An aerial photograph of a city, likely Denver, with a large airplane in the center. The image is semi-transparent, allowing the text to be clearly visible. The text is in yellow and black, and is centered on the page.

Chapter 11

Water Quality Rules and Regulations

Regulations for Wastewater facilities

Collection Systems

Southeast District Engineer

Seth Tourney, P.E

Chapter 11 – Sections for Collection Design

- **Section 6 Engineering Design Report**
- **Section 7 Plans and Specifications**
- **Section 9 Design of Sewers**
- **Section 10 Pumping Stations**



Section 6 – Engineering Design Report

(a) Scope and Purpose

- Existing Conditions and problems
- Proposed Solution



Section 6 – Engineering Design Report

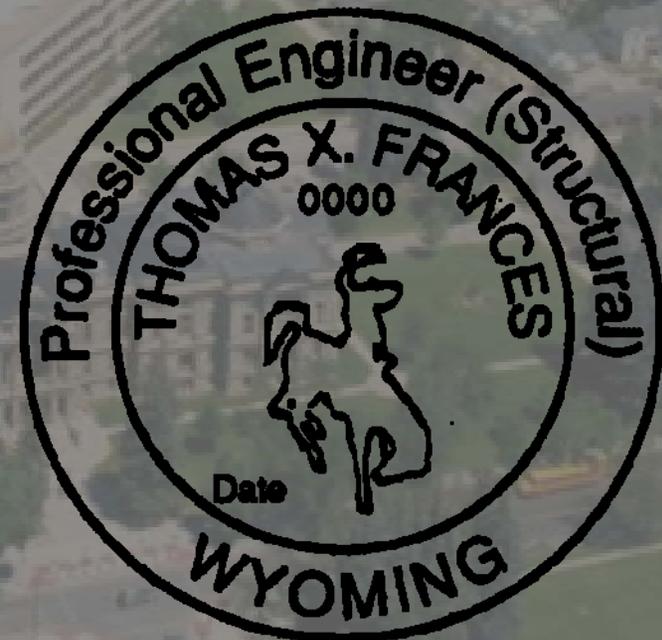
(b) Content

- i) Description of the service area**
- ii) Current and Projected Average, Maximum Day and Peak Flows**
 - Identify Industrial flow characteristics (if necessary)
 - Per Capita Design Flows, Extraneous Flows
 - Industrial and/or Commercial Flows (BOD, TSS, pH, etc.)
- iii) Downstream Impact**
 - Existing sewers, lift stations, and treatment facilities
- iv) Letter of acceptance from receiving system owner**

Section 7 – Plans and Specifications

(a) Cover Sheet

- i. Name of Owner
- ii. Location of Project
- iii. North Arrow and drawing scale
- iv. Name, Seal, and signature of the professional engineer
- v. Datum of the survey



Section 7 – Plans and Specifications

(b)(i) Plan View

- i. Need to be at a legible scale**
- ii. Utilities (Existing and Proposed)**
 - Include sizes of downstream sewers!
 - Water mains within 30 feet of the sewer
 - Private wells within 30 feet of the sewer
- iii. Streets (Existing and Proposed)**
- iv. Adjacent Structures**
- v. Physical Features**



Section 7 – Plans and Specifications

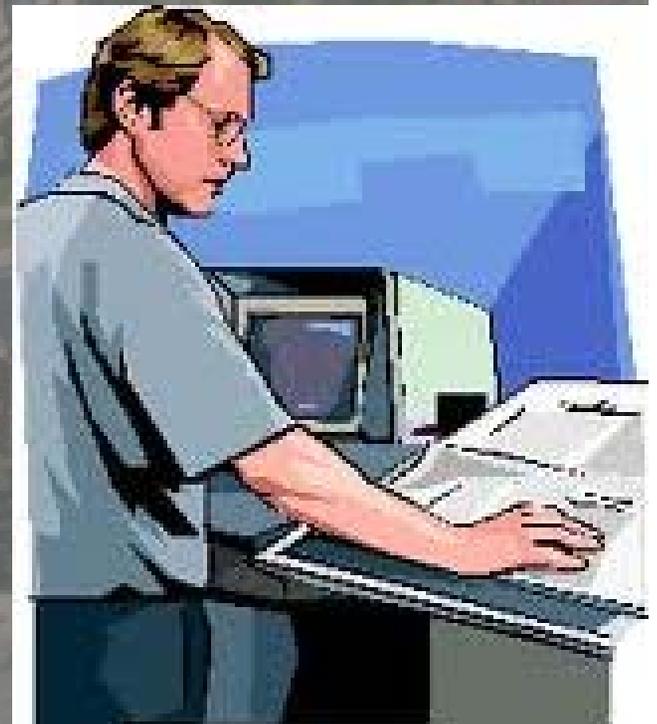
(b)(ii) Profile View

- i. Same sheet as the Plan View
- ii. Existing and proposed ground surface profile
- iii. Sewer sizes and slopes
- iv. Sewer length between manholes
- v. Special Features
 - Borings and Casings
 - Flowfill (cement-treated) encasements

Section 7 – Plans and Specifications

(b)(iii) Details

- i. Manholes
- ii. Cleanouts
- iii. Cross-section of the sewer's bedding
- iv. Special Design Features



Section 7 – Plans and Specifications

(c) Pumping Stations

i. Site Location and Layout

- Topographic and physical features
- Arrangement of pipes and pumping units
- Power Supply
- Road Access Drive and fencing
- Outfall sewer or structure

ii. Hydraulic Profiles

iii. Plan and Section view of wetwell and drywell

- Elevations
- Specific Construction features

Section 7 – Plans and Specifications

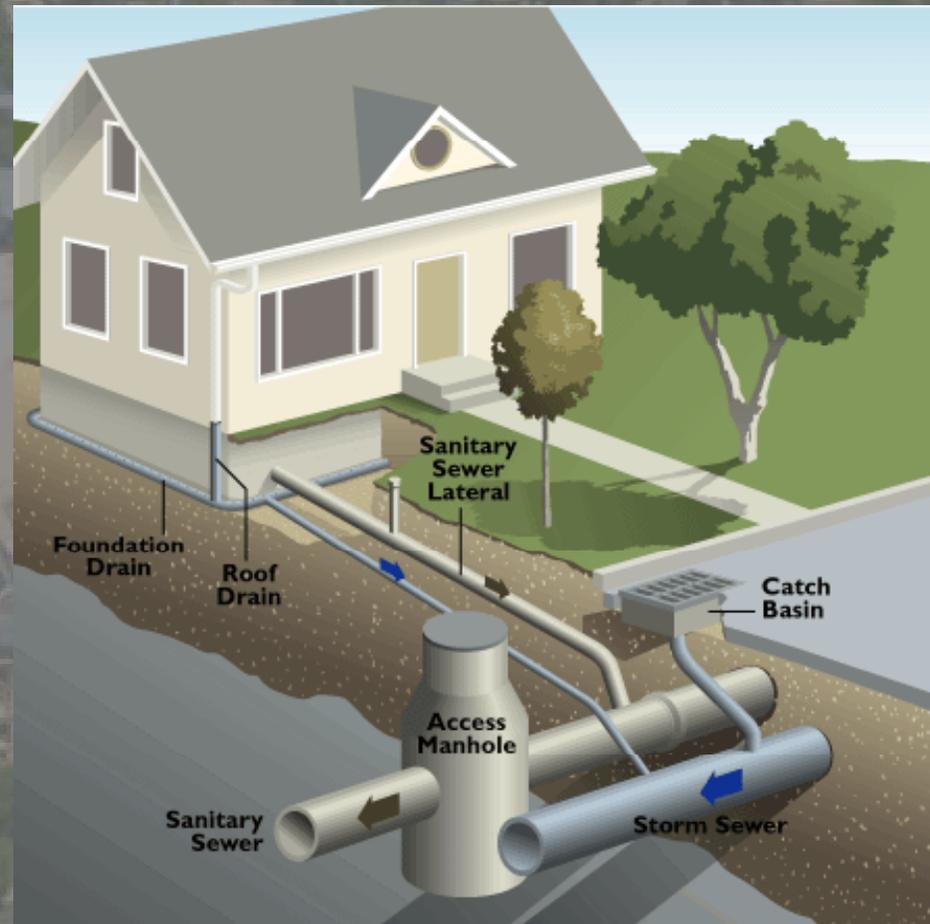
(d) Specifications

- i. Identify Construction Materials**
- ii. Mechanical or Electric Equipment**
 - Type, Size, Strength
 - Operating characteristics, power requirements or ratings
- iii. Procedure for construction or installation**
- iv. Requirements and tests of Materials**
 - Necessary to meet design standards
 - Backfill Requirements!
- v. Performance test for operation of completed works**

Section 9 – Design of Sewers

(a) Separate Sewers

1. Sanitary Sewer
2. Stormwater



Section 9 – Design of Sewers

(b) Pipe materials

1. Wastewater Characteristics

- Resist acid and alkaline solutions

2. Pipe Loadings

- Rigid pipe has a safety factor of 1.5
- Flexible pipe has a safety factor of 1.25

3. Soil Characteristics

- Resist Corrosion

4. Joints

- Minimize infiltration/exfiltration
- Exclude roots from pipe



Section 9 – Design of Sewers

(b) Pipe materials

5. Approved Pipe Material Specifications

i. Gravity Sewers

- *PVC Sewer Pipe – ASTM D3034, SDR35, ASTM F679, or ASTM F794*
- *HDPE (Not listed but approved)*
 - ✓ Recommend light color interior coating.
- *Clay, ABS, Plastic Mortar, Asbestos Cement, Concrete, Ductile Iron*



Section 9 – Design of Sewers

(b) Pipe materials

5. Approved Pipe Material Specifications (Cont.)

ii. Pressure Sanitary Sewers

- *PVC water pipe – ASTM D2241 or AWWA C900*
- *Asbestos cement pressure pipe*
- *Ductile Iron*
- *Glass Fiber-Reinforced Thermo-setting-Resin Pressure – AWWA C950*
- *HDPE (Not listed but approved)*



Section 9 – Design of Sewers

(b) Pipe materials

6. Performance Tests

- i. Infiltration Test – Max 200 gallons/inch-dia/mile/day with 2 feet of head over top of pipe
- ii. Exfiltration Test - Max 200 gallons/inch-dia/mile/day with 2 feet of head over top of pipe
- iii. Air Test – Conform to ASTM C-828-80.
- iv. Deflection – Maximum five percent (5%) deflection after backfilled for 30 days.
 - Pull Mandrel (95% of pipe diameter)
 - No mechanical pulling of mandrel is permitted



Section 9 – Design of Sewers

(c) Collection Design and Construction

- 7. Definition of Sewage Collection Line – carries wastewater from two or more buildings or greater than 2,000 gpd of average daily flow**
- 8. Depth**
 - Protect from freezing and frost heave**



Section 9 – Design of Sewers

(c) Collection Design and Construction

9. Size

- i. Carry 200% of maximum daily flow or more
- ii. Straight sewers
 - 8-inch or larger
 - 6-inch may be used on cul-de-sacs or no possible extension
- iii. Sewers on Curves
 - 18-inch or larger



Section 9 – Design of Sewers

(c) Collection Design and Construction

10. Slopes

| Size (inch) | Slope (ft/ft) |
|-------------|---------------|
| 6 | 0.60 |
| 8 | 0.40 |
| 10 | 0.28 |
| 12 | 0.22 |

11. Flat Sewer Design Policy (13.9.13)

- **Require Letter from owner responsible for maintenance**
- **No less than ½ of the minimum slopes above**

Section 9 – Design of Sewers

(c) Collection Design and Construction

12. Maximum Slopes

- 20 percent without concrete anchors
- Over 20 percent Requires:

| Slopes (percent) | Concrete Anchor Spacing (feet) |
|----------------------|--------------------------------|
| 20-35 | 36 |
| 35-50 | 24 |
| More than 50 percent | 16 |

Section 9 – Design of Sewers

(c) Collection Design and Construction

13. Velocities

- Minimum = 2 feet/sec
- Maximum = 10 feet/sec
- Greater than 10 feet/sec require special design considerations

14. Tractive Force Design (ASCE Manual of Practice No. 60)

- Q_{min} versus pipe slope
- Q_{max} versus pipe slope

Section 9 – Design of Sewers

(c) Collection Design and Construction

15. Increasing size

- **Diameter change only at manholes**
- **Diameter shall not decrease in direction of flow**



Section 9 – Design of Sewers

(c) Collection Design and Construction

16. Bedding

i. Rigid Pipe

- **Types A, B, C (Water Pollution control Federation Manual of Practice No. 9) or ASTM C12**

ii. Flexible Pipe

- **Types I, II, III, ASTM D2321**

17. Backfill

- Performed without disturbing pipe alignment**
- Not contain debris, frozen material, unstable material**
- Stone greater than 3 inches not within 2 feet of pipe**
- Compaction density equal to or greater than surroundings**

Section 9 – Design of Sewers

(c) Collection Design and Construction

18. Force Mains

- i. Depth – Protect from freezing and frost heave**
- ii. Size – Minimum shall be 4-inches**
- iii. Velocity – 2.5 feet/sec**
- iv. Air release – required at high points**
- v. Cleanouts – required every 400 feet**
- vi. Preceded Grinder pumps or septic tanks**
- vii. Pumps shall have isolation and check valves**

Section 9 – Design of Sewers

(c) Collection Design and Construction

19. Sanitary Services

- i. **Definition – Any conduit carrying wastewater that does not meet the definition of a sanitary sewer line**
- ii. **Size: minimum of 4-inches**
- iii. **Slope: minimum slope is 2 ft/100 ft**
- iv. **Flow: determined from a fixture count and sewage size based on flowing full**
- v. **Connections:**
 - **New Construction – WYE**
 - **Connection to existing – tapping saddle**

Section 9 – Design of Sewers

(c) Collection Design and Construction

20. Manholes

i. Location

- **Changes in Pipe Size**
- **Changes in vertical or horizontal alignment**
- **Sewer main intersections**
- **End of sewer mains**
 - ✓ **Terminal sewer cleanouts allowed within 150 feet of downstream manhole**

Section 9 – Design of Sewers

(c) Collection Design and Construction

20. Manholes (Cont.)

- ii. Size = interior diameter is 4 feet
- iii. Drop manholes
 - Required if change in elevation is 24 inches or greater
 - Concrete encasement required around drop pipe
 - External drops are encouraged
 - ✓ Internal drops allowed if physical constraints present



Section 9 – Design of Sewers

(c) Collection Design and Construction

20. Manholes (*Cont.*)

iv. Materials

- **Cast in place concrete**
- **Precast concrete with gasketed joints**



Section 9 – Design of Sewers

(c) Collection Design and Construction

20. Manholes (Cont.)

v. Access

- Minimum Clear Opening is 22 inches
- Located to be accessible by motorized equipment



Section 9 – Design of Sewers

(f) Potable Water Supply Protection

- 1. No cross connections between sewer and potable water lines**
- 2. Horizontal Separation**
 - i. Ten (10) feet where water main is less than 1.5 feet above sewer**
 - ii. Policy 14.14.10 – Allows variance if sanitary sewer is water grade pipe**
- 3. Vertical Separation**
 - i. Minimum 1.5 feet at crossing.**
 - ii. Joints in sewer at least 10 feet away from crossing**
 - iii. Upper line of crossing shall be supported**
 - iv. Where not possible, use separate casing or flowfill**

Questions ?



