City of Bentonville

Water Utilities

Wastewater Collection System

Capacity Study Guidelines

Revision – 4

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City of Bentonville Water Utilities - Technical Services
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Wastewater Collection System Capacity Study Flow Chart

City of Bentonville | Private Development

1. Determine projected flow from the project (gpm)
2. Does the flow warrant a downstream sewer analysis (Section 1.1)
   - Yes → Perform the analysis based on requirement within Section 1.
     - Does the development exceed the capacity of the studied lines
       - Yes → Upgrade sewer line to include proposed flows
       - No
     - Provide the proposed flow data to BWU to be applied to the interceptor
   - No
3. Does the proposed development exceed the flow of the downstream interceptors
   - Yes → The development will determine the upsize needed to handle the proposed flow
     - BWU will determine size of line required for maximum buildout of the basin
     - BWU may choose to enter into an agreement with the developer to cost share on an upgrade to meet maximum buildout.
     - The Development may partner with the City of Bentonville to install the sewer improvements
   - No

1. Consult the Flow Calculation Guidelines (Section 2).
2. A Sewer Analysis is req'd if your development exceeds 10% of the flow in the pipe (table 1)
3. Interceptors were determined in the 2021 Sewer Analysis
4. All agreements are subject to City Council approval

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1. Flow Calculation Guidelines

1.1. All proposed developments which will impact the wastewater collection and treatment systems within the Bentonville Water Utilities (BWU) service boundary shall be required to calculate the sanitary sewer flow anticipated to be generated by the development and conveyed through the city's wastewater collection and treatment systems.

1.2. Flow calculations shall be completed in accordance with *Ten States Recommended Standards for Wastewater Facilities, 2014 Edition (Ten States Standards), and* the *Arkansas State Board of Health Rules and Regulations Pertaining to Onsite Wastewater Systems – Appendix B, Effective September 05, 2024 (ADH Rules). In instances where Appendix B of ADH Rules does not accurately describe the use, Table 4-2 of City of Virginia Beach Department of Public Utilities Design Standards Manual, 2024 Revision (Virginia Beach Manual)* shall be used. The Water Utilities Director, or their designated representative, has final authority regarding interpretation and application of this manual and all references herein.

1.3. Average flows shall be calculated as described below.

A. Average flows for all residential dwelling units shall be calculated as 100 gallons per person per day consistent with Ten States Standards and the average household size of 2.64 for Bentonville as determined by the United States Census Bureau – 2021 American Community Survey 5-YR Estimate.

B. Average commercial flows shall be calculated using Appendix B of ADH Rules. In instances where Appendix B of ADH rules does not accurately describe the use, it shall be necessary to reference the Virginia Beach Manual. Justification for the use of Virginia Beach manual will be required and will be reviewed case by case.

1.4. Peak-Hour design flows shall be calculated using a peaking factor determined from Figure-1 in Chapter 10 of Ten States Standards (included as a reference with this document.) The use of peaking factors calculated by other means are subject to approval by BWU and ADH.

$$\text{Q Peak Hourly/Q Design Ave} = \frac{18+\sqrt{P}}{4+\sqrt{P}} \qquad \text{(P= population in thousands)}$$

2. Determination of Downstream Study Requirements

2.1. Each Development Plan submitted to The City of Bentonville which will impact the wastewater collection and treatment systems will be required to evaluate the need for a downstream capacity study. To ensure consistency, the applicant and BWU will evaluate downstream capacity study requirements based on the size of the public sewer main that the development is connecting to and the amount of wastewater flow generated by the development.

2.2. The engineer of record (EOR) shall calculate the peak design flow for the proposed development using the methods outlined in the earlier section of this manual. That calculated

peak design flow shall then be compared to the full flow capacity (calculated using Manning's formula, with nominal pipe size at the minimum allowable slope, and n=0.013) of the sewer main they are connecting to. See Table 1 below for the Pipe Full Capacities of various sewer main sizes at their respective allowable minimum slopes.

Table 1 – Full Flow Pipe Capacities at Minimum Slope

Pipe Size (in)	Full Flow Capacity at min. slope (gpm)	10% of Pipe Full Capacity at min. slope (gpm)
6	178	17.8
8	343	34.3
10	520	52.0
12	750	75.0
15	1123	112.3
18	1633	163.3
24	2872	287.2
30	4434	443.4
36	6421	642.1

A. If the peak design flow from the development is less than ten percent of the Pipe Full Capacity at minimum slope and there are no known capacity constraints downstream, BWU will generally not require an initial capacity study; however, Arkansas Department of Health (ADH) may require additional information or study during their review if applicable. BWU also reserves the right to require studies for developments in this category when deemed necessary by staff. The EOR shall submit a technical memorandum with the project submittal, including flow calculations proving that the project is exempt from the initial study requirements.

B. If the peak design flow from the development is equal to or greater than ten percent of the pipe full capacity at minimum slope, a capacity study will be required. The EOR shall submit a signed and sealed report documenting existing and proposed conditions of the system, and recommendations for improvements, if any. More information on the required study and deliverables is provided in following sections.

2.3. Developments for which it is required that a capacity study be completed will generally be responsible for completing a study from their point of connection downstream to the next largest interceptor main. If the development connects to an existing six inch main, the study must continue to an interceptor that is ten inches or larger. Calculations for the developer's portion of the study should be completed using the methods outlined in this manual.

A. The developer may request any existing flow data from BWU, and it will be shared when available; however, BWU reserves the right to require that the development perform new

calculations in accordance with this manual The EOR is responsible for verification of any data sourced from BWU, the City's GIS, studies completed by other firms, or any other source.

2.4. When a capacity study is required, the development will be responsible for analyzing any lift stations impacted to determine if they can accommodate the proposed flows, and what improvements, if any, may be necessary.

A. A field assessment and drawdown test are necessary to determine existing condition and capacity and will be the responsibility of the developer and EOR to complete. Coordination with BWU will be required to gain access to the lift station and have a member of our staff onsite to operate the pumps during the test. The developer may request any existing flow data from BWU, and it will be shared when available; however, BWU reserves the right to require that the development perform a new test. The EOR is responsible for verification of any data sourced from BWU, the City's GIS, studies completed by other firms ,or any other source.

B. There are three regional lift stations which will generally not be subject to study by developments. These include McKissic Creek Lift Station, North Lift Station, and South Lift Station.

2.5. BWU will continue the analysis further downstream using the hydraulic model of the system and flows provided in developers portion of the study. If the proposed development exceeds the available capacity in the downstream interceptors, BWU will work with the developer to determine the necessary improvements and may choose to enter into a cost share agreement with the developer for those improvements. In areas where model and/or existing flow data is insufficient to make the necessary determinations, BWU reserves the right to require further analysis from the developer.

2.6 The capacity of each section of sewer main downstream of the development shall be calculated using Manning's formula, assuming nominal pipe diameter, full flow conditions (depth of flow equal to pipe diameter), n=0.013, and slope as identified through survey, as-built documents or other approved means

3. Deliverables

3.1. The proposed average and peak design flows generated from all proposed developments shall be calculated in accordance with this manual and presented as an easily seen note or table on the utility page of the civil plan set. These flows shall be provided at the time of application and shall remain on all revisions including construction plans and record drawings.

3.2. For developments which are exempt from initial study requirements in accordance with this manual, BWU staff may request a signed and sealed engineering memorandum including flow calculations proving that the project is exempt from the initial study requirements.

3.3. For developments which are required to complete a capacity study in accordance with this manual, it is required that the EOR prepare and submit a signed and sealed engineering report discussing the study and calculation methods, assumptions, analysis of existing and proposed conditions and any recommendations.

A. Sewer manholes shall reference the city manhole dentification number ("MHID") and mains shall be referenced by their "Entity ID" throughout the report and associated deliverables. These identifiers are available in the City's GIS system.

B. Detailed calculations shall be submitted calculating the capacity of each sewer main along with the existing and proposed flows. All calculations shall be completed in accordance with this manual and presented in an organized and easy to follow manner. All calculations shall be completed using the "Sewer Capacity Study Calculation Template" excel file available for download on BWU's website. Instructions are provided within the file for inputting the appropriate information. This deliverable shall include this document in printed form and as a .xslm file with all original cell and sheet protections in place.

C. A table shall be provided within the report summarizing the Entity ID, size, slope, capacity, proposed peak flow, and percentage of capacity utilized (Q/q, or ratio of peak flow to pipe full capacity) for each sewer main in the scope of the study. The "Summary Table" tab within the calculations template provides the necessary headings and format, and will auto populate from the user input on the "Capacity Calculations" tab. This deliverable shall include this document in printed form and as a .xslm file with all original cell and sheet protections in place.

D. A map, or maps of the study area shall be included which identify the overall basin contributing to the study point, and the parcels that directly contribute to each section of sewer main. Multiple maps at an appropriate scale may be required to accurately depict the information in the necessary detail. The maps shall reference sewer manholes and mains by their assigned identifiers as discussed earlier in this section.

E. A shape file (.shp) shall be provided containing a polygon representing the study boundary for import in the City's GIS. The polygon shall follow and "snap" to the most up-to-date established Benton County parcel lines, which are available for download from the county's GIS website in several formats. https://gis.bentoncountyar.gov/downloads/index.html

4. Submittal and Review Process

4.1. The proposed average and peak design flows generated from the development shall be calculated and included on the utility sheet of a plan set no later than the first submittal. Including this information at the pre-application level is beneficial and allows for project specific discussion during the meeting.

4.2. A draft of the deliverables outlined in sections 3.2 or 3.3 shall be submitted no later than the first submittal. Earlier submittals and coordination with BWU are encouraged when possible, to assist in maintaining the desired review timeline.

4.3. Each submittal shall include all required deliverables, updated as necessary, along with a revision number and date. No partial submittals or partial resubmittals are allowed.

4.4. When review by ADH is required, all documents intended for their review shall be sent to BWU for review and stamping prior to making to the submittal to ADH. This includes any required resubmittals resulting from ADH comments or any other changes. BWU will assist with comment responses and requests for additional data as available.

Appendix B

QUANTITIES OF WASTEWATER FLOW FOR VARIOUS TYPES OF ESTABLISHMENTS

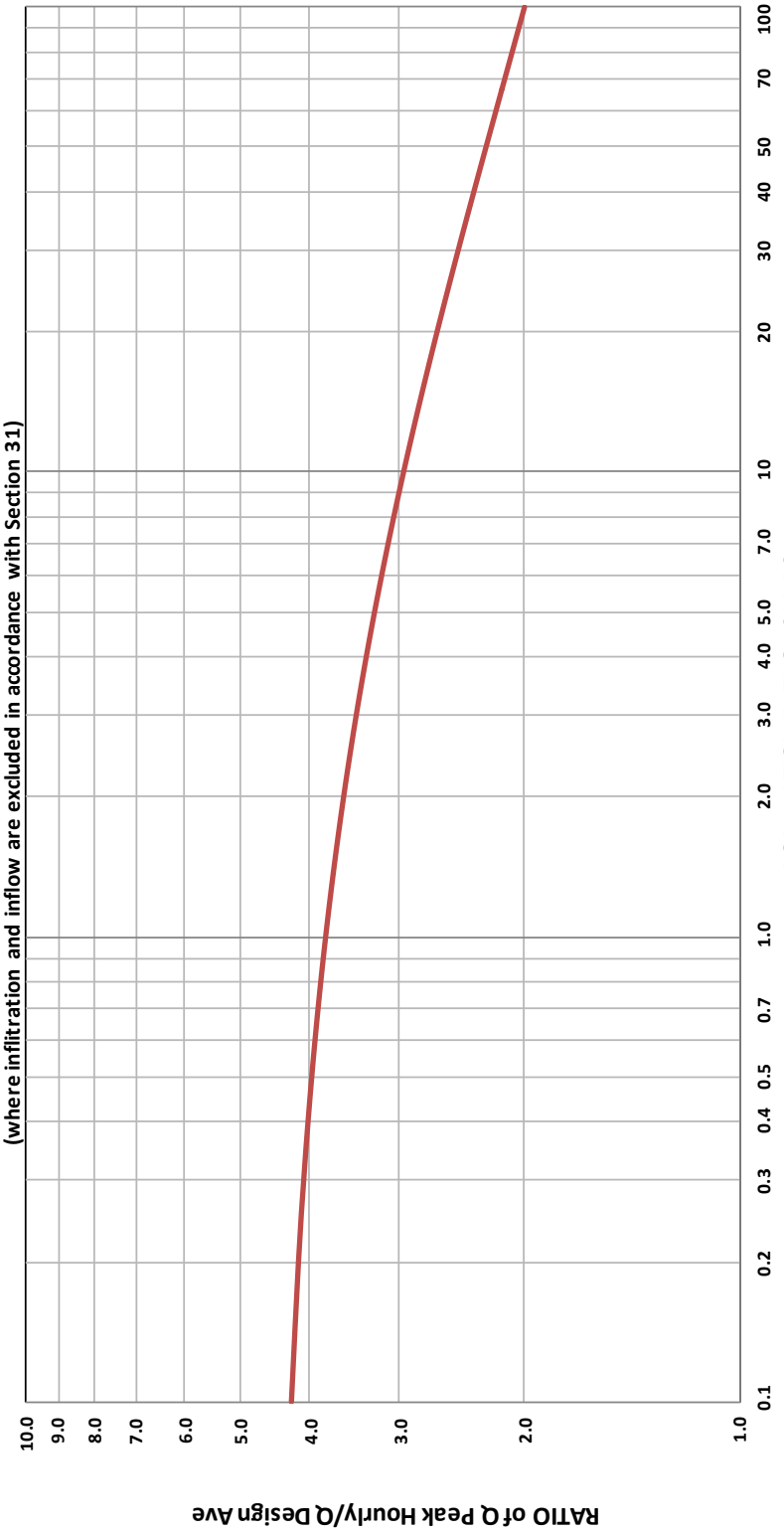
ESTABLISHMENT TYPE	GALLONS PER DAY
Airports, Bus Terminals, Train Stations	
Per passenger	5
Add per employee per 8-hour shift	20
Barber & Beauty Shops (*per chair*)	100
Bowling Alleys	
Toilet wastes per lane	100
For food service, add Food Service usage below	
Camps	
Campground with central comfort stations per camper	35
Day camps (no meals served) per camper	15
w/ food service, add Food Service usage below	
Churches	
Per seat/no food service	5
For food service, add Food Service usage below	
For daycares, add school usage below	
Grocery Stores	
Per 100 square feet of floor space	5
Add per 100 square feet of deli floor space	50
Add per 100 square feet of bakery floor space	50
Add per 100 square feet of meat market floor space	100
Country Clubs	
Per resident member (see Food Service usage below)	25
Per non-resident member	10
Dentists Offices	
Per practitioner	200
Add per employee per 8-hour shift	20
Doctors Office	
Per practitioner	200
Add per employee per 8-hour shift	20
Factories (*exclusive of industrial waste*)	
Gallons per employee per 8-hour shift	
No showers provided	20
Showers provided	35
Hospitals	
Per bed space	200
For food service excluding patients, add Food Service usage below	
Hotels & Motels	
Regular per room	150
Resort hotels & cottages	75
Add for establishments with self-service laundry facility per machine	750

Mobile Home Parks	
per single wide mobile home space	300
per double wide mobile home space	450
Nursing Homes, Rest Homes, Adult Congregate Living Facilities	
Per bed	100
Add for food service	65
Office Buildings (*per employee per 8-hour shift*)	15
Parks, Public Picnic	
Toilets only per person	5
With bath house, showers, & toilets per person	10
Recreation Vehicle Park	
Recreational vehicle space for overnight stay, without water & sewer hookup per vehicle space	50
Recreational vehicle space for overnight stay, With water & without sewer hookup per vehicle space	75
Recreational vehicle space for overnight stay, with water & sewer hookup per vehicle space	125
Food Service	
Per day per seat	40
Using single service articles only per seat	25
Bar and cocktail lounge per seat	30
Carry out only	
Per meal served without public restrooms	5
Per meal served with public restrooms	10
Add per employee per 8-hour shift	15
Residences	
Single or multiple family per dwelling unit	
1 bedroom	150
2 bedrooms	270
3 bedrooms	370
4 bedrooms	450
For each additional bedroom add	50
Rooming houses per occupant space	75
Schools (*per student*)	
Day schools & day cares	15
Add for food service	5
Add for day school workers	20
Boarding schools	75
Service Stations & Convenience Stores	
Per vehicle served	10
(See Food Service)	
Stadiums, Race Tracks, Ball Parks (*per seat*)	5
Swimming Pools and Bathhouses (*per patron*)	10
Theaters (*per seat*)	
Indoor, movies/auditorium	5
Outdoor, Drive-Ins (*per space*)	10

FIGURE 1

RATIO OF PEAK HOURLY FLOW TO DESIGN AVERAGE FLOW

(where infiltration and inflow are excluded in accordance with Section 31)



Q peak hourly: Maximum Rate of Wastewater Flow (Peak Hourly Flow)

Q design ave: Design Average Daily Wastewater Flow

Source: $Q \text{ Peak Hourly/Q Design Ave} = \frac{18+\sqrt{P}}{4+\sqrt{P}}$ **(P= population in thousands)**

Fair, G. M. and Geyer, J. C., "Water Supply and Waste-water Disposal"
1 st Ed., John Wiley & Sons, Inc., New York (1954), p. 136