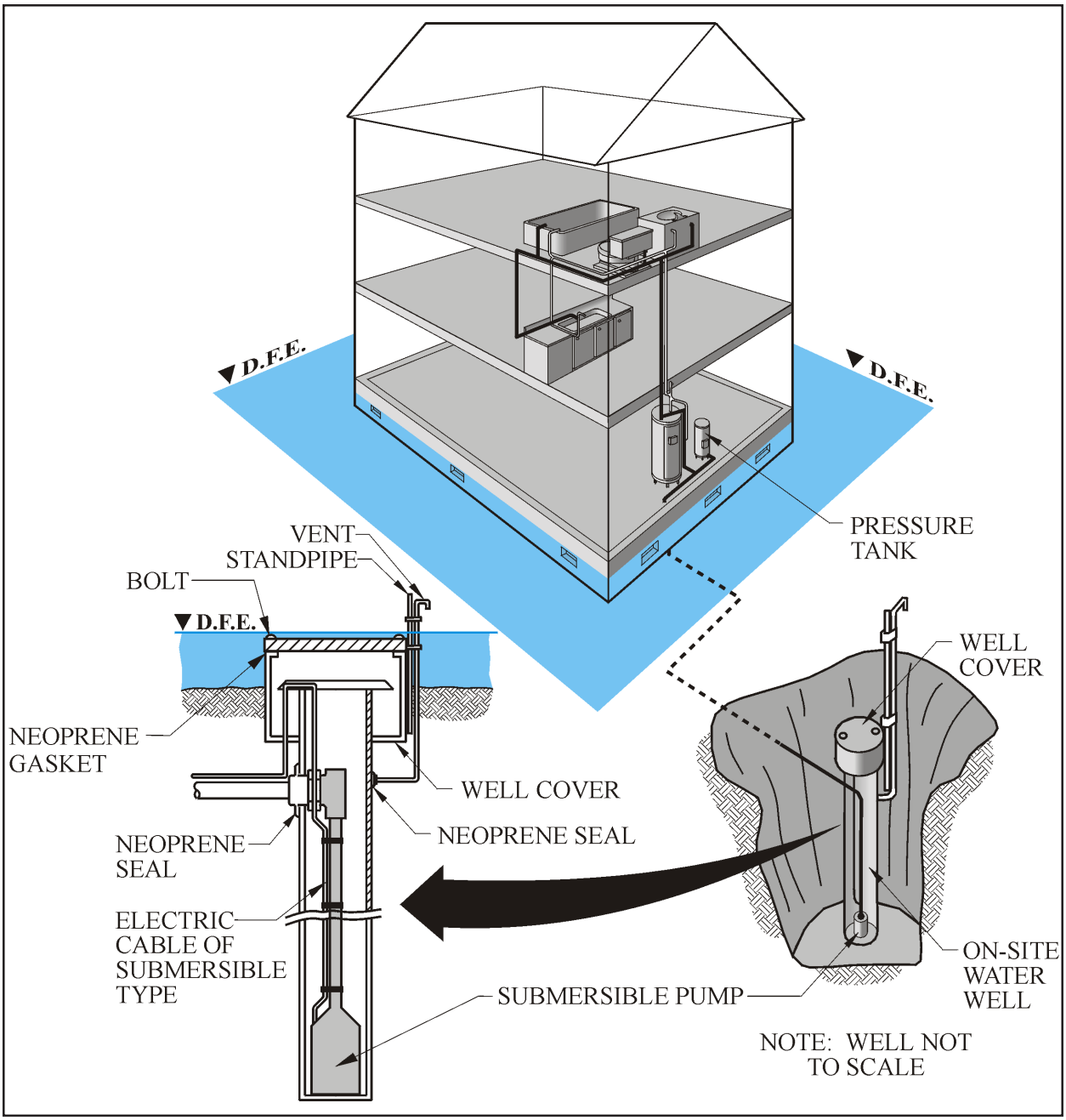

Figure 3.5.1C: The components of an on-site potable water system

NOTE:

This chapter applies to new and substantially improved structures that must be built in compliance with the minimum requirements of the NFIP. Many of the structures that were built prior to the adoption of floodplain management regulations by communities have building utilities systems that are not resistant to flood damages. For additional information on how to protect building utility systems in these structures, see Chapter 4 on Existing Buildings.

system includes the pressure tank and all the pipes and water delivery accessories (faucets, showers, etc.) in a structure.

The two main dangers that floodwaters present to water supply systems are:

1. Damage to pipes and to the on-site well head from the effects of velocity flow, wave action, and debris impact.
2. Water supply contamination in the well, service feed pipe, and distribution system.

In general, the figures in this chapter attempt to illustrate some general practices that meet the requirements of the National Flood Insurance Program (NFIP). Local codes and health/sanitary regulations permit many variations that also meet NFIP regulations. Please refer to your local code officials for specific practices that may meet both the NFIP regulations and local code.

3.5.2 NFIP Requirements

The NFIP requires that the water supply system in a new or substantially improved structure located in a Special Flood Hazard Area (SFHA) be designed so that floodwaters do not enter or accumulate within system components and to additionally ensure that floodwater does not contaminate the potable water supply system. See *Table 3.5.2* for a summary of compliant mitigation methods.

Methods of Mitigation	A Zones	V Zones
1. Elevation	Highly Recommended	Minimum Requirement
2. Component Protection	Minimum Requirement	Not Allowed*

Table 3.5.2: Summary of NFIP regulations
***Allowed only for those items required to descend below the DFE for service connections.**

NOTE:

The Design Flood Elevation (DFE) is a regulatory flood elevation adopted by a community that is the BFE, at a minimum, and may include freeboard, as adopted by the community.

1. **Elevation** refers to the location of a component above the Design Flood Elevation (DFE).
2. **Component Protection** refers to the implementation of design techniques that protect a component or group of components located below the DFE from flood damage by preventing floodwater from entering or accumulating within the system components.

3.5.3 Supply Systems

The main threat that floodwaters pose to water supply systems is contamination. By definition and industry standards, water supply systems are designed to be watertight. Water supply systems are often contaminated by floodwaters through infiltration into the on-site water well or public supply.

Velocity flow, wave action, and floating debris, which are characteristic of floods in areas with high velocity flows, can cause considerable damage to exposed on-site well heads located below the DFE. This can result in contamination of the water system. Erosion and scour can expose public water mains and service connections, leaving them vulnerable to being contaminated.

Protecting On-Site Water Wells

Water wells in flood-prone areas that experience velocity flow must be designed to withstand the effects of velocity flow, wave action, and debris impact. Velocity flow can erode and scour the soil away from the well head and expose it to the direct impact of debris and moving water. Damage to the well head would allow floodwaters to infiltrate and contaminate the well.

It is strongly recommended that all water wells located in flood-prone areas be equipped with a watertight casing that extends from one foot above grade to 25 feet below grade. In flood-prone areas that experience velocity flow, the watertight casing can be protected from damage by one of the following methods:

1. The casing could be ductile iron pipe which is strong enough to resist debris impact.
2. A commercially available protective well cover could be installed. These covers range from metal boxes or cylinders to concrete manholes.

NOTE:

For more information, see FEMA Publication 102—*Floodproofing Non-Residential Structures*, page 100.

3.5.4 Distribution Components

The main threat that floodwaters pose to water supply distribution system components is contamination. By definition and industry standards, water supply systems are designed to be watertight. Water supply systems are often contaminated by floodwaters through infiltration into open faucets and/or broken pipes.

Velocity flow, wave action, and floating debris, which are characteristic of floods in areas with high velocity flows, can cause considerable damage to exposed service connection pipes and outdoor faucets located below the DFE. This can result in contamination of the water system.

Elevation

Outdoor faucets, showerheads, and utility sinks can best be protected by elevation above the DFE. To allow proper accessibility of faucets, they could be located so that they can be reached from a deck, porch, or staircase. In addition, a backflow prevention valve can be installed on the water connection to prevent contamination of the water supply.

In A Zones, the water heater and pressure tank must be elevated or protected in place. In V Zones, all potable water system components must be elevated except for service connections. The water heater is particularly susceptible to damage by flood inundation. Floodwaters could damage the heating element and render the unit inoperable when the floodwaters recede.

The location of the water meters is usually dictated by the water utility. Typically, they will not permit the meter to be raised above the DFE because of possible freeze damage. Therefore, these units must typically be protected in place.

Component Protection

Water meters are typically located below grade to protect them from frost damage or freezing. However, some precautions can be taken to minimize damage to the water meter. If possible, locate the meter on a portion of the property that is above the DFE. If it must be located below the DFE, it should be protected using, for example, riprap. If erosion, due to velocity flow, is a concern, the local water utility can choose to locate the meter above the DFE if proper access is provided and it can be protected from freezing.

If, in A Zones, a hot water heater or pressure tank is not located above the DFE, a waterproof wall must be constructed around them to at least the DFE as shown in *Figure 3.1.4.D*. In addition, they should be firmly secured to the floor or adjacent wall.

When distribution pipes must be located below the DFE, they should be protected from debris impact, velocity flow, wave action, as well as erosion

and scour. Pipes that are located below grade should be properly embedded to minimize potential exposure to debris impact when the overburden scours away. Distribution piping located below the DFE should be located on the landward or downstream side of the flood and be protected in a debris impact resistant chase adjacent to a permanent building member.

3.5.5 Conclusion

When the water supply system of a building is properly protected from flood damage, the structure can be brought back into operating order more quickly. *Figure 3.5.5* is a flow chart designed to assist you with the design of flood-resistant water supply systems in new and substantially improved buildings. *Table 3.5.5* is a checklist to aid in the review of proposed designs or existing systems for compliance with Federal, State, and local regulations. In addition, a sketch sheet is included that can be used to make notes about the potable water system. With a proper assessment of a building and some careful planning before a flooding event occurs, the damage to the building's water supply system can be minimized.

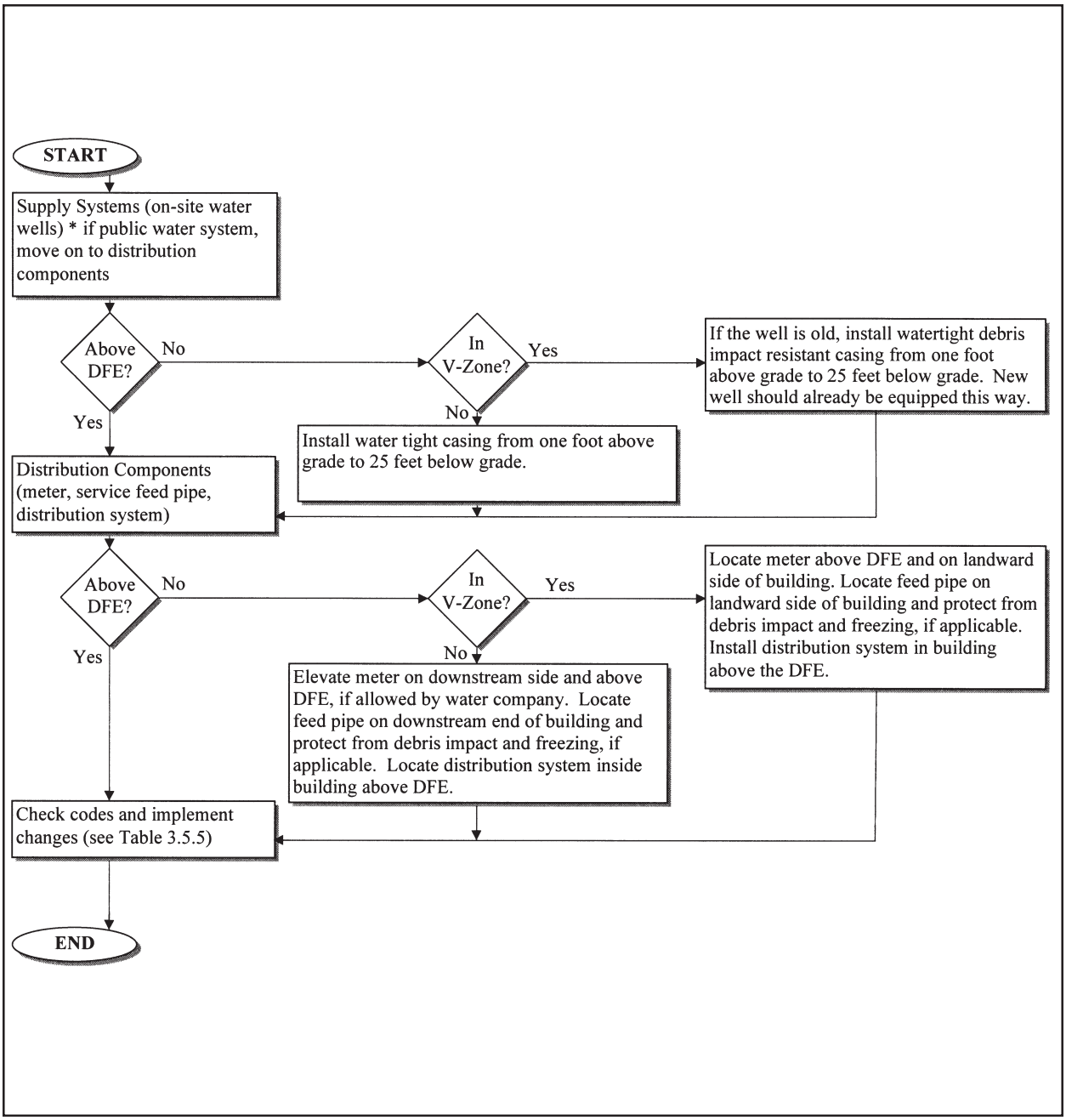

Figure 3.5.5: Flow chart of flood resistant sewage management system design

FLOOD RESISTANT POTABLE WATER SYSTEM CHECKLIST

Property ID:	Property Contact:
Property Name:	Interviewed:
Property Address:	Phone:
Surveyed By:	Date Surveyed:

DFE:	

- What type of water supply system is used for the building?

☐ On-site Is the well head above the DFE? ☐ Y ☐ N Is the well protected from impact? ☐ Y ☐ N Is the feed pipe protected from impact? ☐ Y ☐ N Is the pressure tank above the DFE? ☐ Y ☐ N	☐ Off site Is the feed pipe protected from impact? ☐ Y ☐ N Is meter protected from ☐ Flood? ☐ Frost? ☐ Impact?

Where is the water heater located? Elevation:

Are any fixtures located below the DFE? ☐ Yes ☐ No
Description/elevation:

What piping is located below the DFE? And what type.

- What equipment is located below the DFE?

☐ Meter	☐ Well Head	☐ Water Heater	☐ Fixtures	☐ Piping

☐ Other:	☐ Other:

Table 3.5.5: Checklist for flood resistant sewage management system design

Sketch sheet
(for details, notes, or data regarding system installations)