



Design of Hydraulic Control Structures for Sanitary Sewer Interceptors

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CH2M HILL

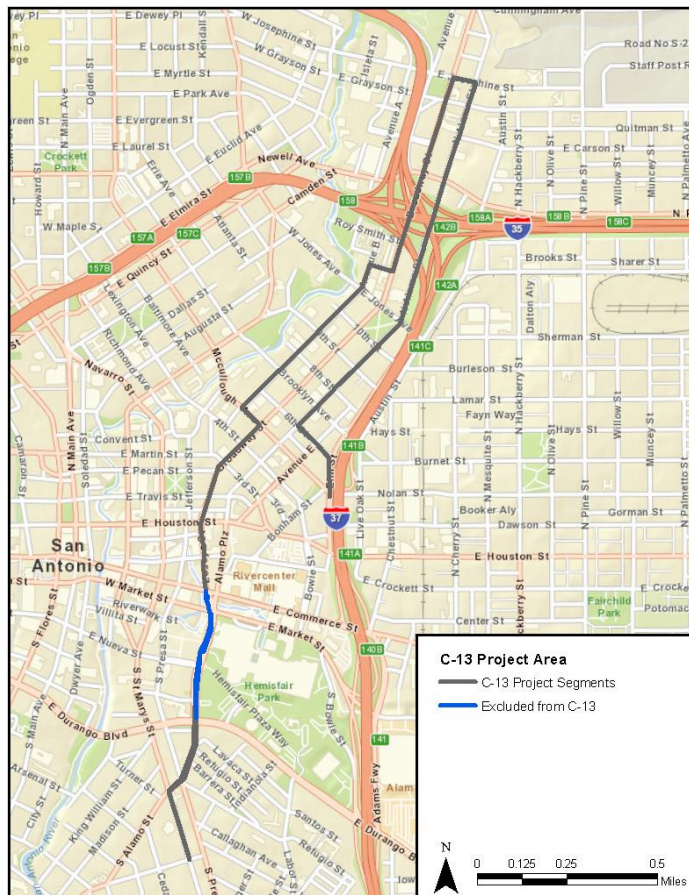
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*The 4Ms of Collection System Management
Conference and Expo
San Marcos, TX
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Agenda

- Project Background and Requirements
- Control Structures – Purpose and Hydraulic Considerations
 - Manholes
 - Diversion structures
 - Manifolds (Split/Combination)
 - Overflow structures (Relief Sewers)
 - Inverted Siphon Inlet/Outlet Structures
- Control Structure Layout
 - Operator input
 - Operation Considerations
 - Maintenance Considerations
 - Construction/Cost Considerations
- Summary

SAWS C_13 Broadway Corridor



- Capacity Evaluation
 - Condition Assessment
 - Design Improvements
-
- System:
 - 6,400 LF 60" RCP
 - 16,000+ LF 18"-39" (clay, RCP, brick)
 - 67 manholes
 - 5 inverted siphons

Control Structures

Purpose and Hydraulic Considerations



- **Manholes**
- Diversion structures
- Manifolds (Split/Combination)
- Overflow structures (Relief Sewers)
- Inverted Siphon Inlet/Outlet Structures

Manholes

■ Purpose

- Access
- Maintenance
- Combination of sewers
- Change in direction
- Change in gradient

■ Hydraulic Considerations

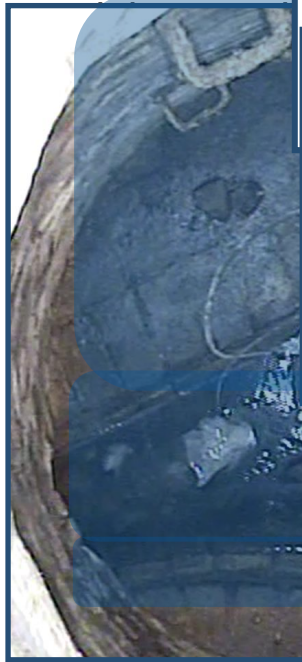
- Shape
- Headloss

Manholes – Hydraulic Considerations

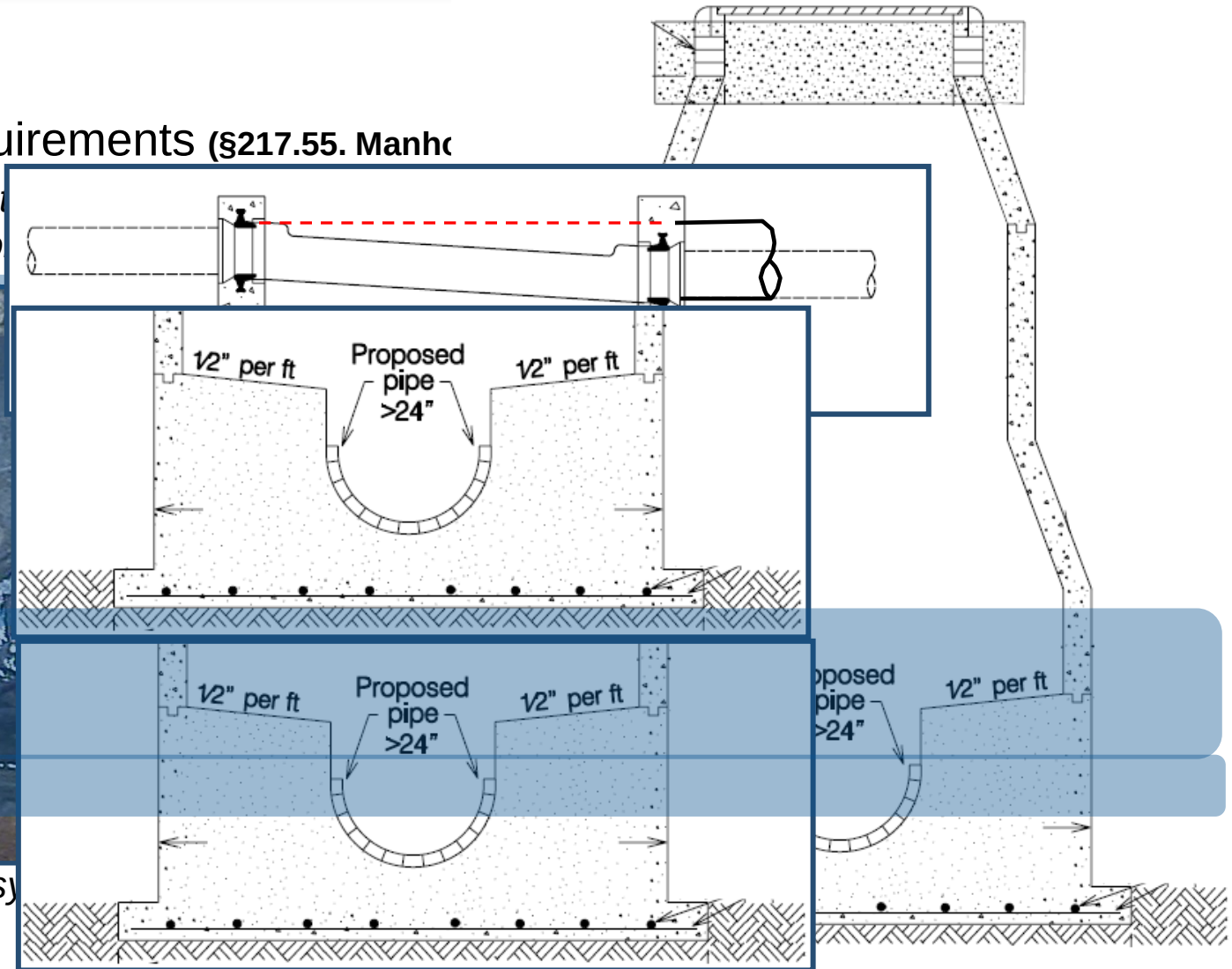
■ Shape

– TCEQ Requirements (§217.55. Manholes)

- (A) The bottom of the manhole shall be the same as the bottom of the pipe continuation.

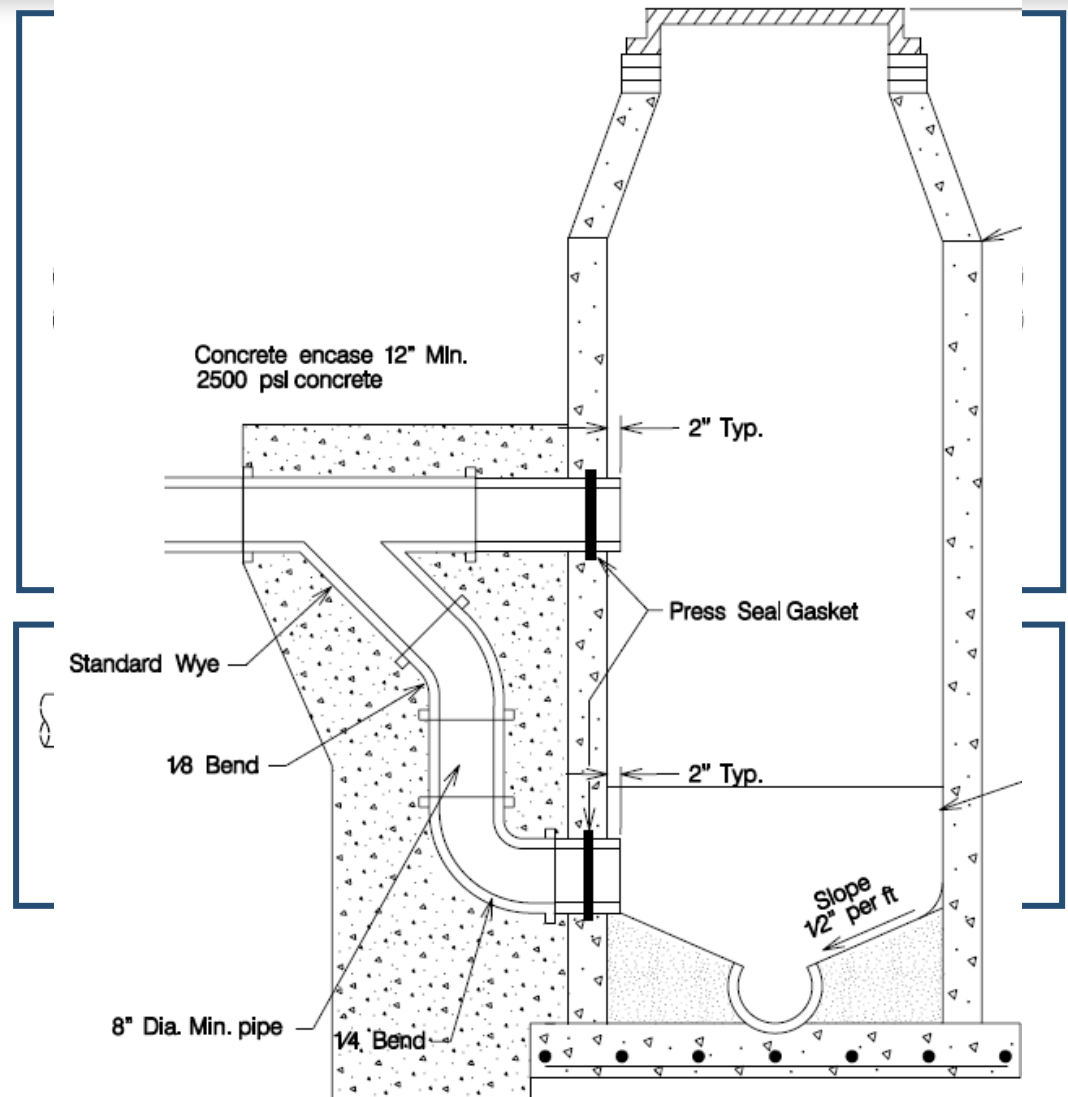


collection system
invert.



Manholes – Hydraulic Considerations

- Shape
 - Flow-through
 - Drop



Manholes – Hydraulic Considerations

■ Headloss Considerations

- Flat terrain
- Steep terrain
- Number of connecting conduits
- Flow
 - Minimum depth
 - Maximum depth

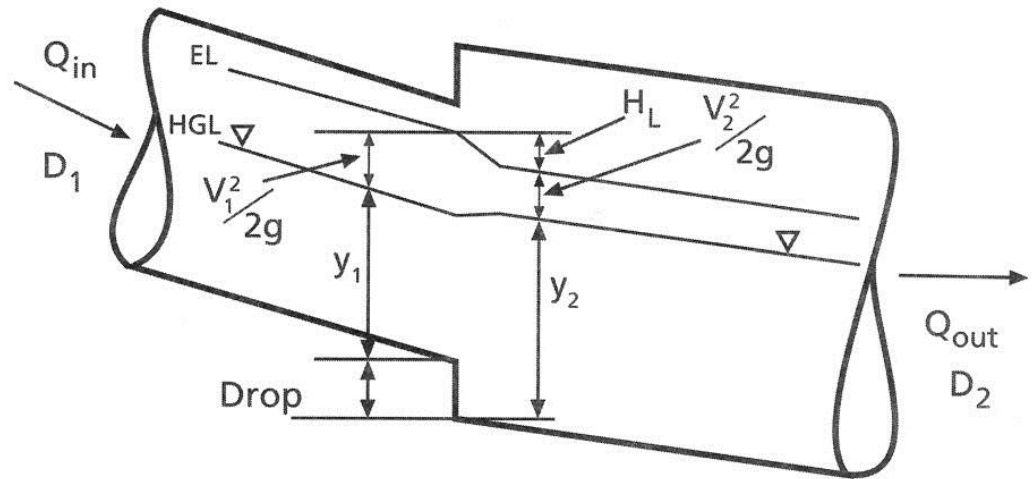
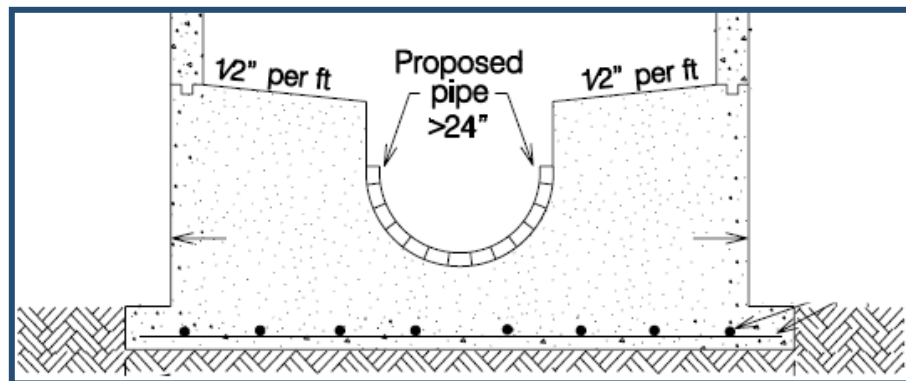


FIGURE 5-13. Hydraulic continuity through a manhole.

Source: Gravity Sanitary Sewer Design and Construction (ASCE Manuals and Reports on Engineering Practice No. 60; WEF Manual of Practice No. FD-5)



Control Structures

Purpose and Hydraulic Considerations



- Manholes
- **Diversion structures**
- **Manifolds (Split/Combination)**
- Overflow structures (Relief Sewers)
- Inverted Siphon Inlet/Outlet Structures

Diversion Structures / Manifolds

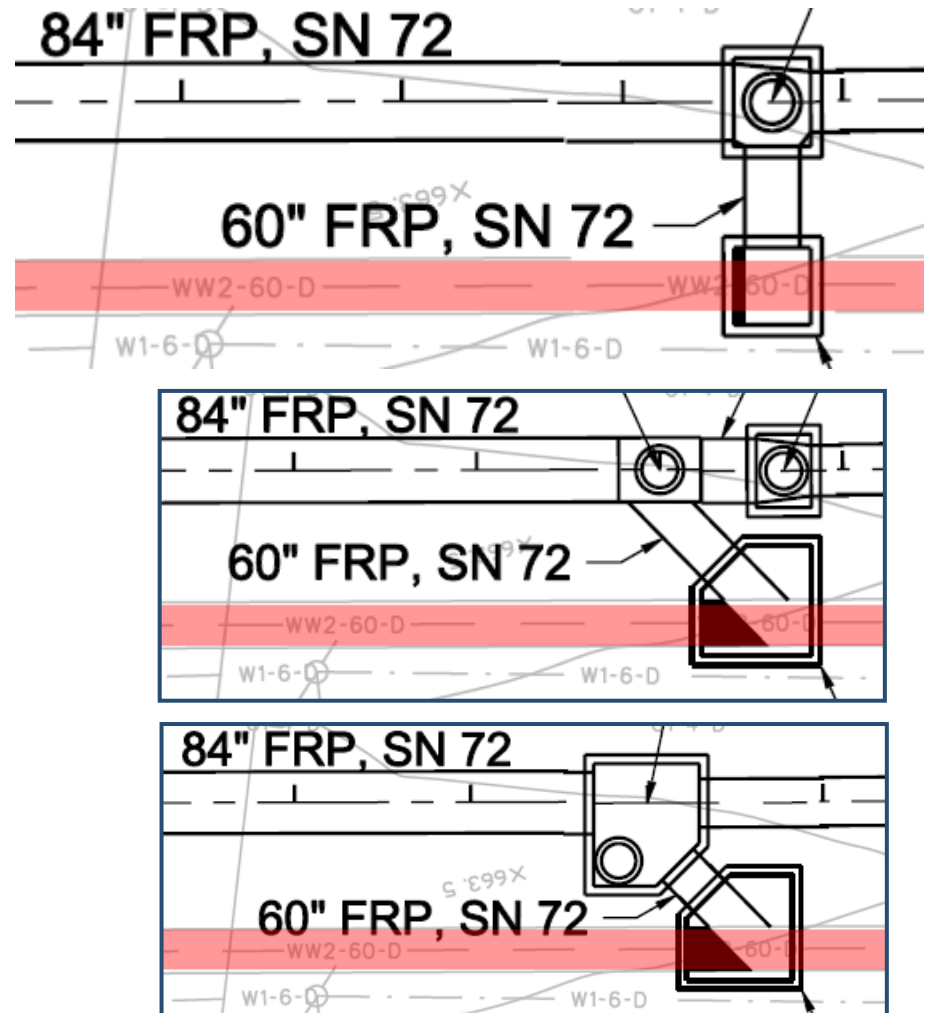
■ Purpose

- Diversion Structure: divert flow from one alignment to another
- Manifold: combine or split flow

■ Hydraulic Considerations

- Configuration
 - Manholes
 - Structure(s)
 - May be pipe size restricted
- Headloss

$$h_L = K \frac{V_2^2}{2g}$$



Control Structures

Purpose and Hydraulic Considerations



- Manholes
- Diversion structures
- Manifolds (Split/Combination)
- **Overflow structures (Relief Sewers)**
- Inverted Siphon Inlet/Outlet Structures

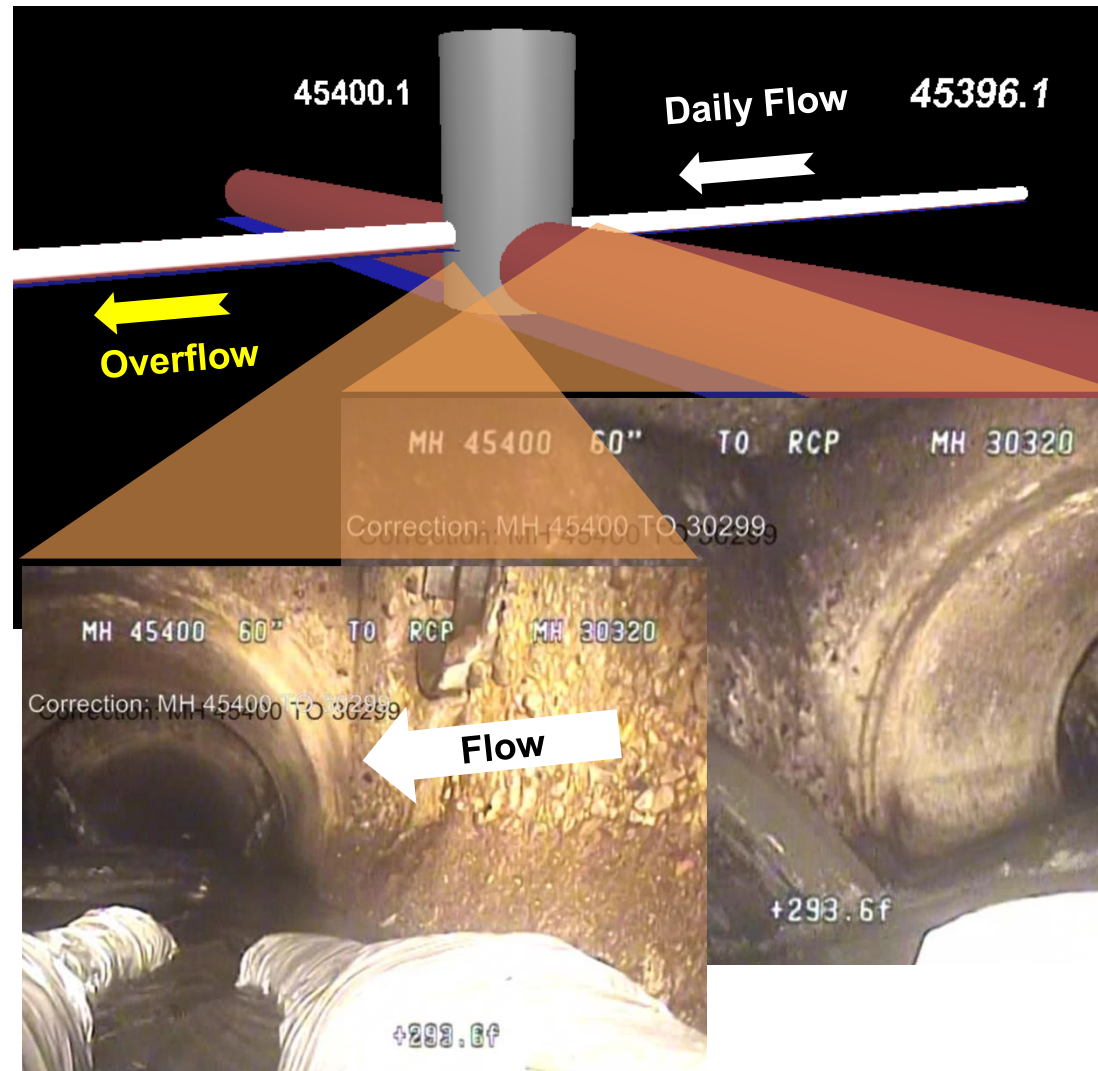
Overflow Structures

■ Purpose

- Divert flows to an additional outlet

■ Hydraulic Considerations

- Configuration
 - **Manholes**
 - Structure(s)
- Mode of Operation
 - Shared base flow
 - Divert flows over a specified limit
 - Location(s) of overflows



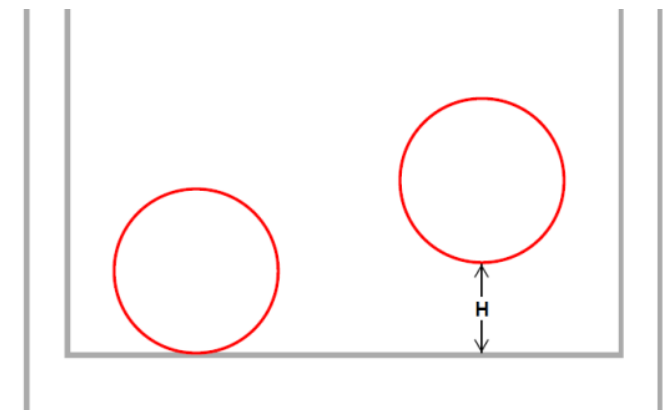
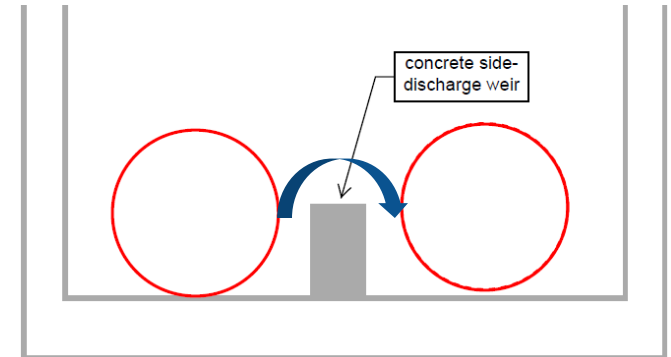
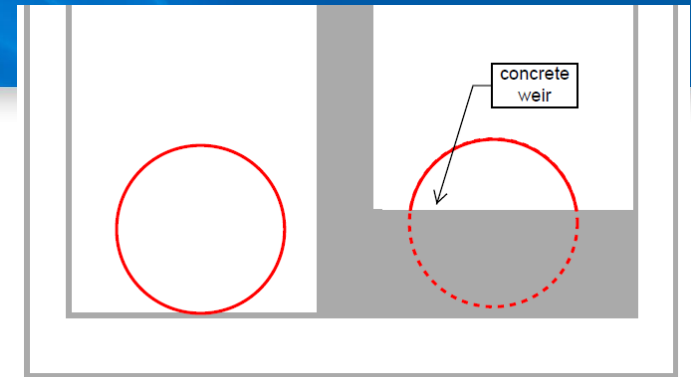
Overflow Structures

■ Purpose

- Divert flows to an additional outlet

■ Hydraulic Considerations

- Configuration
 - Manholes
 - **Structure(s)**
- Mode of Operation
 - Shared base flow
 - Divert flows over a specified limit
 - Location(s) of overflows



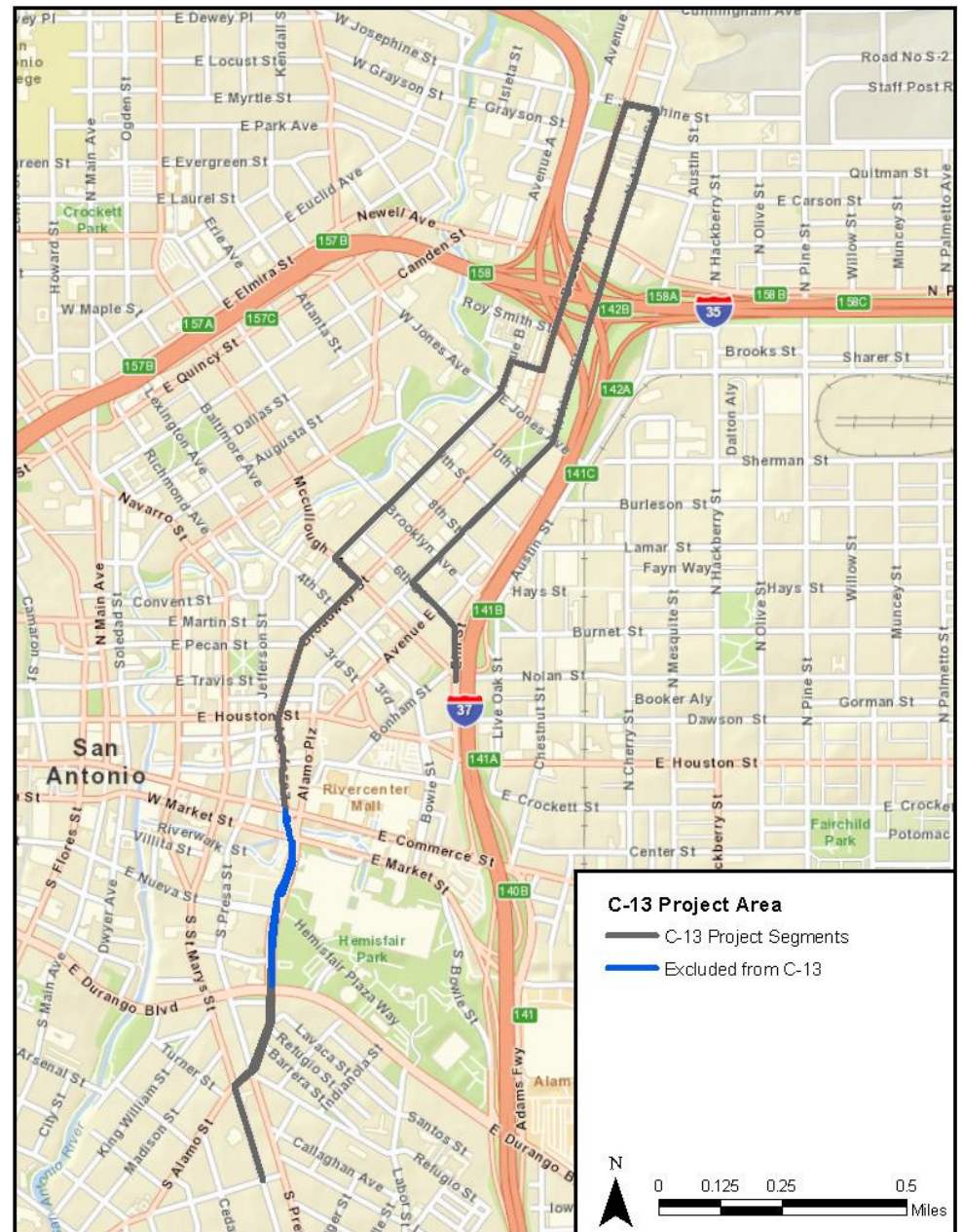
Overflow Structures

■ Purpose

- Divert flows to an additional outlet

■ Hydraulic Considerations

- Configuration
 - Manholes
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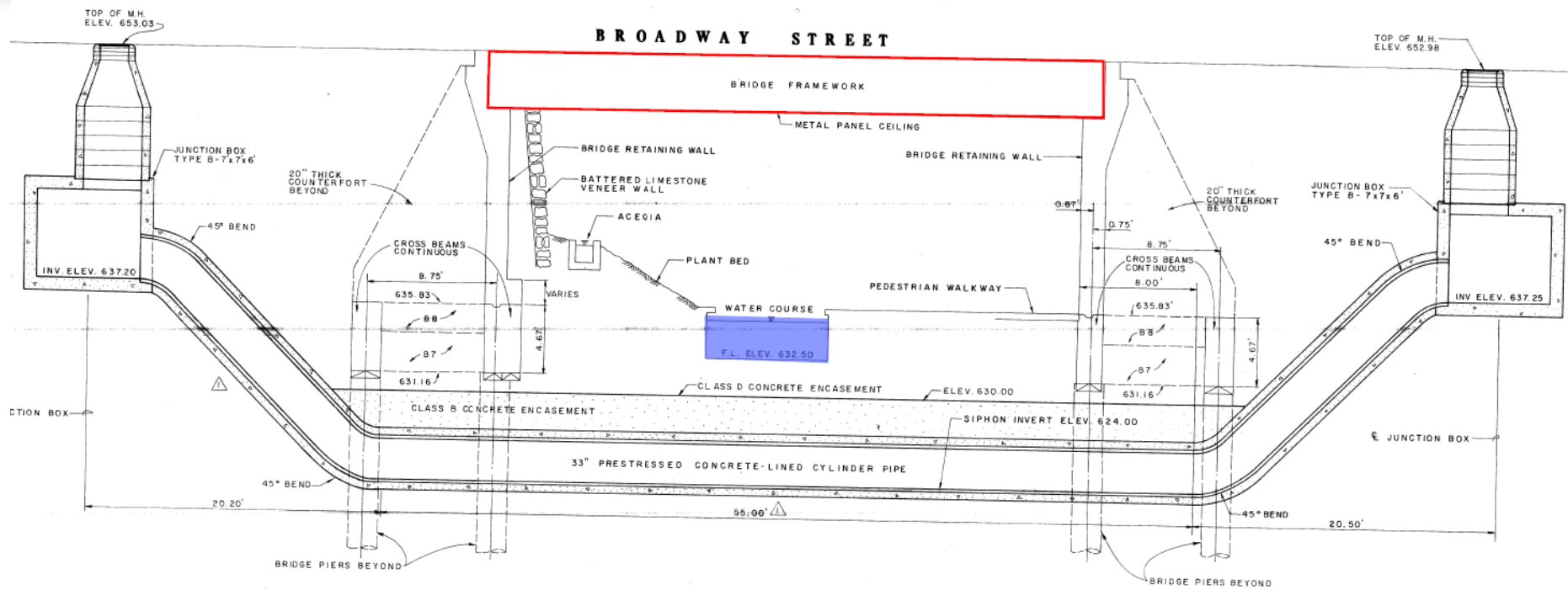
Control Structures

Purpose and Hydraulic Considerations



- Manholes
- Diversion structures
- Manifolds (Split/Combination)
- Overflow structures (Relief Sewers)
- **Inverted Siphon Inlet/Outlet Structures**

Inverted Siphons Inlet/Outlet Structures



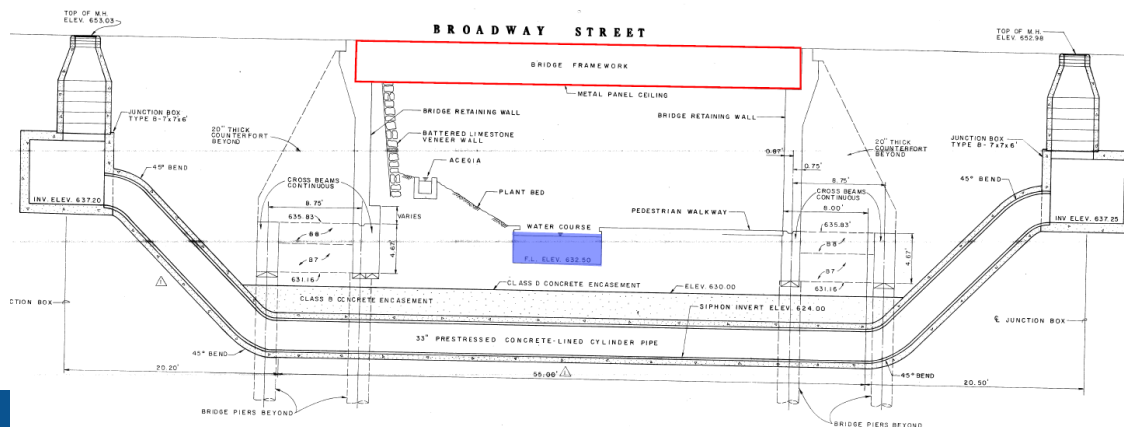
- Configuration
 - Manholes
 - Structure(s)
- Headloss

Inverted Siphons Inlet/Outlet Structures

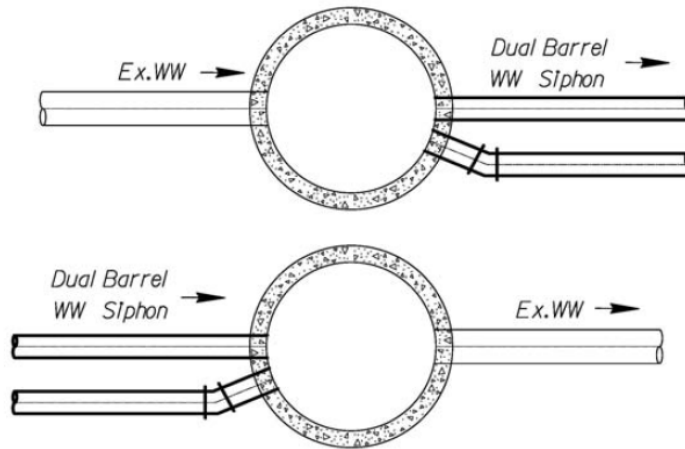
TCEQ Requirements (§217.53. Pipe Design)

(n) Inverted Siphons and Sag Pipes.

- (1) A sag pipe must include:
 - (A) two or more barrels;
 - (B) a minimum pipe diameter of 6.0 inches; and
 - (C) the necessary appurtenances for convenient flushing and maintenance.
- (2) A manhole must include adequate clearance for rodding and cleaning.
- (3) Sag pipes must be sized and designed with sufficient head to achieve a velocity of at least 3.0 feet per second at initial and design flows.
- (4) The arrangement of inlet and outlet details must divert the normal flow to one barrel.
- (5) A system must allow any barrel to be taken out of service for cleaning.
- (6) Provisions must be made to allow cleaning across each bend with equipment available to the entity operating the collection system.
- (7) Sag pipe must be designed to minimize nuisance odors.



Inverted Siphons Inlet/Outlet Structures



**Source: DWU Water
Wastewater Pipeline Design
Manual**

Figure 5.5.2.2: Typical Siphon Inlet and Outlet Manholes

■ Hydraulic Considerations

- Configuration
 - **Manholes**
 - Structure(s)
- Headloss

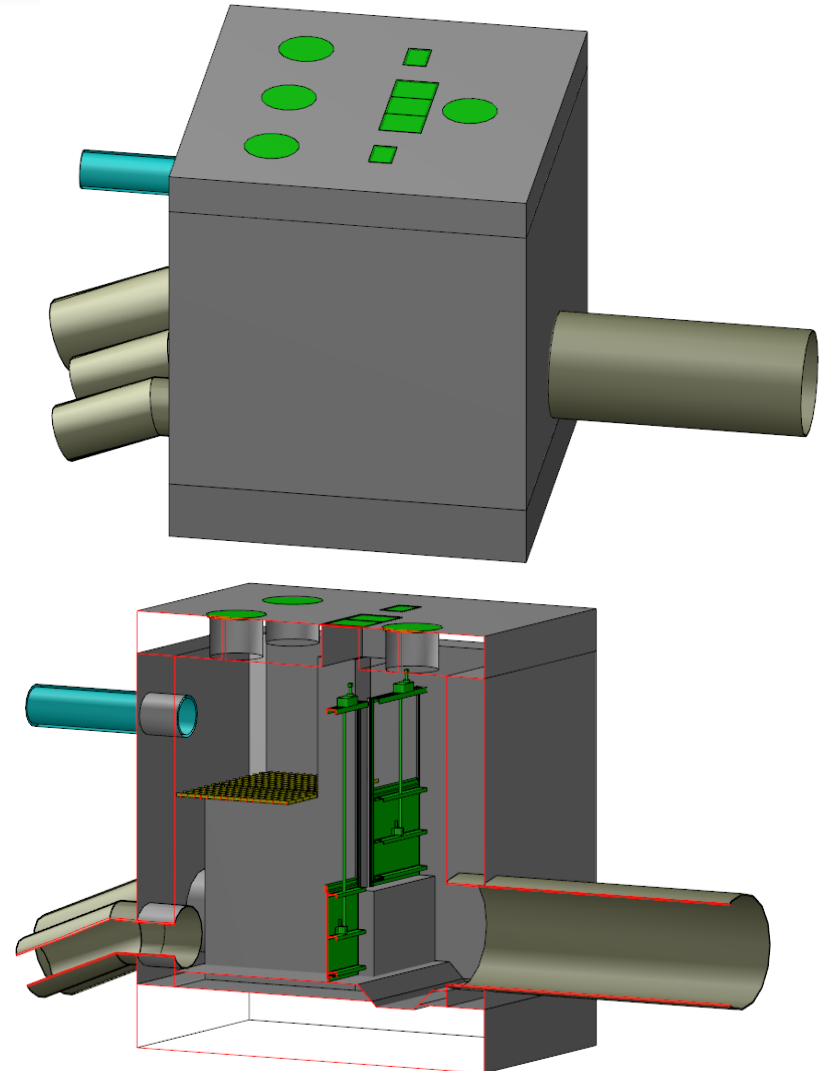
Inverted Siphons Inlet/Outlet Structures

■ Purpose

- Convert sewer from gravity to full-pipe flow (avoid obstacle)
- Controls flow to barrels (if multiple barrel siphon)
- a.k.a. “sag pipes”, “depressed sewer”, “siphon”

■ Hydraulic Considerations

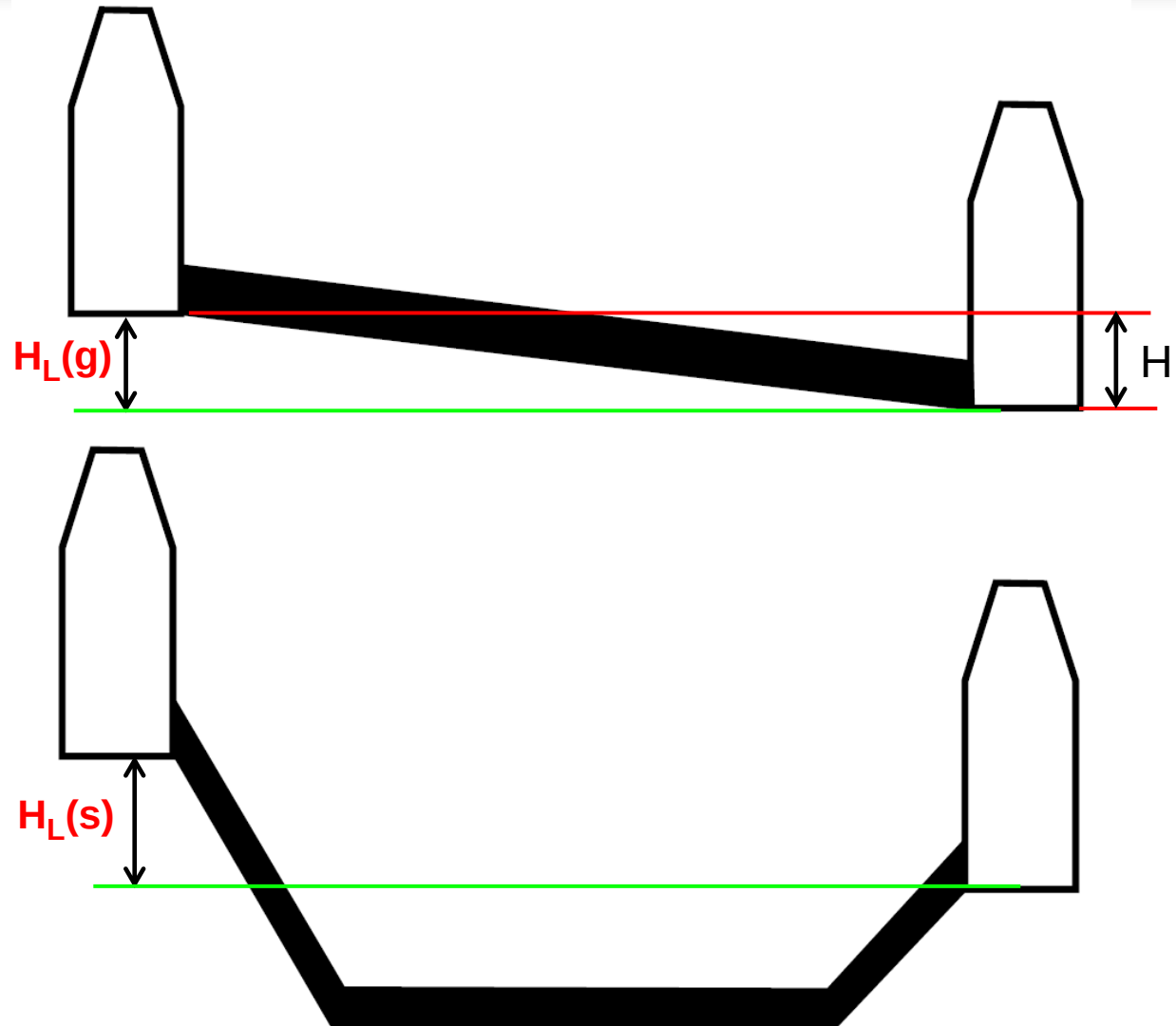
- Configuration
 - Manholes
 - **Structure(s)**
- Headloss



Inverted Siphons Inlet/Outlet Structures

Headloss

- Headloss through a siphon (inlet – barrels – outlet) is always greater than through manholes/gravity system



$$H_L(s) > H_L(g)$$

Control Structures

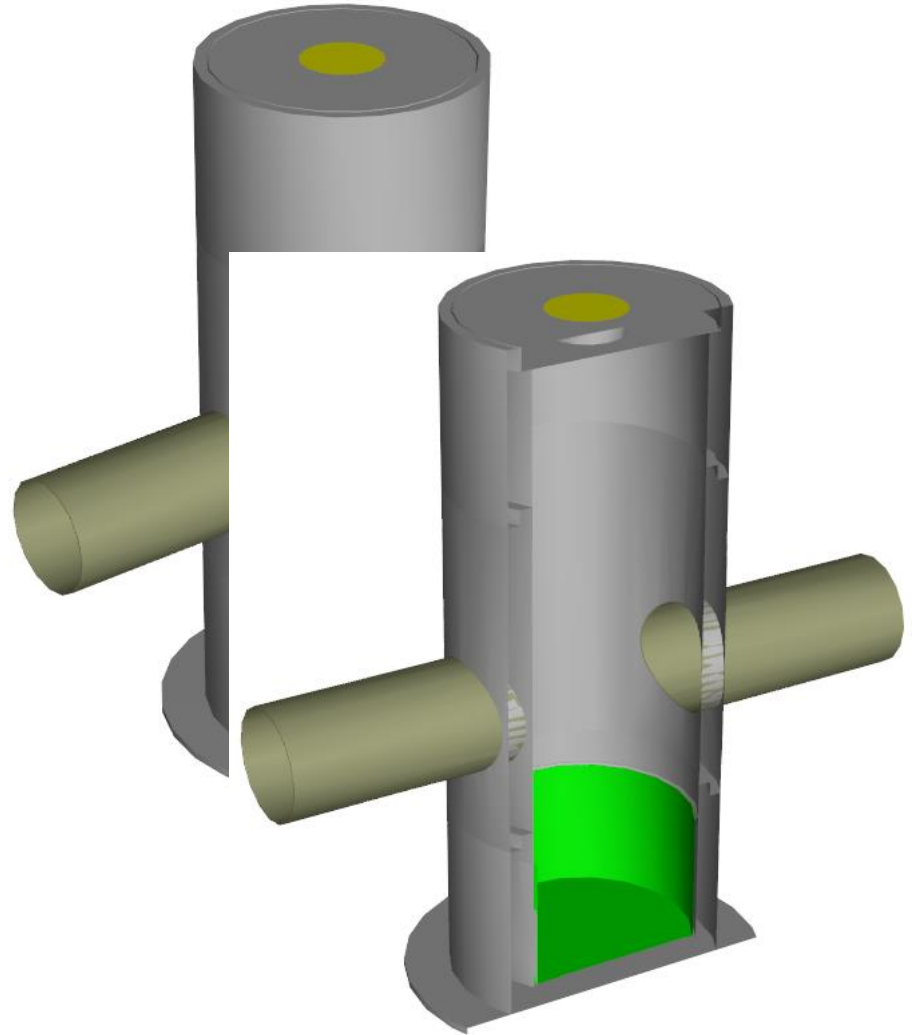
Layout



- **Operator Input**
- **Operation Considerations**
- **Maintenance Considerations**
- **Construction/Cost Considerations**

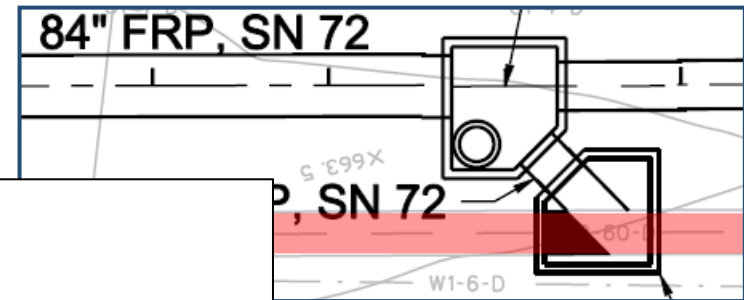
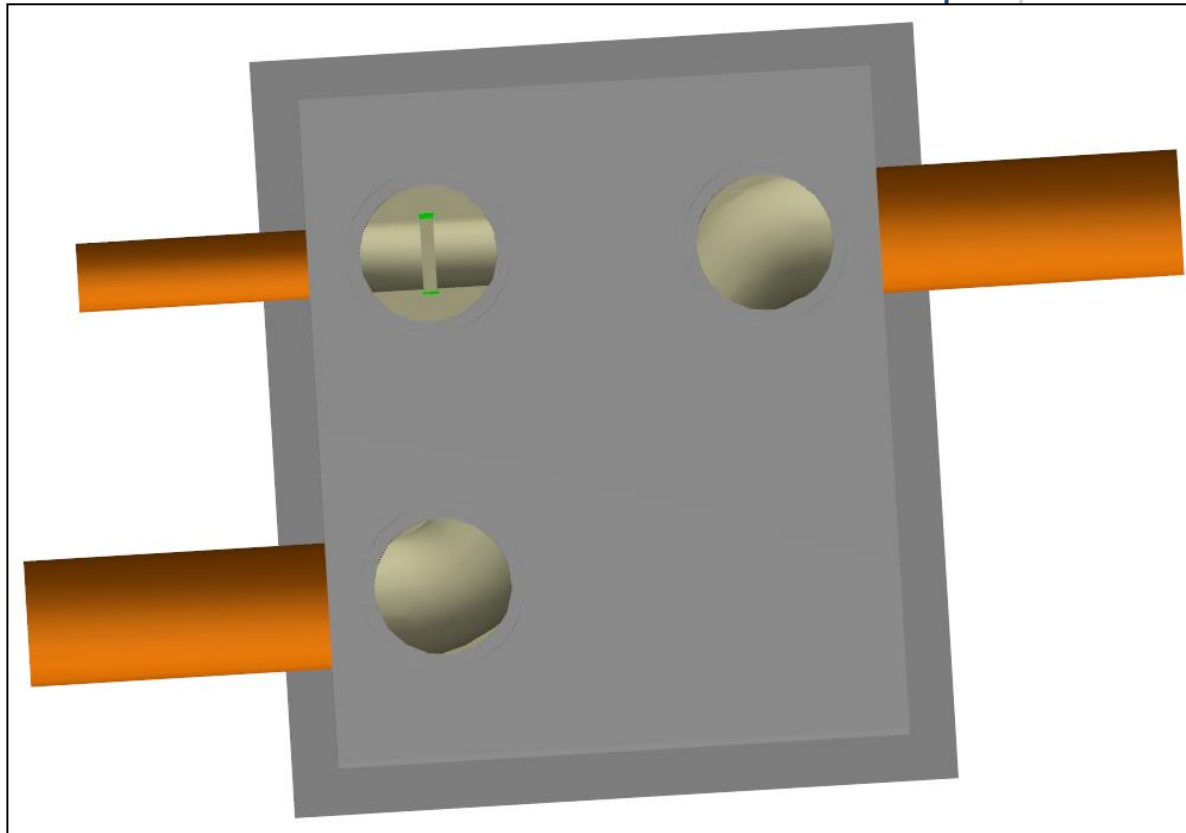
Operator Input

- More emphasis being placed on maintaining sewer infrastructure
- No longer “forget about it until there is a problem”
- Regular maintenance:
 - Cleaning
 - CCTV
 - Switching siphon barrels
 - Exercising slide gates
 - Cleaning weirs
 - Flow monitoring
 - In-line grit chambers



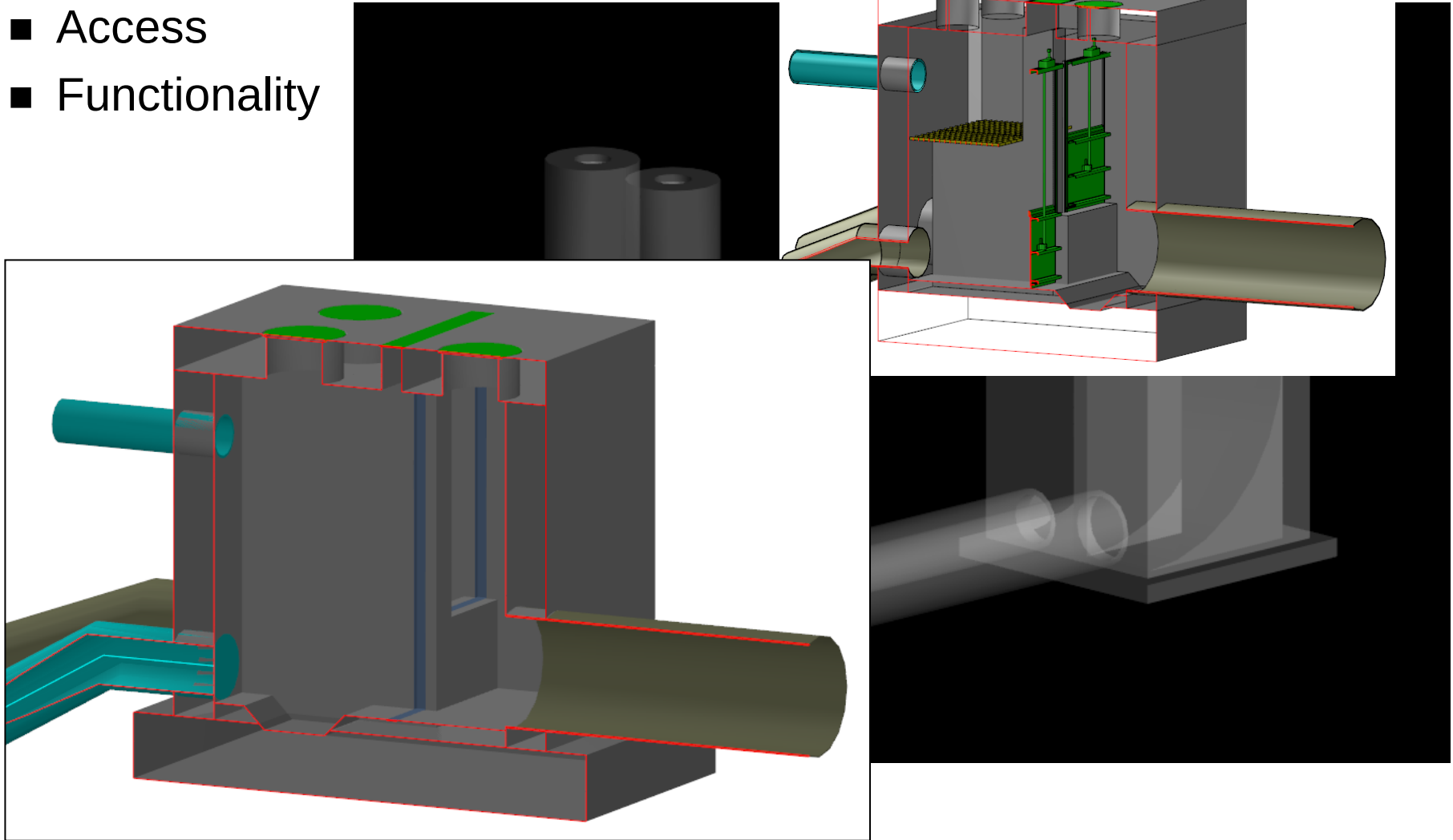
Operator Input Diversion Structure

- Access
- Functionality



Operator Input Siphon Inlet/Outlet Structures

- Access
- Functionality



Control Structures

Summary



- Purpose
- Hydraulics
- Operator Input
- Operation
- Considerations
- Maintenance
- Considerations
- Construction/Cost
- Considerations

Discussion

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