

City of Brookings
Sanitary Sewer Collection Design Standards
(Brookings Municipal Utilities - BMU)

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General Requirements

Design: The design for sanitary sewer main collection facilities shall be in conformance with this chapter. Where design information is not provided herein, the most current edition of the following standards shall be used.

City of Brookings Design Standards, Standard Specifications, and Standard Plates.

Requirements and Standards of the South Dakota Department of Environment and Natural Resources.

Recommended Standards for Wastewater Facilities Great Lakes-Upper Mississippi River Board of State Public Health and Environmental Managers.” Edition (Ten State Standards).

South Dakota State Plumbing Code.

Uniform Plumbing Code of International Association of Plumbing and Mechanical Officials.

Conflict: In case of a conflict between the above design standards, the most restrictive requirement shall apply.

Construction Standards: Construction standards shall be the current version of the City of Brookings Standard Specifications for Sanitary Sewer Main Construction and Standard Plates together with the latest addenda. All details, materials, and sewer appurtenances shall conform to these standards.

City of Brookings Standard Specifications for Sanitary Sewer Main Construction shall be included with Designer’s bid package. Specifications can be retrieved from the BMU website <http://www.brookingsutilities.com/>.

Facility Requirements in Development Area: Developer shall extend sanitary sewer main facilities to the development area perimeter extents, whether it is required internally or not. This will ensure the sanitary sewer main is in place for extension by the adjacent Developer.

Approved Pipe Materials: Refer to City of Brookings Standard Specifications for Sanitary Sewer Main Construction.

Sewer Main Size: The BMU Engineer shall determine if a sanitary sewer main larger than 8-inches is required for the benefit of the overall sanitary sewer collection system. Minimum sanitary sewer main size shall be 8-inches in diameter.

Sanitary Sewer Main Location: Sanitary sewer mains shall be located to best conform to the layout of the existing facilities. In streets where no pattern has been established, sanitary sewer mains shall generally be located in the centerline of the road. A minimum horizontal separation of 10-feet shall be provided between the sanitary sewer mains and the water mains and storm sewers except as allowed in the Ten States Standards.

With the exception of sanitary sewer interceptor mains (12" and larger) sanitary sewer main extensions shall be installed in public right-of-ways and are not allowed to cross private property without a BMU approved easement width and a hard surfacing width of 8-foot (min) to allow access for BMU maintenance vehicles. Asphalt is the preferred hard surfacing method but compacted gravel may be allowed.

Sanitary sewer mains shall be at least 20-feet away from buildings and located under paved areas whenever possible. Sanitary sewer mains will not be allowed under buildings and must be encased under enclosed walkways and tunnels.

Submittals

Application for Sanitary Sewer Main Extension: Application for sanitary sewer main extension must be submitted to the Brookings Municipal Utility (BMU) board for approval. The BMU board meets the 2nd Monday of each month, application submittal required a week prior. Application retrieval: <http://www.brookingsutilities.com/>

Plan Submittals: Designer shall submit plan and profile sheets to the BMU Engineer for review prior to soliciting bids for the Owner. Allow BMU 1-2 weeks for review, depending on project size. Plans shall include, but not limited to, the following:

Plan and profile of sanitary sewer main and services with main and service sizes noted, manhole rim and invert elevations noted, sanitary sewer main installation notes, etc.

Plan and profile of all existing facility info obtained, including all other proposed facilities; such as water main, storm sewer, sump pump collection system, etc.

Easement locations for drainage or other facilities, noted and dimensioned.

City Hall approved road grades.

Lot numbers with block & addition info, street/avenue names, reference business names for driveways and any other pertinent info.

NAVD(88) benchmark(s) on project site, preferably to an 'O' on open on hydrant.

Determination of Flow

Lateral Sewers:

Discharge (Q_A) Average Daily Flow (gpd)

Equation 1: $\text{Area} \times \text{Area Density} \times \text{Unit Density} \times \text{Rate} = \text{Average Daily Flow}$

Equation 2: $\text{Number of Units} \times \text{Unit Density} \times \text{Rate} = \text{Average Daily Flow}$. Density for multiple dwelling units shall be not less than 2.5 persons/unit. Density for single family dwelling units shall be not less than 3.5 persons per unit.

Discharge (Q_P) Peak Lateral Sewer Flow (gpm)

$\text{Average Daily Flow} \times 400\% = \text{Peak Lateral Sewer Flow}$

Design Density and Rate (reference Density Design Table below)

Trunk Sewers:Discharge (Q_A) Average Daily Flow (gpm)

Equation 1: Area x Area Density x Unit Density x Rate = Average Daily Flow

Equation 2: Number of Units x Unit Density x Rate = Average Daily Flow

Discharge (Q_P) Peak Trunk Flow (gpm)

Average Daily Flow x 250% = Peak Trunk Sewer Flow

Design Density and Rate (reference Density Design Table below)

Area: Gross area shall be used in determining design flows and shall include streets and alleys but exclude parks, school grounds, and similar dedicated open space.

Density Design Table:

<u>Land Use</u>	<u>Area Density</u>	<u>Unit Density</u>	<u>Rate*</u>
Low Density			
Residential.....	6 units/acre.....	3 people/unit.....	100 gpd
Medium Density			
Residential.....	12 units/acre.....	2 people/unit.....	100 gpd
High Density			
Residential.....	25 units/acre.....	2 people/unit.....	100 gpd
Office and Institutional.....	Special Design Density – dependent on water use		
Commercial.....	Special Design Density – dependent on water use		
Industrial.....	Special Design Density – dependent on water use		

*gpcd – gallons per capita per day

Special Design Densities: Special design densities shall be subject to approval by the BMU Engineer based on methodology provided by the Design Professional.**Facility Design**Capacity of Pipe: The Manning Equation shall be used to determine pipe capacities. The design Manning's (n) for PVC Pipe Materials.

"n" = 0.011

Gravity Pipe Minimum and Maximum Velocity:

Min. at peak flow = 2-feet per second (fps)

Max. at peak flow = 14-feet per second (fps)

Force Main Minimum and Maximum Velocity:

The minimum force main velocity shall be 2-feet per second.

Suction and discharging piping for lift stations shall be sized so that the maximum velocities do not exceed 5-feet per second and 8-feet per second, respectively.

Dual force mains will be required if the initial force main velocities cannot meet the minimum velocity standards or if odor problems are anticipated.

Minimum Sewer Size: No gravity sanitary sewer to be maintained by BMU shall be less than 8-inch diameter. Single-family residential building sanitary sewer stub-outs shall be 4-inch (min) diameter. All sanitary sewer services other than single-family residential units (example: commercial, industrial, office, multifamily, etc.) shall be a minimum of 6-inch diameter. No private lateral sewer shall be less than 6-inches in diameter; however, 8-inch diameter sewers are recommended. 6-inch diameter pipe may be used as private laterals where there are relatively low flows, a small number of people to be served, future extensions are not anticipated, and the sewer is capable of handling the design flows. The justification for using the 6-inch pipe shall be provided by the design professional in writing. The possibility of cleaning problems shall be identified by the design professional and accepted by the development.

Depth of Sewer: Gravity sewers shall have a minimum depth of 7-feet to the invert where practical. Sewers should be well below the frost line at all points. Insulation shall be required above the sanitary sewer where the dimension from the finished grade elevation to the top of the pipe is 5-feet or less. Risers on service stub-outs shall be provided for sewers greater than 14-feet deep. Maximum depth of sewer shall not exceed the depth recommended by the pipe Manufacturer.

Alignment of Sewers: Sewers shall be straight between manholes. All sanitary sewers on curved streets shall be located as close to the centerline as possible and at a distance of 8-feet minimum from the back of curb.

Physical Requirements:

Manhole Liners: All manholes installed on sanitary sewer mains 15-inch or larger shall require manhole liners. Manhole liners may be required on sanitary sewer mains smaller than 15-inch, if deemed necessary by the BMU Engineer, to service a commercial or industrial business that produces industrial or high strength wastewater.

Minimum Manhole Diameter: 48-inches when the influent or effluent piping is less than 18-inches. Manholes are to have a minimum diameter of 60-inches when either the influent or effluent pipes are 18-inches and greater. In all cases, the Manufacturer's recommended minimum spacing between pipes shall be followed.

Maximum Manhole Spacing:

<u>Diameter of Sewer</u>	<u>Distance</u>
All sanitary sewer pipe diameters.....	450-feet

Note: Exceptions will be permitted within a development; however, said exceptions shall not be for more than 5-percent of the manholes in the development. Said exceptions shall not exceed 5-percent of the above distance unless BMU Engineer approved.

Manhole Locations: Manholes shall be installed at the following locations:

- At the end of each sewer main.
- At all changes in pipe size, grade, or alignment.
- At all sewer pipe intersections.

Minimum Manhole Pipe Invert Drop:

- Same pipe size for opposite directions: 0.10-feet.
- Same pipe size for adjacent or offset directions: 0.20-feet.
- Change in pipe size: match 0.8 depth point of all lines as a minimum, and match tops of pipes whenever possible.

Maximum Manhole Pipe Invert Drop:

Without inside drop connection: 2-feet as measured from high invert to 0.8 depth of carrier pipe. When the drop is less than 2-feet from invert to invert, the manhole channel shall be constructed to form a uniform slope from the incoming pipes to the outgoing pipe.

Manhole in Cul-De-Sac: Manholes located at the end of cul-de-sacs shall be located 8-feet to 10-feet from the back of curb and gutter to shorten the sewer service lengths.

Dead-end Manholes: Dead-end manholes shall be extended beyond the midpoint of the last serviced lot. If the dead-end manhole is the last manhole of an Owner's development, the manhole shall be extended to the end of the Owner's property.

Manhole Frame and Lids: For approved types of manhole frame & lids, refer to City of Brookings Standard Specifications for Sanitary Sewer Construction.

Manhole Rim Elevations in Floodplain: BMU Engineer shall determine minimum height of manhole rim elevation in floodplain: 1-foot minimum above 100 year flood elevation.

Manufactured Home Parks: The building pad for manufactured home park dwellings shall be a minimum elevation of 1-foot above the 100-year flood elevation. Sanitary sewer service risers which accommodate the manufactured home park dwellings shall extend above the pad.

Minimum Grade: Sewers shall have minimum grade sufficient to maintain 2 fps at peak flow. For low flow lines where feasible, a minimum grade of 1-percent shall be used. Minimum grade on building sanitary sewer stub-outs shall be 1-percent, the preferred grade is 2-percent.

Crossings: Sanitary sewer crossings of storm sewers shall have no less than 6-inches of clearance. Special structural support and insulation will be required if there is less than 18-inches clearance. The minimum horizontal clearance shall be 2-feet. Clearance refers to the distance from the outside of the sewer pipe to the outside of the storm sewer pipe. Sanitary sewer crossings of other utilities shall be done in accordance with the South Dakota Department of Environment and Natural Resources, the City of Brookings Standard Specifications for Sanitary Sewer Construction, and the City Standard Plates.

Pipe Plug: Sanitary sewer mains ending at development phase boundaries that do not terminate with a manhole shall be ended with a bell end section of pipe and watertight plug. A one foot or less section of pipe with a glued-on cap inserted into the bell end of the pipe will be allowable as a watertight plug. Couplings will not be allowed for this type of connection.

Cleanouts: Private sanitary sewer service clean-outs will not be allowed in the public right-of-way. All clean-outs shall be protected with a BMU Engineer approved cover protection.

Standard Plates: See City of Brookings Standard Specifications for Sanitary Sewer Main Construction and Standard Plates for such details as manholes, drop connections, risers, and other appurtenances.

Industrial Sewer Monitoring Facility: New buildings constructed or proposed to be constructed which produce industrial or high strength wastewater shall install a BMU Engineer approved sanitary sewer monitoring facility prior to final building inspection approval. The monitoring facility shall normally be situated outside of the building on the Owners' premises. If the industrial Owners' sanitary sewer service line ties into an existing BMU manhole and such manhole allows for safe sampling and isolation of the industrial Owners' discharge, the BMU Engineer may allow said manhole to serve as the industrial Owners' monitoring facility.

Sewage Lift Stations: The Design Standards and Standard Details for sanitary sewage lift stations shall be used for all lift stations unless a separate design is determined necessary by the BMU Engineer. Permanent lift stations shall be BMU owned, operated and maintained after meeting all design criteria and testing requirements.

Temporary lift stations (Developer owned) may be considered by the BMU Engineer where future gravity sanitary sewer mains are planned to eliminate the need for the lift station within a reasonable time frame.

Each pumping station shall be provided with a minimum of two pumps, each having a capacity sufficient to pump the peak design flow. Submersible pump system is preferred (no drywell with wetwell).

No sanitary sewage shall be allowed to be discharged into a newly constructed lift station wet well until final completion is made and notification is made by BMU assuring operation responsibilities.

Specific Equipment Required: The sewage lift station shall be supplied with, but not be limited to, the following specific items:

Wet well shall be 8-foot diameter (min) and HDPE lined precast concrete with monolithic base.

Wet well shall require fall protection under both the pump and trash basket access hatch doors. A 3-sided railing, opposite the hinged side of pump access hatch door, shall be required.

Wet well steel bar screen style trash basket with rail system (solid aluminum wheels and stainless steel axles) and pump guide rail system shall be 316 stainless steel.

Valve vault shall be a separate precast manhole for housing check valves, gate valves, and shall include a hatch operated blower.

Discharge piping from the pumps through the valve vault shall be schedule 80.

Pump voltage shall be 208/120Y 4-wire (preferred) or 480/277Y 4-wire.

Control system including electrical equipment and apparatus shall be housed in climate controlled building, with heating & cooling systems that are energy star qualified.

Secondary power supply – diesel engine generator system with adequate diesel storage for prolonged run time. Exterior stand-alone generator systems are allowed.

Automatic closed-transition transfer switch for the secondary power supply.

Programmable logic controller and HMI to control and monitor the lift station remotely and locally shall be Allen-Bradley; coordinated and approved with BMU. Control system shall include an online UPS backup approved by BMU Engineer.

Wet well level control shall include level sensor and float backup.

Telemetry shall be compatible with existing BMU equipment; coordinated and approved with BMU.

Variable Frequency Drive (VFD) with factory bypass shall be required for all pump motors and shall be Allen-Bradley; coordinated and approved with BMU.

Wet Well Design: The wet well design shall be coordinated with pump sizing in order to avoid frequent on/off cycling of the pumps. To prevent septicity, wet well detention time at average daily flow (QA) should not exceed 30 minutes.

Cycle time is the total time between starts of an individual pump and can be determined by comparing the volume between the “on” and “off” levels in the wet well with the pump capacity. Cycle time is computed as follows:

Where:

CT = Cycle Time (minutes)

V = Wet Well Volume between On and Off Levels (gallons)

D = Rated Pump Capacity (gallons per minute) and

(Q_P) = Peak Hourly Lateral Sewer Flow (gallons per minute)

$$CT = V / (D - Q_P) + V / Q_P$$

With a given wet well volume and pumps of uniform pumping rate, minimum cycle time will occur when the rate of inflow is equal to one-half of the discharge rate of the individual pump under consideration and the formula for cycle time simplifies to $CT = 2V / Q_P = 4V / D$. An effective wet well volume of at least:

2.5 times the discharge rate of the pump is required.

The operating volume of the wet well shall be designed to provide the following maximum motor starting times at the design pumping rates.

<u>Motor Size (hp)</u>	<u>Maximum Motor Starting Times</u>
0–25.....	6 starts per hour
26–35.....	5 starts per hour
36–60.....	4 starts per hour

Pump Design: The operating speed of the pumps shall not exceed 1,800-rpm. The test sphere minimum diameter shall be no less than 3-inches in diameter. The minimum suction and discharge diameter shall be no less than 4-inches in diameter.

Engine Generator Design: The engine generator shall be designed to operate each pump separately; the generator controls shall be set up so it interlocks to allow operation of only a single pump (in a duplex application) and all other electrical equipment when under generation. If more than two pumps are used, the engine generator shall be designed to start the pumps necessary for the firm pumping capacity of the station simultaneously. It shall be at the BMU Engineer's discretion to change the generator sizing requirements when the size of the lift station warrants it. The engine generator system shall be a four-cycle water-cooled type. The generator shall be supplied with a closed-transition automatic transfer switch. An enclosure for the automatic transfer switch shall be supplied and sized large enough to contain the station on/off switches, telephone termination boxes, and other necessary controls. The generator shall be enclosed in a sound attenuation enclosure and supplied with all accessories which make it a complete operating system.

Power Supply: Power supply shall be coordinated with BMU Electrical Department.

Access Road to the Lift Station: An access into the lift station will be required and shall be shown on the construction drawings. The access road shall meet minimum thickness and materials standards for streets. The surfacing shall be asphalt or concrete.

Site Landscaping: The Contractor shall maintain the grass areas by watering, fertilizing, reseeding, mulching, and mowing until the grass has established a 2-inch catch of grass. The Contractor shall immediately reseed and mulch areas which show bare spots at no additional cost.

Odor Control: Odor control shall be provided at the lift station and/or the force main discharge where it is determined to be a detectable problem.

Flooding: Wastewater pumping station structures and electrical and mechanical equipment shall be protected from physical damage by a 100-year flood event and shall remain fully accessible during a 100-year flood event.

Sanitary Sewer Services

Sanitary Sewer Service Ownership: Sanitary sewer services are privately owned by the property Owner from the sanitary sewer main to the home, business or industry, and any maintenance required to the sanitary sewer service shall be at the property Owner's expense.

Individual Sanitary Sewer Service per Residence: A separate sanitary sewer service is required for each residence which has the potential of being sold individually, which shall include but not be limited to, duplexes, four plex's, townhouses, etc.

Apartments and over/under duplexes & triplexes, etc., do not need separate sanitary sewer service lines.

All platted lots of a proposed subdivision are to front on and have a separate sanitary sewer service to a public sanitary sewer main without crossing adjacent properties. Additional sanitary sewer services will be required for each additional principal structure on a given lot.

Residential service lines shall be constructed to the property line as a part of the street construction project.

Commercial and industrial service lines may be constructed to the property line if the service line size is known.

Sanitary Sewer Service Size: The minimum sanitary sewer service size for a single family dwelling shall not be less than 4-inches in diameter and commercial buildings shall not be less than 6-inches in diameter.

Sanitary Sewer Service Location: The sanitary sewer service location shall be determined by the Owner or Engineer, but the sanitary sewer service and sanitary sewer service tap must be installed a minimum of 10-feet from the side property line or ownership line, adjacent to the right-of-way line. No sanitary sewer service bends shall be allowed from the sanitary sewer service tap to the sanitary sewer service stub location at the right-of-way line.

Minimum Sanitary Sewer Service Cover: Minimum depth of cover for a sanitary sewer service, as measured from the top of the pipe to the finished surface elevation, shall be 4-feet, and this may not be allowed if the BMU Engineer deems that the cover material will allow additional freezing depth or the sewage flows are minimal to allow freezing. Any sanitary sewer service with less than 5-foot of cover shall require the BMU Engineers' approval prior to installation.

Connections to Manholes: Individual services may not be connected into manholes unless BMU Engineer approved.

Sanitary Sewer Main Easements and Access

Sanitary Sewer Main Easements: Sanitary sewer main easements shall be obtained for all sanitary sewer mains located on private property. Sanitary sewer main easements shall have a minimum width of 20-feet. In addition, temporary construction easements may be required for construction.

The most current version of the sanitary sewer easement forms shall be used and obtained from the BMU Engineer's Office.

The following Easement Table lists the minimum easement widths for sanitary sewer main with a pipe diameter of 30-inches or less. The minimum easement widths shall be used when preparing plans. Easements shall be shown on the Preliminary Plans, Development Engineering Plans, and CIP Plans. Plans are to show the easement dimensioned from the centerline of the pipe to the outside edge of the easement and labeled "Utility Easement" (preferred) or "Sanitary Sewer Easement". The easement widths may be required to be wider depending upon specific site conditions.

Easement Table:

<u>Pipe</u> <u>Depth</u> (feet)	<u>Min Easement</u> <u>Width Required</u> (feet)	<u>Pipe</u> <u>Depth</u> (feet)	<u>Min Easement</u> <u>Width Required</u> (feet)
8.....	20	20.....	48
9.....	20	21.....	52
10.....	20	22.....	54
11.....	22	23.....	58
12.....	24	24.....	60
13.....	28	25.....	64
14.....	30	26.....	66
15.....	34	27.....	70
16.....	36	28.....	72
17.....	40	29.....	76
18.....	42	30.....	78
19.....	46		

Access to Sanitary Sewer Mains: Sanitary sewer mains located outside of public right-of-ways shall require easement access and must be accessible by BMU maintenance vehicles. Easement access road topping shall be asphalt (preferred) or 6-inches of compacted gravel, as determined by BMU Engineer. Manhole lids to be installed up to the road topping grade.