

Village of Shorewood, Wisconsin



# SEWER BACKUPS & BASEMENT FLOODING PREVENTATIVE SOLUTIONS FOR THE BUILDING OWNER

Prepared By:

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# Introduction

## **Purpose**

This presentation has been prepared to help educate the property owner about their private plumbing system, including preventative actions that can be taken to help prevent basement flooding.

## Contents

- Pages 3 – 7 – General information about sewers and flooding
- Pages 7 – 12 – Solutions to prevent flooding from surcharges
- Pages 13 – 14 – Information on clear water sump pump systems
- Page 15 – Information on the Building Sewer Lateral

## **Professional Background**

Based on our working relationship with the Village and my professional knowledge and experience, Mid City Plumbing & Heating Inc. was asked to prepare this information for the residents and business owners. Mid City has been working with the Village of Shorewood DPW, providing sewer and water repair services, since the mid 1960's. Mid City Plumbing & Heating Inc. is a plumbing, HVAC and sewer water contractor based out of Butler, WI and was started in 1965 by Robert and William Zoulek.

## **Thomas Zoulek, P.E.**

Licensed Master Plumber and Professional Engineer in the State of Wisconsin  
Graduated Milwaukee School of Engineering with a Bachelor of Science degree in  
Architectural Engineer in 2001

15+ years of plumbing field experience including residential, commercial and industrial  
plumbing and municipal sewer and water infrastructure

# Sewer System Types

## 1. Combined Sewer- Primarily east of Oakland

- Both storm water and sanitary sewage combine into one system
- Typically the downspouts are connected to this system
- Drain tile (if any) are connected by gravity to this system

## 2. Separated Sewer- Primarily west of Oakland

- Separate storm and sanitary drainage systems
- Most Shorewood homes do not have a storm sewer lateral
- Downspouts discharge to grade
- Drain tile (if any) discharge to the sanitary sewer via a drain tile receiver (Homes built before 1955)

# Sources of Basement Flooding

**Two sources of flooding during rain storms**

- 1) Sewer System Surcharge
- 2) Rain/surface water drainage

**Other sources of basement flooding**

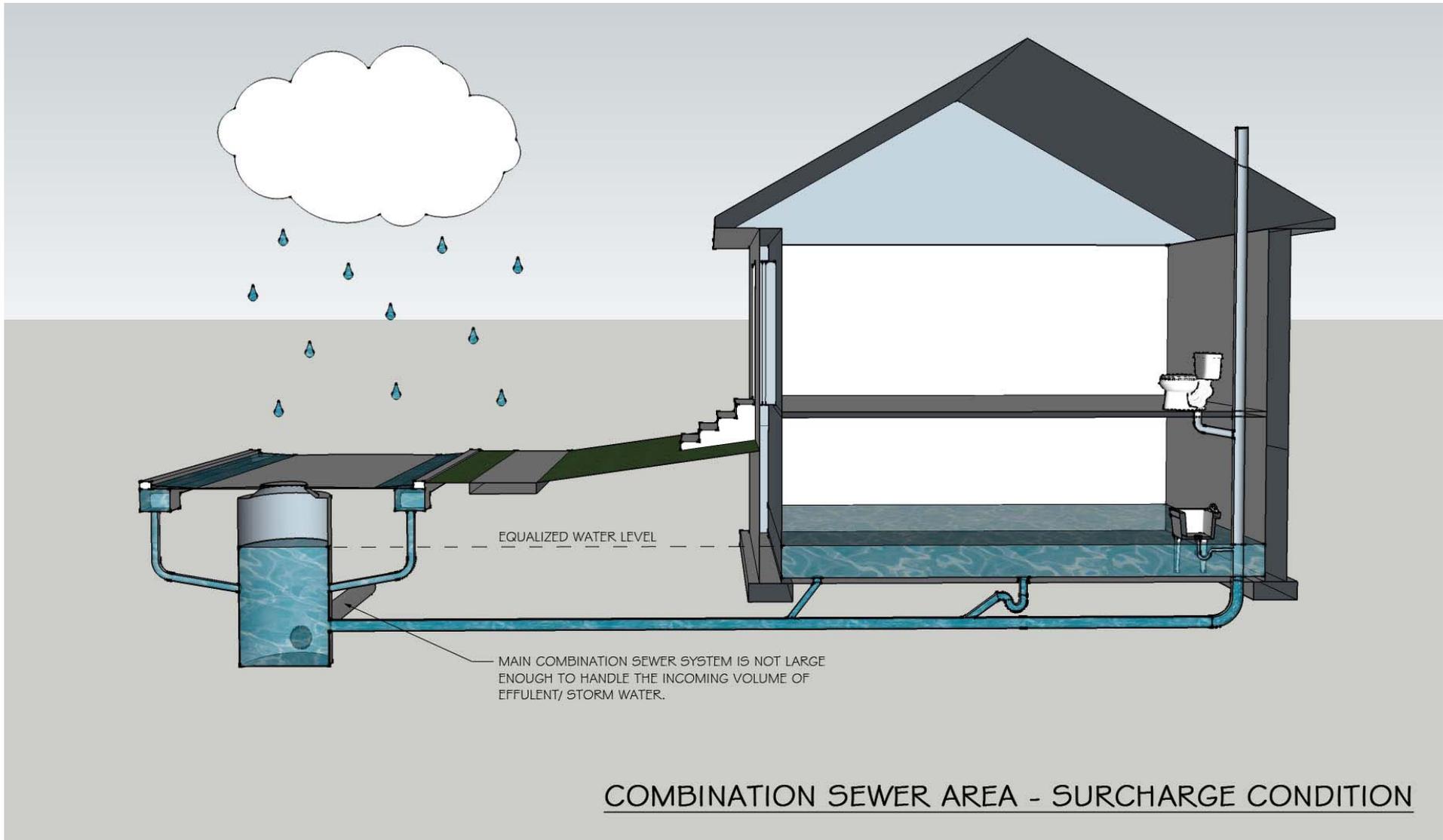
- 1) Sewer back up (plugged sewer)
- 2) Broken water lines

# Sewer System Surcharge

**Definition:** Surcharge means to overload the sewer system (greater volume of water and/or sewage than the system can convey per unit of time)

**Result:** Water level in the system raises causing water to flow backwards from normal flow and causing flooding in areas that are at a lower elevation than the system water level. (Ex. Water flows backwards in a sewer lateral, continues to rise, comes out of the basement floor drain and begins to flood the basement)

# Combination Sewer Area- Surcharge Condition



# Sources of Surcharge

## Combination Sewer Areas

- Capacity of the sewer system is less than that of the storm. Capacity of the mainline system and/or the private system may be less than that of the storm intensity. (You can have a mainline system designed for a 100 year rain storm but still have basement flooding if your private system is only designed for a 10 year storm.)

## Separated Sewer Systems

- Capacity problems as mentioned above based on the following problems:

### **Infiltration of the sanitary sewer system.**

–Infiltration is the result of ground water entering the sanitary sewer system due to leaks in the system such as cracked pipes, leaking joints and manholes, non sealed manhole lids and cross connections (a clear water fixture or sump pump connected to the sanitary system)

–As per present day design standards a sanitary sewer system should have NO increase in sewer flow during a rain storm.

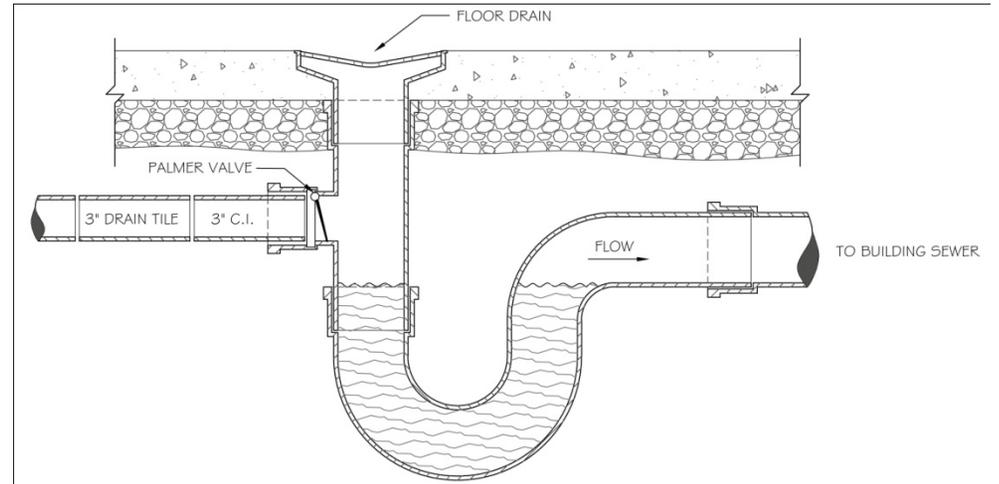
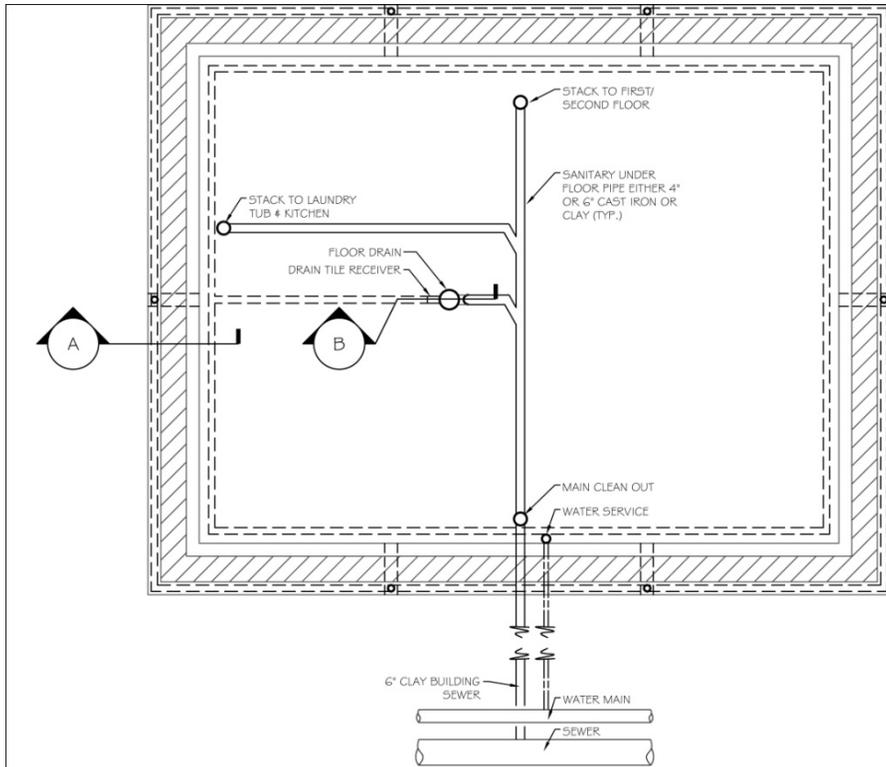
### **Drain Tile Receivers**

–Most homes in Shorewood, regardless of sewer type, have drain tile which connect directly to the sanitary or combination sewer. These drain tile receivers directly convey ground water into the sewer system.

–Drain tile receivers are typically 3" in diameter and are connected to the basement floor drain. (Drain tile receivers / drain tile system can flow in excess of 50 gallons per minute)



# Drain Tile Receiver



**B** DRAIN TILE RECEIVER CONNECTED TO FLOOR DRAIN  
SCALE: N.T.S.

**A** TYPICAL SINGLE FAMILY RESIDENCE W/ DRAIN TILE RECEIVER - NO DOWNSPOUT CONNECTIONS  
COMBINATION SEWER AREAS & SEPARATED SEWER AREAS PRIOR TO THE 1960S.  
SCALE: N.T.S.



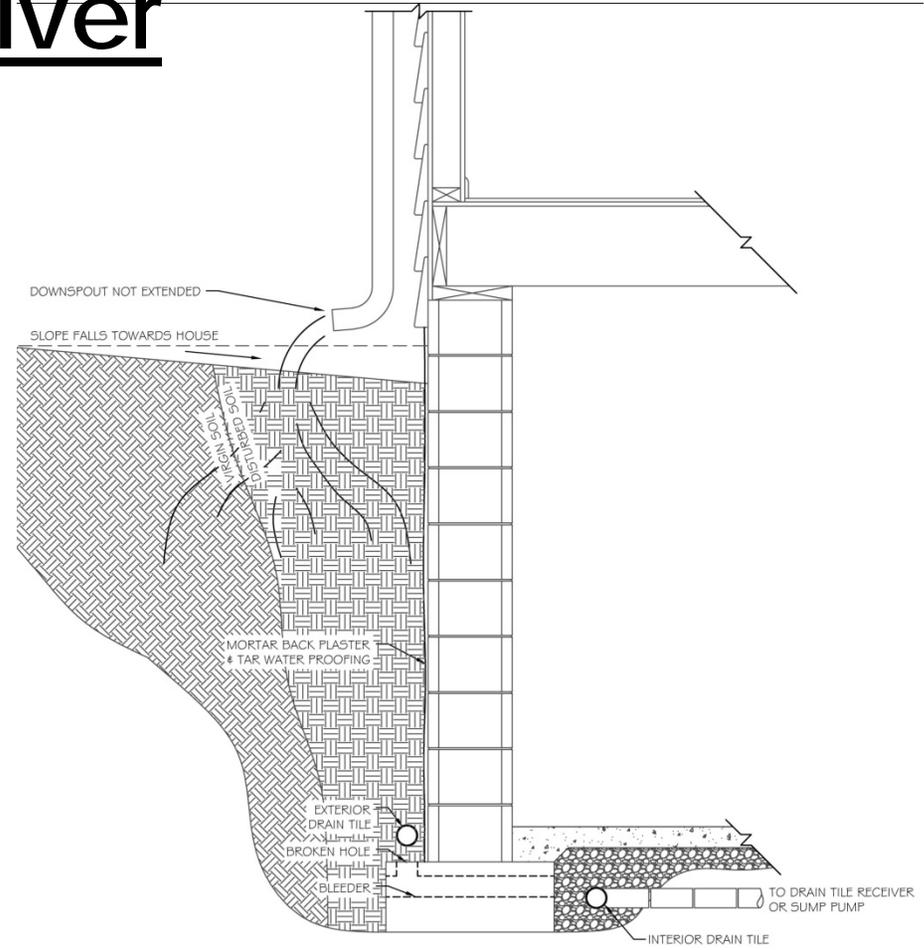
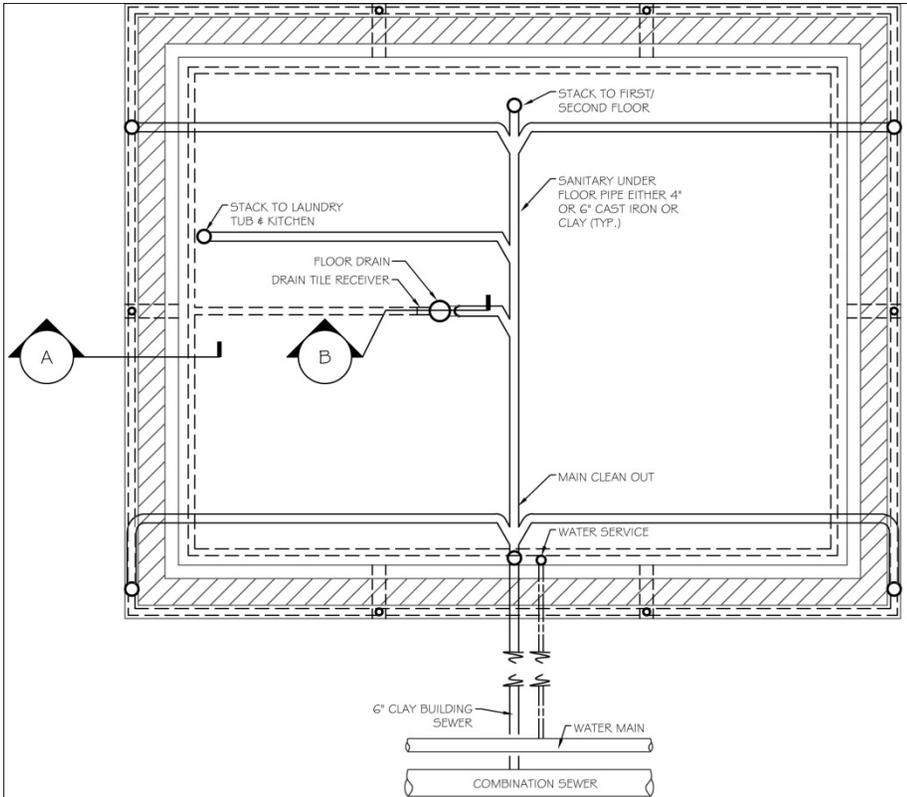
# Other Sources of Basement Flooding

*Besides sewer surcharges there are other factors that cause basement flooding.*

- **Ground & Surface Water**

- Downspouts that do not discharge away from the home. Instead of the water running away from the structure, it follows down the basement walls and into the basement.
- Improper grading. Surface water ponds and/or flows toward the house instead of away. Varying degrees of difficulty on how to correct (Sometimes it can not be corrected without installing a drainage system)
- More water traveling through the ground than the drain tile and/or sewer system/sump pump can handle. (During a surcharge event ground water / drain tile receivers do not work)
- Ground water conveyed through excavations/ditches. Very common problem in new construction where pipes are installed with stone bedding. The stone acts as a vein for ground water to enter the basement. (Typically a clay dam is installed to help prevent this in lower elevation settings)

# Drain Tile Receiver



○ TYPICAL SINGLE FAMILY RESIDENCE W/ DRAIN TILE RECEIVER & CONNECTED DOWNSP  
COMBINATION SEWER AREA SC.

○ A DRAIN TILE  
SCALE: N.T.S.



# Surcharge Solutions

**Design Premise:** Design a system that prevents the backflow of water in the sewer line from entering the basement through the plumbing fixtures.

## **Primary Questions in Design**

1. What type of sewer system is the structure connected to and what fixtures are connected to the sewer?
2. In previous floods where has the water come from?
3. What value does the client put on preventing flooding? Determination of system type, budget and sophistication.

# Back Water Valves

**Definition:** A mechanical device that prevents the backwards flow of water/sewage in a sewer line

## *Installation Types:*

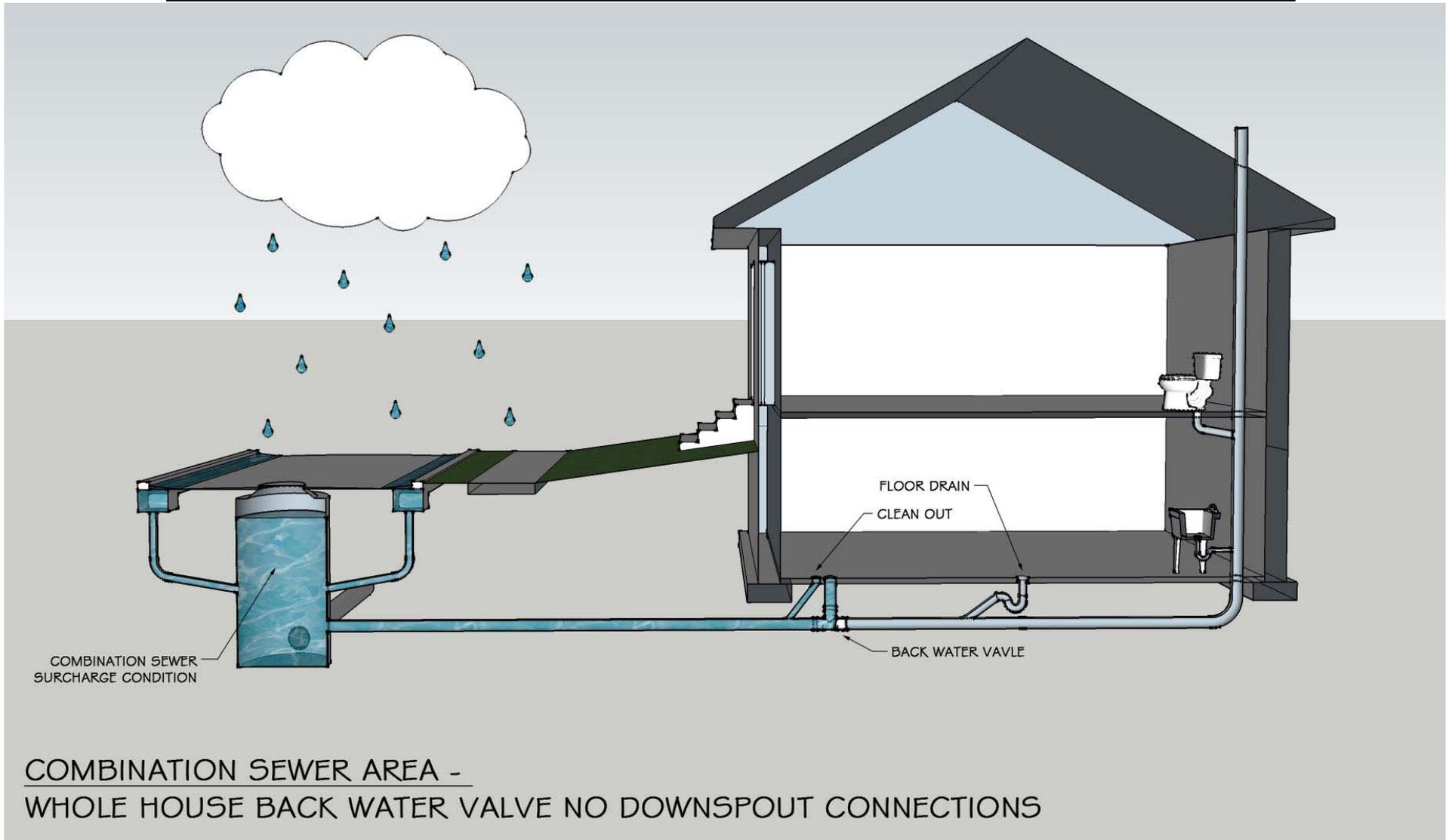
### 1) Whole House

- Can only be used if there is no drain tile receiver and the downspouts do not drain to the interior sewer
- Most amount of options available
- Typically located just upstream of the main cleanout in the basement

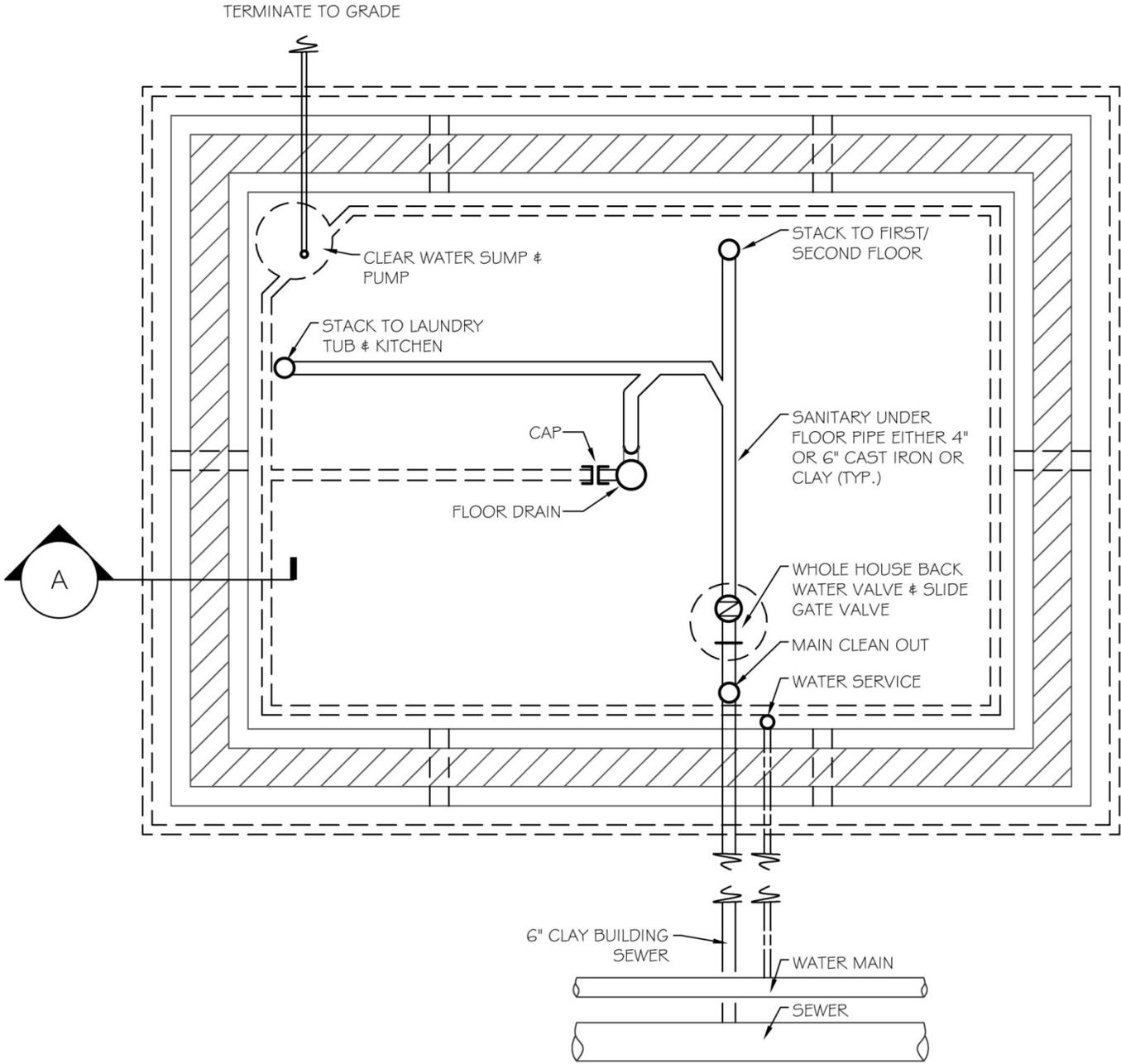
### 2) Fixture / Branch

- Each basement fixture or fixture branch has a back water valve installed
- Increased number of valves increases percentage of malfunction
- Allows for a drain tile receiver (not recommended) and downspout connections (combined sewer areas)
- Typically more costly and less valve options available

# Back Water Valve- no downspout connection



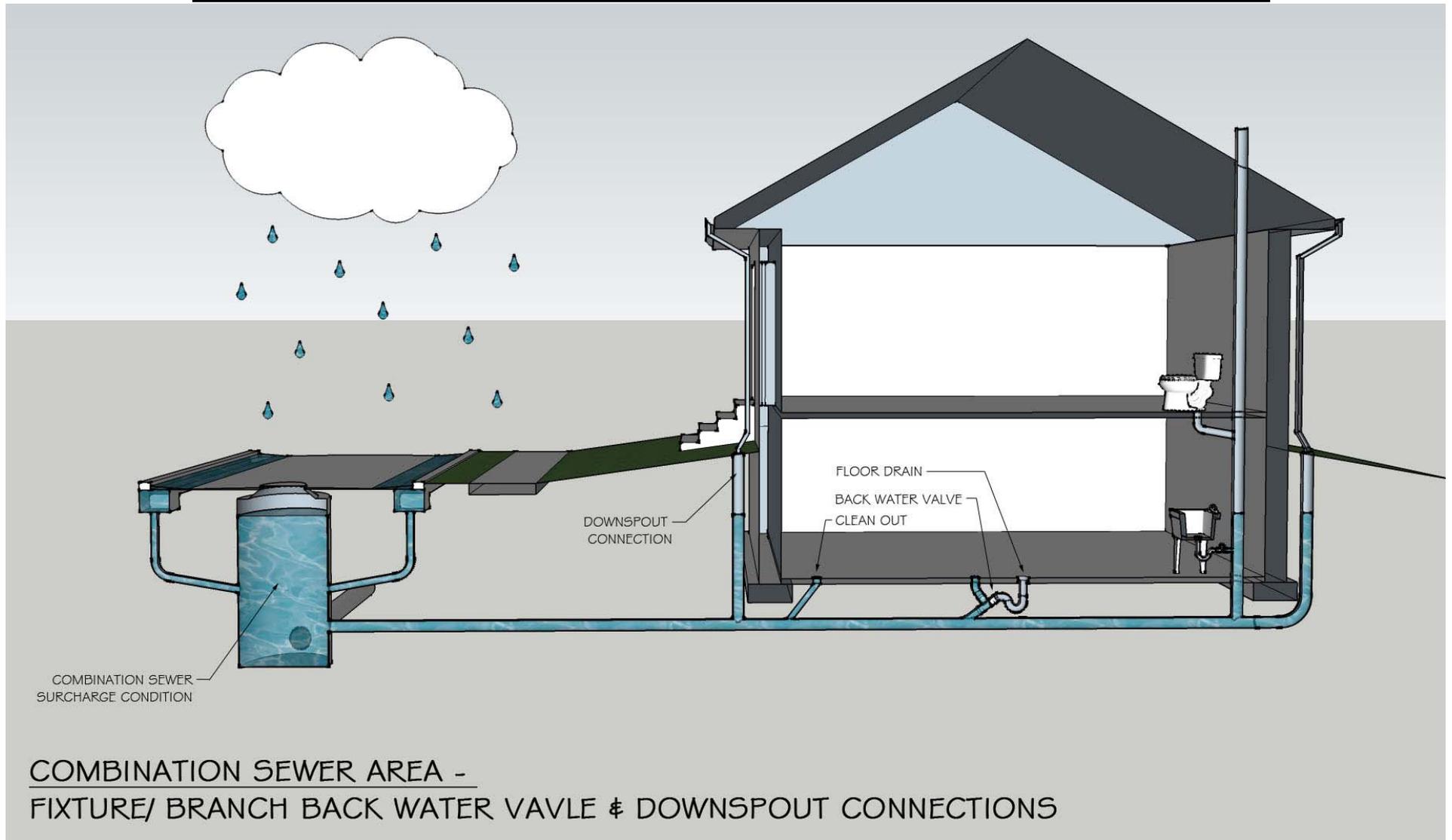
# Back Water Valve



WHOLE HOUSE BACK WATER VALVE  
SCALE: N.T.S.



# Back Water Valve & downspout connection



# Valve Types

## 1) Conventional Style (Check Valve Type)

- Least expensive (\$40 to \$800 + Installation)
- Multiple material options
- Average reliability

### Common Brands

PVC: Spears, Rectorseal, Canplas  
Cast Iron: JR Smith & Zurn



Check Valve (ZURN 1090)

## 2) Valve Style (Manual and Automated)

- Typically more expensive (\$100 to \$2,000 + Installation)
- Plastic (manual only), cast iron and stainless steel
- Increased reliability
- Manual valves are sometimes used in conjunction with conventional style valves for added protection
- Automated valves can sometimes be an assembly including the valve, sensor and actuator.

### Common Brands

PVC: Spears, Valterra  
Cast Iron: JR Smith (Flood Gate)



Flood Gate (JR Smith)

*NOTE: Valves require access pits for cleaning. Pits are of vary sizes but range from 10 to 24 inches in diameter*

# Back Water Valves

## Installation & Maintenance

### Install

- Need to have access to the valve for cleaning. (pit or access manhole, the pit can be a source of ground water entering the basement when hydraulic pressure builds under the floor)
- Valves have an approximate ½" to 1" elevation difference in them, so installation on an existing sewer can be problematic. In some cases the valve can not be installed or modifications to the basement sewer have to be done.

### Maintenance

- Valves need to be cleaned as often as possible. (manufacturer's recommendation at a minimum)
- Can not clean the sewer through a back water valve, rodder will get stuck and wreck the valve.
- Can only give the client a limited warranty.

# Alternate Methods

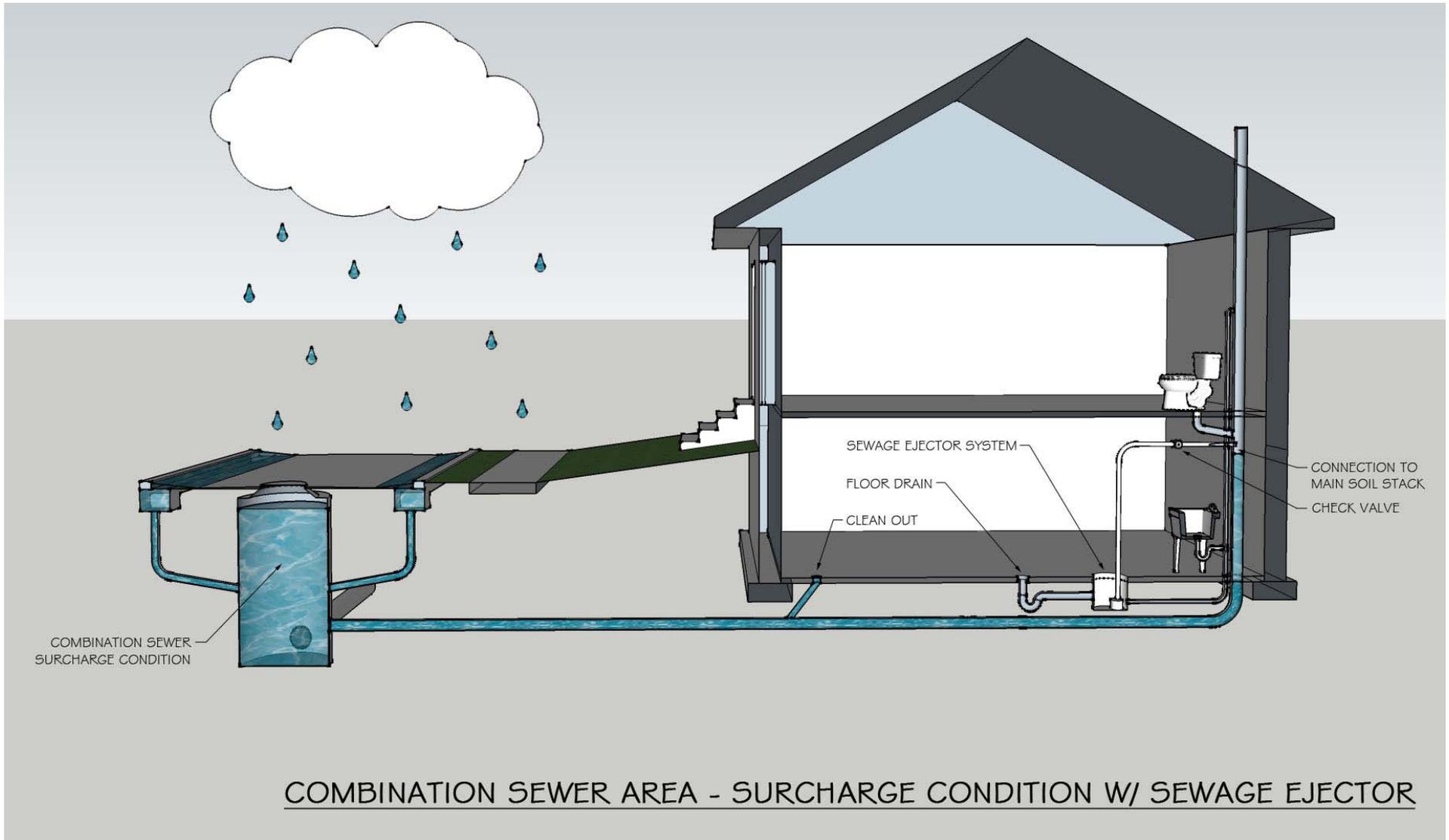
## **Sewage Ejection System**

- Most effective/reliable way of preventing backflow from a surcharged sewer.
- Lets the waste stack act as a standpipe during a surcharge.
- Only pump sanitary waste from the basement fixtures.
- Multiple pump options along with alarms, etc...
- Does require maintenance, energy consumption and is a mechanical system; however, the ejector pumps do not need to run to prevent a sewer surcharge during a rain storm.
- Assumes that the basement under floor piping can withstand pressure during a surcharge. (usually not a problem, minor leakage only)

## **Automated Valves**

- High end system.
- Install a whole house valve (sluice gate style) with an automatic actuator, (air or electric). Valve closes when a sensor recognizes a backflow condition. Can be programmed to exercise itself on a regular basis.
- JR Smith Flood Gate works on a similar premise without the controls but does not have the closing force that an automated valve can have.
- These system are custom tailored to the homeowner and would require the knowledge of a plumbing engineer.

# Combination Sewer- sewage ejector



# Clear Water Sump Pump Systems

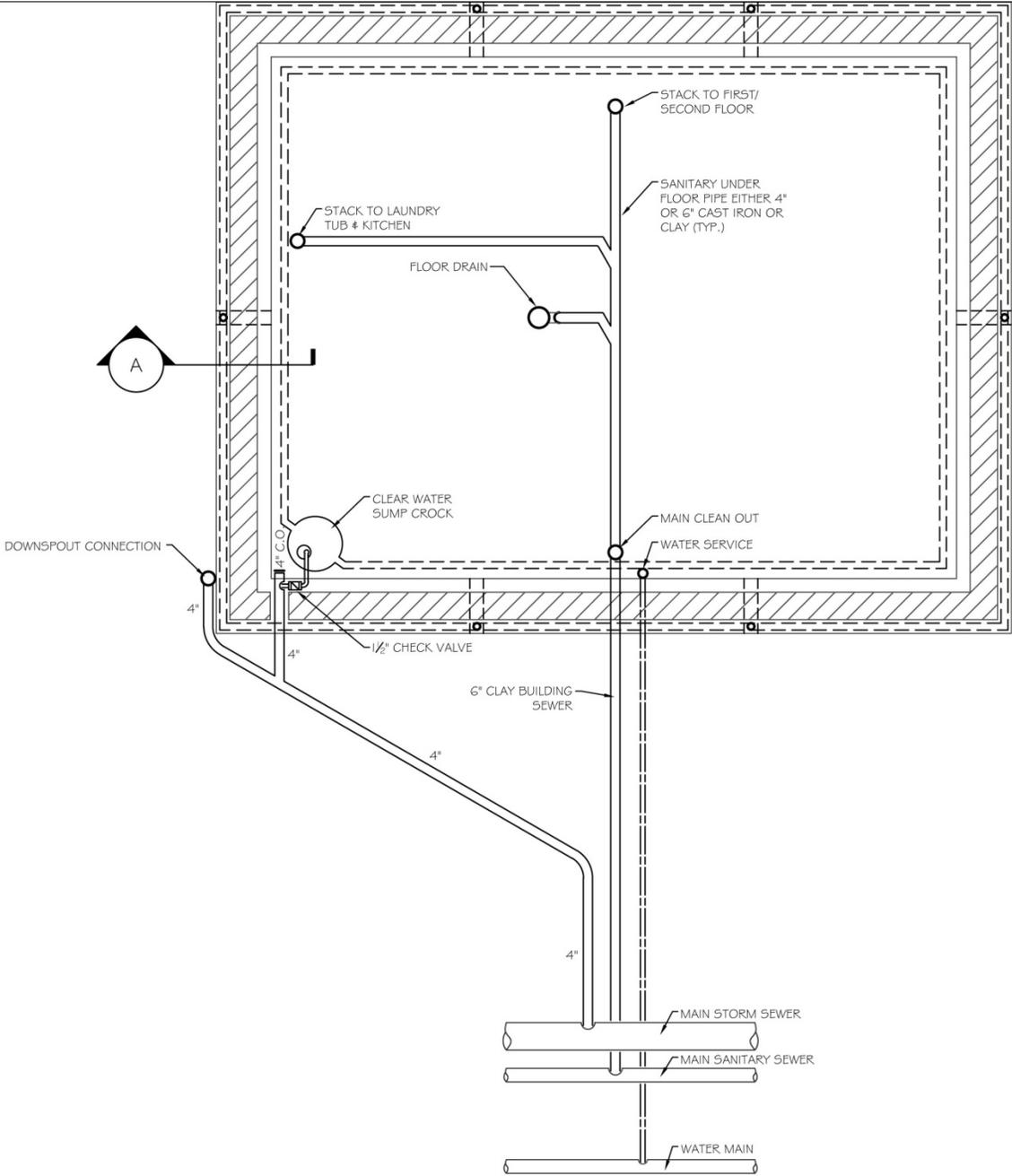
**Definition:** A mechanical system for conveying ground water that is collected from the foundation drains of a structure.

**Reason for System:** Need a way of removing ground water when the drain tile receiver is not effective. (during a surcharge event or if the drain tile receiver is removed from service) If groundwater is not removed then hydraulic pressure is created under the floor and on the exterior of the basement walls. Water seeps into the basement through any open crevice. Hydraulic pressure can lead to structural failure of a building.

## **Obstacles to Consider:**

- Discharge location – must discharge far enough from the structure to prevent “circling”, but not cause problems for neighbors. Need to prevent from creating an “icing condition” during cold months.
- Reliability of power supply – The system needs power. No power, the basement can flood. Battery back up systems are available but are limited in size and run time. Higher end systems include a source of back up power such as a back up generator.

# House with Downspout Connection



TYPICAL SINGLE FAMILY RESIDENCE W/ DOWNSPOUT CONNECTIONS  
SCALE: N.T.S.



# Clear Water Sump Pump Systems

**Sizing of the System:** In order to size the clear water system an analysis of the ground water level and hydrology of the soil needs to be done for peak rain events. The goal of this analysis is to try and determine a peak flow rate for the system. From this the sump crock and pump can be sized.

**Sump Pumps:** Now that the flow rate has been established, the size of the clear water pump(s) need to be determined. Typically we want to have at least 10% more pumping capacity than our peak flow. However, this does not mean we need one large pump to do this. Typically, two smaller pumps are better than one. The logic is that under low flow conditions only one pump needs to run and the key to pump life is duration of run time. If the pump does not run for a long enough period (15 seconds) then the life of the pump is compromised. Redundancy is also important- the worst time for a pump failure is when you need it the most.

**Sump Crock:** The sump crock size is determined by the flow rate and pump selection. As mentioned above, the pump, when activated, needs to run for a minimum on 15 seconds. In order to do that there needs to be enough storage capacity in the crock. Cocks have to be a minimum of 18" in diameter and are as large as 36" in diameter, with some even larger. They are made out of plastic, fiberglass, concrete, even steel with lids to match.

**Installation:** The installation time varies on the size of the crock and the number and type of pump(s) used. For a typical installation the primary labor hours are in the breaking and removal of the basement floor, the remove of the necessary dirt and the backfilling of the excavation with stone. For a smaller sump crock it takes approximately one day for a plumber and laborer to fully complete the installation.

# Building Sewer Laterals and Infiltration

**What is the Building Sewer?** – The building sewer is the pipe that connects the house or property to the sewer in the street. Building sewers in Shorewood are typically 6 inch clay pipes. These pipe have “bell and spigot” ends. When installed the spigot is placed inside the bell and either cement mortar or tar was used to seal the joint. These pipes are typically 2 to 5 feet long.

**Who maintains the Building Sewer?** – The property owner. In Wisconsin the property owner is responsible for cleaning and repairs of the building sewer from the building to, and including, the connection to the mainline sewer. Sewer repairs tend to be costly due the depth and restoration requirements. (IE – roadway repairs)

**Infiltration of the Building Sewer?** – Infiltration refers to ground water that seeps into the sanitary sewer system through cracks, breaks, etc.. in the system. For years MMSD and the local sewer utilities have been working on reducing infiltration. Repairs include pipe replacement, pipe lining, manhole replacement and lining and watertight manhole covers and casting assemblies. The next area to address is the 3000+ miles of old sanitary sewer laterals in the MMSD coverage area. The same principals that have been used to reduce infiltration for the mainline system should be implemented for the private building sewers.

**Sewer Maintenance:** What do I need to do, if anything? and why? By maintaining your sewer lateral you can greatly extend the life of the system and help reduce infiltration. Tree roots are the enemy of a sewer lateral. Roots tend to ground downward in the disturbed, moist soil of a sewer ditch. After awhile the root leaders (very narrow, web like roots) tend to grow through the weak cement joints of the clay sewer pipe. After time the roots grow and widen. This causes multiple problems including plugged sewers and cracks or holes in the sewer pipe. If not treated the sewer pipe will loose enough of its structure and collapse. At that time there is no way of repairing or correcting the problem without excavation. To help prevent this a reputable plumber should clean and video inspect the sewer. If tree roots or scale is a problem a cleaning program should be set in place. A periodic video inspection is a good tool to forewarn and possible prevent a sewer problem.

**Sewer Repairs and Replacement:** In the event that a sewer repair or replacement is necessary, there are some options. There are four basic ways of dealing with a repair/replacement. 1) Spot Repair, this involves digging a hole just where the problem is and replacing a section of bad sewer. 2) Open Cut Replacement, as it sounds, involves digging from the front of the residence to the sewer connection and replacing the sewer the entire way. 3) Pipe Bursting, this technology allows you to replace the sewer from the basement to the main while only digging one hole at the sewer main. Basically a new pipe, (typically High Density Polyetheylene) is pulled through the old sewer and reconnected on both ends. 4) Lateral Lining – Lining is great alternative for a sewer that is in poor condition but does not have any failure points or dips. The liner is typically installed from the basement.

# Sanitary Sewer Lateral

