

DESIGN MANUAL
WATER SUPPLY

**BALTIMORE COUNTY
DEPARTMENT OF PUBLIC WORKS DESIGN MANUAL**

WATER DESIGN

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**Baltimore County Department of Public Works
Design Manual
WATER MAIN DESIGN STANDARDS**

I. GENERAL

A. Application

The water design criteria presented herein shall apply to developer projects as well as to County-funded Capital Projects.

B. Limitation of Design Manual

It is not possible to include in this manual all features of design that are necessary to accomplish the development of construction documents for all projects. The topics addressed are limited to those that will help the designer perform most engineering tasks in an efficient manner and will comply with County practice.

C. Check for Availability of Water

Design engineers shall check with the Bureau of Engineering and Construction to determine the availability of water at the site of a proposed sub-division.

D. Water Supply System

Water supply for Baltimore County consists of extensions of the Baltimore City water supply system. These extensions are designed by Baltimore County DPW or by a consulting engineer and constructed by a Baltimore County pre-approved contractor.

E. Responsibility

After completion of construction, the water supply system is maintained and operated by Baltimore City's Bureau of Water and Wastewater. The parts of the system that are considered the property and responsibility of Baltimore County are the water mains, appurtenances, and those parts of the system which lie in public rights-of-way. The parts which lie within private property are the responsibility of the owner and are constructed and maintained by the property owner.

II. DESIGN

A. Residual Pressure

Residual pressure of 30 psi minimum at the meter during peak hour demand must be met within the distribution system and is to be used in the design of public water mains. The water system storage facilities shall be considered at their minimum operating elevation when determining this pressure.

B. Service Connections

1. General: Service connections for water shall be built from the water main to the meter vaults located near the property line for all lots within a proposed development. All adjacent improved lots, which are not a part of the proposed development but may be served by the water line, shall be shown on the Contract Drawings. (Service connections will not be shown for these lots.) Unless approved in writing by the Chief of the Bureau of Engineering and Construction, service connections cannot be made on water lines greater than 24 inches.
2. Location
 - a. On the plans, indicate service connection, 2 inches and smaller, schematically 15 feet from the property line on the high end of the lot. Exact location will be fixed in the field after a conference with the property owner(s).
 - b. Service connection, 3 inches and larger, must be explicitly designed, including utility crossings, and vault locations. The design must be approved by both Baltimore County and Baltimore City.
3. Sizing
 - a. Service connections must be no smaller than $\frac{3}{4}$ inches, the normal size for a residential dwelling. Twin house connections (twin $\frac{3}{4}$ -inch meters or twin 1-inch meters) may be permitted in group and semi-detached developments to serve two adjacent houses.
 - b. For other than a residential dwelling, determine the water supply demand pursuant to the Baltimore County Plumbing Code and fire demand pursuant to the Baltimore County Building Code. The plumbing demand and fire demand must be indicated within the property bounds for other than single-family residences. The velocity in the service connection must not exceed 8 fps.
4. Cover: Cover over service lines must be as indicated in the Standard Details measured from established grade.
5. Clearances: Place water house services ordinarily at least 7 feet horizontally from house connections for sewer and a minimum of 1 foot clear above the sewer connections. For clearance less than specified, obtain approval from Baltimore County DPW and from Maryland Department of the Environment (MDE).
6. Materials: Pipe material must conform to Baltimore County Standard Specifications.

C. Appurtenances For Service Connections

1. Meters (location) – Also See Standard Details

- a. In new and existing subdivisions with curb streets: locate 2-feet, 6-inches behind face of curb.
- b. In existing developed areas without curb streets: locate 3 feet from the property line in the public right-of-way.
- c. In roads with drainage ditch: locate 3 feet from the edge of the ditch, between the ditch and the property line.
- d. The designer shall avoid locating meters within driveways or any other traffic bearing areas whenever possible.

2. Meters (sizing)

- a. In selecting meters, determine the supply demand according to the requirements of the Baltimore County Plumbing Code. The supply demand must not exceed the “Maximum Rate for Continuous Operations,” as listed in:
 - AWWA C700-95 Cold Water Meters – Displacement Type, Table 1
 - AWWA C702-92 Cold Water Meters – Compound Type, Table 1
 - AWWA C703-96 Cold Water Meters – Fire Service Type, Table 1
Proportional Type Main LinesSee Page W-25 of this manual for referenced tables.

- b. For Fire Service Type, the fire demand must be determined in addition to the supply demand. The fire demand is determined according to the Baltimore County Building Code and must not exceed the “Safe Maximum Operating Capacity,” as listed in:
 - AWWA C703-96 Cold Water Meters – Fire Service Type, Table 1
Proportional Type Main Lines (see Page W-25).

- c. All meters in the Metropolitan System are pre-tested and certified by the Baltimore City Bureau of Water and Wastewater. Meters are obtained by applying to the Baltimore County Department of Permits and Development Management.

3. Valves: Install a valve or corporation stop on the water main side of each meter installation as indicated in the Standard Details.

4. Meter Vaults: Vaults for meter installations must be as indicated in the Standard Details. When meter vaults must be located in driveways or any other traffic bearing areas, the vault must be designed for traffic bearing.

D. Service Mains

1. General: The designer has the responsibility to identify where factors of good planning and design are in conflict with these guidelines and requirements of other agencies. The proposed alignment must be the best overall design. Failure to

identify conflicts during the preliminary design may result in delays and possibly costly changes.

Consideration must be given to space requirements for future utilities, particularly sanitary sewers and storm drains. In the absence of sewer or storm drain design, the designer shall recommend the space requirements of the sewer or drainage facilities and shall provide the necessary clearances. This requirement is particularly important at roadway intersections.

The designer shall identify and locate all existing and underground facilities before selecting the location of the pipeline. When plans of existing facilities are insufficient to accurately locate existing underground obstructions, the designer shall request DPW for permission to perform test pit excavations to uncover the subject facility so that the horizontal and vertical positions of existing utilities can be accurately determined.

2. Description: Service mains are 24 inches and smaller in diameter. For larger mains, the design engineer should consult with the Bureau of Engineering and Construction regarding special design criteria.
3. Looping: In the layout of service mains, non-looped situations shall be avoided. All mains, both internal to the project and external, shall be continued to the nearest point of connection as directed by DPW. All easements shall be provided where required by DPW for the looping of the public water systems.
4. Location
 - a. In new subdivisions: Lay water mains 7 feet from the centerline of the road right-of-way, generally on the side of the road toward high ground (opposite side of road from the sanitary sewer). Locate mains within the pavement area wherever possible, no less than 5 feet from curb or proposed curb.
 - b. In existing developments with curbs: Generally, location must be the same as in new subdivisions. The location of other existing and proposed utilities must be fully considered.
 - c. In existing developments with pavement and no curbs: The water main is generally placed outside the edge of pavement and inside the right-of-way line on the opposite side of the road from the sanitary sewer. The main must not be laid under a future curb or within 5 feet of the right-of-way line. The location of other existing and proposed utilities must be fully considered.
 - d. In public rights-of-way: Where location of water mains would require removal of, or damage to, trees within public rights-of-way, design engineers shall obtain approval of the Maryland Department of Natural Resources for alignment and identification of trees to be removed.
 - e. Curves: Along curves, the water main may be deflected at each joint within the limits set forth in the Standard Details.

- f. State Highway Rights-of-Way: Where proposed water mains are located in a State Highway right-of-way, the designer must make provisions for a permit and must follow specific requirements of the permit, including but not limited to, traffic control and pavement restoration standards.

5. Size

- a. Primary Feeders: The engineer shall consult with the Bureau of Engineering and Construction regarding sizing of the main and its interconnection with secondary feeders.
- b. Secondary Feeders: 12-inch and larger mains shall be used where necessary to reinforce the distributor grid and/or to aid in the concentration of required fire flow for the areas involved. The engineer shall consult with the Bureau of Engineering and Construction and the Fire Department's duly authorized representative regarding sizing of the main, its interconnection to the distribution grid, and the required fire flows involved.
- c. Distribution Mains: Distribution mains shall be 8 inches minimum size and shall be interconnected at all intersecting streets. Where the required flow exceeds the capacity of an 8-inch main or of the existing system, larger mains will be required as determined by the Bureau of Engineering and Construction. The engineer shall consult with the Fire Department's duly authorized representative where necessary to ascertain the required fire flow. The Fire Department's representative shall use the following publication as the source document for determining fire flow requirements:
 - Guide for Determination of Required Fire Flow*, 2003 edition, published by the Insurance Service Office and referenced in Urban Guide for Fire Prevention and Control Master Planning by the National Fire Prevention and Control Administration.
- d. Domestic Service Only: Where no fire hydrants or fire protection equipment exist or are planned, water mains for domestic service only may be 4 inches or 6 inches in size. This shall only apply to permanent dead-end road situations.

6. Relocation of Service Mains

- a. General: When designing the relocation of a water main, the designer shall consider such matters as environmental impact, maintenance of pedestrian and vehicular traffic, maintenance of existing and proposed utility services, constructability and system maintenance. In addition to the following, the design shall follow the requirements for water pipelines as stated elsewhere in this manual.
- b. Alignment
 - (1) When selecting an alignment, the existing pipeline must be maintained and must stay in service until the relocated pipeline is ready for final connection to the existing main. The final connection must be designed to allow a quick shutdown and transfer of services so that water service is not disrupted for an extended period.

- (2) The relocated alignment shall not disturb the existing blocking/restraints on the existing pipeline that is in service. Pipe restraints shall be designed for the relocated pipeline. If the shutdown time is limited, the design will require quick-type blocking for restraining the relocated pipeline.
 - (3) The design of the relocated pipeline must provide for continuous service from the existing pipeline until the relocated pipeline is placed into service. At that time, the existing pipeline shall be shut down and all tie-ins and transfer of service connections, between the existing pipeline and the relocated pipeline, shall be made.
 - (4) The designer must contact DPW for limitations on shutdowns of the existing pipeline. Conceptual approval from DPW must be obtained if the designer determines the existing pipeline must be replaced in the same location/alignment which may require an extended shutdown period or provisions for temporary service.
 - (5) Abandonment of the existing pipeline, structures, and/or appurtenance shall be shown on the plans indicating the limits of abandonment and description of the facility to be abandoned and the method of abandonment.
7. Survey: The date of survey work used to establish ground lines shall be noted on the drawings. Proposed, interim, future and possible future ground line shall be shown where applicable as well as the source from which the information was acquired. The following information as minimum requirements shall be shown on the drawings.
- property lines and property owner's name with lot, parcel number, liber/folio and street address
 - road names
 - areas requiring fill and compaction prior to pipe installation
 - utilities, existing and proposed
 - storm drains, existing and proposed
 - existing ground elevation line
 - proposed ground elevation line
 - obstructions
 - relocations of conflicting utilities
 - establishment of street grades

8. Materials

- a. All water mains shall conform to the Baltimore County Standard Specifications.
- b. At bridge crossings, 12-inch and smaller pipe shall have frost-proof insulation with a stainless steel cover.
- c. Prestressed concrete cylinder pipe and fittings shall be designed to withstand the required internal, test and surge pressures and all external pressures caused by overburden indicated on the profile and traffic loads or any other loads to which the pipe may be subjected.

- d. Steel pipe shall be designed to withstand the required external loads, internal pressure combinations, and handling. Proposed pipe wall thicknesses must be approved by the Chief of the Bureau of Engineering and Construction.
 - e. High-density polyethylene (HDPE) and polyvinyl chloride (PVC) pipe shall only be used on County-funded Capital Projects. Waivers to this criteria can only be approved by the Chief of the Bureau of Engineering and Construction.
9. Cover Over Pipe: Normal cover over water mains shall be 4 feet except at crossings over other utilities where a minimum cover of 3 feet or a maximum of 9 feet may be allowed.
- a. In new subdivisions: Cover shall be measured from established grade of road. Roads shall be graded to subgrade before water mains are laid.
 - b. In existing or ungraded roads: Established grades of roads shall be obtained from the Bureau of Engineering and Construction. If such grades are not available, the design engineer shall submit proposed grades for approval by the Bureau of Engineering and Construction. If established grade is at or below existing surface, cover shall be measured from established grade. If established grade is above existing surface, cover shall be measured from existing surface.
10. Clearances: Clearances shall be measured between outside of pipes.
- a. Crossing sanitary sewer: Water main shall have minimum clearance of 1-foot above sewer.
 - b. Parallel to sanitary sewer: Where sewer and water mains are less than 10 feet apart, water mains shall be 6 feet clear above sewer. Where 10 feet apart or more, water mains shall be above sewer.
 - c. Crossing gas and electric: Water mains shall have a minimum clearance of 12 inches where crossing gas and electric lines.
 - d. Crossing other utilities: Water mains shall have minimum clearance of 6 inches where crossing any other utility.

Exceptions: When specified clearance is not practicable between sewer and water in a new subdivision or in locations where sewer is built along roads having existing water mains, the sewers shall be designed according to Sewer Design Standards. If sewers already exist in a road, and the water main cannot be built to specified clearances, mechanical joints or other approved safety joints shall be used for the water mains.

11. Structure Considerations

- a. Buttresses and Anchorages: Bends, tees, and dead ends shall be anchored or buttressed, as shown in the Standard Details. Approved and properly applied restrained joint systems may be used in lieu of buttresses and anchors.

- b. Jacking Pipe: Water pipe under State roads shall be installed in a tunneled or jacked sleeve, as required by the State Highway Administration. Water pipe and sleeves under railroads shall be designed according to specifications of the railroad being crossed.
- c. Special Structures: Special structures, such as pumping stations, storage tanks, division valves, etc., shall be subject to special consideration and shall be incorporated in the design according to instructions of the Bureau of Engineering and Construction.

E. Corrosion Control Surveys and Design

1. General

- a. All pipelines, 16-inch diameter and larger, are subject to the corrosion control provisions of this manual. In addition, corrosion control design will be required for pipelines less than 16-inch diameter in areas where the County has had a history of pipeline corrosion failures or where soils and conditions are conducive to corrosion failures. The Bureau of Engineering and Construction will require a corrosion control survey in any area of suspected corrosion activity.
- b. The following are guidelines for corrosion control services that the designer is required to provide for the design of a water utility design project. The corrosion control services shall be provided for ductile iron, prestressed concrete, steel, and the metallic fittings/components of non-metallic pipelines. The corrosion control services are intended to minimize and/or eliminate external corrosion for the new piping. All corrosion control services shall be performed by a Corrosion Specialist who is certified by the National Association of Corrosion Engineers (NACE) and is under the direct supervision of a Maryland Registered Professional Engineer.

2. Preliminary Corrosion Analysis

- a. Review of the proposed utility alignment shall be performed to identify possible obstructions, roadways, streams, wetlands, railroads, utility crossings, sources of stray current, or other high-risk features relevant to external corrosion.
- b. Review of proposed utility alignment shall be performed for parallel or crossing of natural gas and petroleum pipelines.
- c. Review of proposed utility alignment shall be performed for parallel high voltage power lines.
- d. Review of proposed boring locations shall be performed to verify that the borings are adequate for the corrosion control analysis. Additional borings shall be obtained if required for the corrosion control evaluation. Samples utilized for corrosion evaluation shall be taken from the proposed pipe depth.
- e. The owners of existing utilities shall be contacted to determine if the piping systems are protected with impressed current cathodic protection systems. If

so, the location and output of all existing impressed current rectifiers and ground beds shall be documented.

3. Field Survey

- a. In-situ soil resistivity measurements shall be obtained at a maximum 500-foot spacing along the alignment. Shorter spacing between resistivity measurements may be used if required for the corrosion control analysis. Soil layer resistivity shall be measured to the bottom of the proposed pipe depth. Layer resistivity values shall be calculated for each test location utilizing Barnes Layer Analysis. Testing shall be conducted using the Wenner Four-Pin Method in accordance with ASTM G57.
- b. In-situ soil pH measurements shall be obtained at a maximum 500-foot spacing along the alignment. Soil pH shall be measured at a minimum depth of 1-foot. Testing shall be conducted in accordance with ASTM G51 soil samples and ASTM D1293 for water samples.
- c. In-situ soil, Redox (reduction-oxidation) Potential Testing shall be performed in the field in accordance with ASTM 1498.
- d. To evaluate stray current activity along the proposed alignment, in-situ stray DC current measurements shall be conducted in the vicinity of natural gas and petroleum pipelines as well as at other locations determined to be necessary. Testing shall include measurement of cell-to-cell earth gradients in select areas and structure-to-earth DC potential measurements on existing utilities where available.
- e. In-situ induced AC voltage measurements shall be conducted in the vicinity of high voltage overhead electric lines as well as at other locations determined to be necessary to evaluate induced AC voltage impacts along the proposed alignment. Testing shall include measurement of the strength of electric fields in select areas and structure-to-earth AC potential measurements on existing utilities where available.

4. Laboratory Evaluations

- a. Soil samples from the anticipated pipe depth shall be obtained by the boring contractor at a maximum spacing of 1,000 feet along the final alignment. Shorter spacing between soil borings may be used if required for the corrosion control analysis. The proposed boring locations shall be reviewed by the Corrosion Specialist before any samples are obtained. Each soil sample shall be between a pint and a quart in size and shall be sealed within an airtight container.
- b. Laboratory testing of each soil sample shall include the following:
 - chloride concentration (ppm): ASTM D4327
 - sulfate concentration (ppm): ASTM D4327
 - presence of sulfides: ASTM D4658

5. Evaluation of Data: The evaluation of the soil corrosivity and stray current risks will include consideration of the following minimum design requirements:
- a. Steel piping shall be cathodically protected. Cathodically protected steel piping shall be provided with an external, bonded, dielectric coating.
 - b. Ductile iron water mains, 16 inches and larger, shall be cathodically protected. Cathodically protected ductile iron piping shall be provided with an external, bonded, dielectric coating.
 - c. Ductile iron water distribution piping may or may not be cathodically protected depending on the corrosivity of the site soils, the presence of stray current, and the critical nature of the distribution piping. Polyethylene encasement shall not be utilized as a corrosion control measure.
 - d. Prestressed concrete piping shall be provided with a corrosion monitoring system.
 - e. Prestressed concrete piping shall be externally coated with a bonded, dielectric coating if installed in corrosive soils. Cathodic protection using zinc anodes may be required for extremely corrosive soils or in stray current areas.
 - f. Metallic fittings of non-metallic pipelines shall be provided with positive corrosion control (this may include cathodic protection in corrosive soils).
 - g. In all cases, proper bedding shall be provided for the piping.
 - h. In all cases, new piping shall be electrically isolated from existing piping.
 - i. In all cases, piping made of different metals shall be electrically isolated from each other.
 - j. Stray DC current mitigation systems shall be provided in areas where existing piping is protected with impressed current cathodic protection systems.
 - k. Induced AC voltage mitigation shall be provided in areas where the pipeline crosses or runs immediately parallel to high voltage, overhead, electric lines.
 - l. Galvanic anodes shall be used when cathodic protection is necessary for corrosion control. Impressed current cathodic protection shall not be utilized.
 - m. Casings shall be electrically isolated from the pipeline.
 - n. Generally, casing pipes shall not be filled with grout. In special instances where casing must be grouted, casings shall only be filled with a Portland cement grout with a minimum pH of 10. Fly ash flowable fills shall not be used to fill casings. Casings that are filled with cement grout shall be provided with a corrosion rate monitoring system that is installed within the casing, between the pipeline and the casing.

6. Corrosion Control Report: The final corrosion control report shall be submitted in hard copy and in digital format. The report shall, as a minimum, include the following items that are pertinent to the project:
 - Title Page
 - Table of Contents
 - to include titles and subtitles
 - Overview
 - Executive Summary of results with conclusions
 - field results, resistivities, pH, redox, stray DC current, induced AC voltage
 - laboratory results, chlorides, sulfates, sulfides
 - Recommendations
 - methods recommended to prevent or mitigate corrosion
 - Scope of Work
 - ASTM Standards
 - standard methods used for corrosion control evaluation
 - Procedures
 - procedures used for field and laboratory evaluations
 - Results
 - field data – in-situ
 - laboratory data
 - Appendices
 - GIS locations
 - relevant photographs
 - estimated construction costs

7. Corrosion Control Submittals: The corrosion control design procedure consists of the Corrosion Control Report discussed previously and a corrosion control design. All corrosion control submittals shall be signed and sealed by a Professional Engineer registered in the State of Maryland. The following shall be submitted to DPW for corrosion control designs:
 - corrosion control report
 - corrosion control layout drawing
 - corrosion control details
 - corrosion control specifications
 - corrosion control cost estimate

F. Appurtenances for Service Mains

1. Valves

- a. Sizes: Mains, 4 inches to 42 inches, shall have valves of the same size as the main. All valves shall be specified in strict accordance with applicable Baltimore City standards. Any deviation from these standards must be approved by the Chief of the Bureau of Engineering and Construction.

- b. Location: Valves shall be installed on the loop or network as such places as to isolate the branch sections as may be necessary with a maximum spacing of 2,000 feet. They shall be installed on all fire hydrant leads as close to the water main as is feasible. When a small main branches from a larger main, the difference in diameters between the two mains being 4 inches or more, a valve

shall be placed on the smaller main as close as practicable to the larger main. Valves at intersections shall be placed on projection of road right-of-way lines.

- c. Water zone division valves shall be provided when directed by Baltimore County DPW. The following information shall be provided on the drawing:
 - label the valve as a division valve and indicate size
 - show pressure zone lines
 - indicate that the valve shall be normally closed
- d. The pipeline vertical alignment at the valve shall be designed as nearly parallel with the road grade as possible so that the valve may be installed upright and perpendicular to the road grade.
- e. When valves are installed on prestressed concrete cylinder pipe transmission mains, a corporation stop of at least 1½-inches diameter must be installed on each side of the valve.
- f. Man access to both sides of a butterfly valve must be provided in the same or adjacent vault.

2. Tapping Sleeves and Valves

- a. Where used: Tapping sleeves and valves on ductile iron or cast iron mains to serve as line valves shall be used for all connections 6 inches and larger to any existing main 12 inches or larger where more than 10 domestic services would be shut off during installation of a standard tee. The main being tapped may be the same size as the proposed main or tapping valve. The location of the tapping sleeve on ductile iron or cast iron pipe shall be designed so that the centerline of the connecting pipeline is a minimum of 5 feet from the face of any existing bell joint.
- b. Tapping sleeves and valves shall be restrained or blocked in the same manner as a tee.
- c. Specifications: Tapping sleeves shall conform to the Baltimore County Standard Specifications (see Section 905.04.02 of the Standard Specifications).
- d. Prestressed Concrete Cylinder Pipe: Tapping sleeves and valves on prestressed concrete cylinder pipe shall be determined by the Bureau of Engineering and Construction. Installation, testing, and tapping shall be done by the contractor, supervised by the pipe manufacturer's representative.
- e. Steel Pipe: Tapping steel pipe shall be in conformance with the methods described in AWWA M11 and Baltimore County Standard Specifications.

3. Fittings

- a. Fittings shall conform to Baltimore County Standard Specifications.

- b. The water main alignment shall minimize the use of bends. The designer shall try to align the pipeline by deflecting the pipe joints. Deflecting the joints on bends is not permitted. (PVC pipe shall not be deflected at joints.)
- c. A cross is required for two perpendicular extensions, in close proximity, from the main pipeline. Tees shall not be used in lieu of crosses unless the connections are spaced far enough apart. If the design requires connections on both sides of the pipeline and a cross cannot be used, the spacing between the tees shall be a minimum of 10 feet apart.

4. Fire Hydrants

- a. Size: Hydrants shall be 6 inches in accordance with Baltimore County Standard Specifications. The engineer shall submit to the Bureau of Engineering and Construction a scale map, 1-inch equals 500-feet (1" = 500'), showing area streets, water mains, and proposed location of fire hydrants for transmittal to the Fire Department (see Standard Details).
- b. Location: Hydrants shall be located in a pattern approved by the Fire Chief or his duly authorized representative and shall be located so as to provide vehicular clearance from the street (see Standard Details).
- c. Spacing: Hydrant spacing in residential areas composed of detached or semi-detached one- and two-family dwellings shall be at each street intersection except where intersections are less than 500 feet apart and at 750-foot maximum intervals between intersections except as approved by the Fire Chief or his duly authorized representative. Hydrant spacing in other residential areas and all other uses of property listed in the Life Safety Code as adopted as part of the Baltimore County Fire Prevention Code shall be at each street intersection and at 300-foot maximum intervals between street intersections.

Hydrant spacing and location for high-rise buildings (as defined by the Baltimore County Building Code) and high-hazard occupancies (as defined by the Baltimore County Building Code) and/or the Baltimore County Fire Prevention Code shall be as determined by the Fire Chief or his duly authorized representative; but in no case, shall spacing for such occupancies be wider than at each road intersection and at 300-foot maximum intervals between street intersections. Hydrant spacing along roads and highways where no property is built on or scheduled or proposed for development shall be at each street intersection and at 900-foot maximum intervals between street intersections.

- d. Hydrants for Emergencies Involving Transportation Vehicles: Where streets pass over, under, or "dead end" up against the right-of-way of interstate or limited access highways or railroad tracks, hydrants shall be provided. Such hydrants are to be located for Fire Department use for emergencies involving transportation vehicles.
- e. End of guard rails shall terminate at least 3 feet from the centerline of the fire hydrant.

5. Blow-Off: A blow-off (see Standard Details) shall be installed at the end of each dead-end main unless a fire hydrant is required and is installed within 5 feet of the cap; in which case, the blow-off is unnecessary.
6. Air Release Valves: Air release valves shall be installed at prominent peaks where fire hydrants are not installed on long supply mains. Air release valves generally will not be required in a grid distribution system because air will normally be released through service lines. For any borderline case, check with the Bureau of Engineering & Construction for instructions. (See Standard Details for further information on air release valve and vault.)
7. Valve Vaults
 - a. Mains, 16 inches and smaller: For valves and for tapping sleeves and valves, use precast concrete vaults as shown in the Standard Details.
 - b. Mains, larger than 16 inches: For valves, use reinforced concrete vaults as shown in Standard Details. For tapping tees and valves, use vaults as shown on Contract Drawings.
 - c. Fire hydrant valves: Small precast concrete vaults shall be installed for fire hydrant valves.
8. Pipe Access: Where more than 2,000 feet of pipe, 30 inches or larger, is proposed, design engineers shall consult the Bureau of Engineering & Construction to determine whether pipe access is required. Where required, pipe access shall be in vaults detailed on the Contract Drawings.
9. Blocking/Bracing Side Line or Terminal Valves: When tying into existing water mains in the vicinity of closed valves, the designer must design a method to block or brace these valves to protect them from blowing off due to unbalanced forces which may result in property damage and/or personal injury.

G. Temporary Water Service

1. General: Temporary water lines are sometimes needed to provide water service for cleaning and cement lining projects, directional drilling or pipe bursting projects, or water main replacement projects. All work must be done according to AWWA Standard C602-8, and all temporary piping and hose bypass must be NSF approved.
2. Criteria
 - a. In general, bypass lines must be shown on drawings including temporary lines to all dwellings, shops, and places of business that normally are served by the underground water pipelines. These drawings must be approved by both Baltimore City DPW and Baltimore County DPW.
 - b. Water for temporary bypass lines shall be taken from the nearest available fire hydrant or from below ground installations, as shown on the plans. All of these feed connections shall be equipped with a backflow preventer.

- c. The pipe and other materials shall be clean, watertight, and fully adequate to withstand existing pressure. The temporary line and corporations shall be installed in such a manner as to produce a minimum hazard and inconvenience to the public. Temporary bypass lines that cross public roadways shall be placed below the existing road surface. Temporary bypass lines that cross a driveway shall be ramped over with wooden or metal planking or with bituminous concrete placed upon 15-pound felt. These temporary vehicular crossings shall be maintained to the satisfaction of the engineer and the property owner. When temporary bypass lines cross sidewalks, suitable means shall be provided to allow safe pedestrian traffic at all times.
- d. Temporary connections shall be made in the meter vaults unless approved by the engineer. The meter vaults shall be covered with slotted planks or another approved method. The service connection must be sized to be at least equal to the existing service connection, but never smaller. All removed meters must be tagged for proper identification and stored in a safe place during the pipeline rehabilitation. The pipe and fittings shall provide adequate water tightness, and care must be exercised throughout the installation of any temporary pipe and service fittings to avoid any possible pollution of any mains or house service or contamination of the temporary pipe itself.
- e. No bypass or service connection shall be installed in freezing weather. Freezing weather shall be expected between November 15 and April 1.
- f. All temporary pipes shall be chlorinated prior to putting them into service. The County Engineer will collect water samples and will provide for their analysis for bacteriological quality. All tests shall comply with the AWWA standard for disinfecting water mains, Standard No. C601-68.
- g. Any fire hydrants removed from service during construction must be provided with a temporary fire connection using the thread pattern that is identical to that shown in the Baltimore County Standard Details. Normally, a 4-inch or 6-inch temporary bypass is used to feed these hydrants; but it is up to the design engineer to adequately design for the required fire capacity. In no cases shall fire protection be below 800 GPM in a residential area.
- h. Upon restoration to normal water service, the contractor shall remove any corresponding section of temporary bypass pipes and shall leave the streets, sidewalks, and adjacent property in a neat and orderly condition, and in every respect, equal to their original condition.

III. CONTRACT DRAWINGS AND DOCUMENTS TO BE SUBMITTED TO THE BUREAU OF ENGINEERING & CONSTRUCTION

A. General Instructions

For additional information, refer to the General Instructions Section in the front of this Design Manual.

B. Preliminary Reports

1. Extensions from Existing Water Mains: A preliminary plan shall be submitted showing the tentative location and size for all such extensions.
2. Large Water Supply Mains: The engineer shall consult with the Bureau of Engineering & Construction before submitting a tentative plan showing location and size for large water mains.

C. Contract Drawings

1. Sample Drawing: See Sample Drawings on Pages W-22 and W-23 of this Manual.
2. Preparation: Water main Contract Drawings shall be prepared on drawings separate from other utilities and on sheets with appropriate title blocks. Separate drawings shall be used for each street. The drawing numbers of plans of other utilities being prepared at the same time shall be listed on the water main drawings. Drawing numbers of adjacent existing water main plans also shall be shown.
3. Plan
 - a. Scale: 1-inch equals 50 feet (1" = 50') or as approved by the Bureau of Engineering and Construction.
 - b. Method of Indicating Location: The designer shall provide the necessary stakeout controls on the plans for setting the alignment, both horizontally and vertically, to construct the pipeline. Generally, water mains and structures shall be located in plan by dimensions from property markers or other well defined physical features. However, in areas where physical features are not available, coordinates of structures and bearings of water mains based on the NAD 83/91 and NAVD 88 coordinate systems shall be used.
 - c. Fittings: A list of all valves and fittings required shall be shown on each drawing.
4. Profile: Profiles shall be shown for all water mains over 12-inches in diameter in any location and for other mains if directed by the Bureau of Engineering & Construction. Profile shall be on same sheet as the plan.
 - a. Scale: Scale of all profiles shall be 1-inch equals 50-feet (1"= 50') horizontal; 1-inch equals 5 feet (1"-5') vertical or as approved by the Bureau of Engineering and Construction. Water main profiles on straight streets shall be shown to correct scale. On curved streets, horizontal distances between structures shall be plotted using length of street centerline between radial projections to structures. The true length between structures shall be shown by figures.
 - b. Road Grades: Approved, established grades shall be obtained from the Bureau of Engineering & Construction. When such grades are not available, they shall be established by the design engineer and submitted to the Bureau of Engineering & Construction for approval. When grades are more than four years old, a new profile shall be taken in the field to verify the elevations shown on the plans.

The established grade (noted as top of curb or centerline) shall be shown. Where water main is located in present or proposed pavement or shoulders, the existing centerline grade of road shall be shown. Where water main is outside pavement or shoulders for a length greater than 50 feet, existing ground over water main shall be shown and labeled.

- c. Water Main on Fill: Where water main is to be constructed on fill, a profile of the undisturbed earth (at water main location) shall be shown.
5. Other Utilities: Other existing and proposed utilities shall be shown accurately and clearly in plan and profile according to the standard symbols in the General Instructions.
6. Location and Design Information: A location plan showing well-known streets, at a scale of 1-inch equals 500-feet (1"= 500'), shall appear on the first drawing of each set of Contract Drawings. A schematic layout of the proposed extensions to the water system and adjacent existing lines along with existing valves shall be shown. Valves that are required to be closed when the new line is connected, must be so designated.

Manipulation of valves is prohibited by any party other than Baltimore City or their duly authorized representative. This practice shall be stated in all plans and specifications.

7. Special Details: Structures or details not included in the Standard Details shall be detailed clearly on the Contract Drawings, preferably where the detail is located in plan. (See General Instructions for scale.)

D. Contract Specifications

See Section 1.1.4 of the General Specifications Section.

E. Estimate of Project Costs

The Engineer shall submit an estimate of project costs for each contract including contingent items and in the format with commodity codes consistent with County design standards. (see General Instructions).

F. Design Calculations

1. When Required: Design Engineers shall submit design data and calculations only when specifically requested by the Bureau of Engineering & Construction. They shall be submitted on 8½" x 11" reproducible sheets, bound in a folder satisfactory for filing, and labeled for identification by title and job order number.
2. Water Flows

The design data and computations shall include:

- average and peak demands
- fire demand
- future requirements

- probable pressures
 - losses
 - calculations
 - computations for determining pipe sizes
 - other data requested by the Bureau of Engineering & Construction
3. Structural Design: For all special structures, design computations shall be submitted, signed, and sealed by a Professional Engineer licensed in the State of Maryland.
 4. Coordinates: Computations of coordinates shall be submitted when coordinates are shown on the Contract Drawings.
 5. Results of Borings: Where information pertinent to design (such as borings) has been collected, this information shall be submitted to the Bureau of Engineering and Construction and shown on drawings as directed.

IV. REFERENCE SOURCES

Latest editions of:

American Water Works Associations Specifications
Baltimore County Standard Details for Construction
Baltimore City Bureau of Water and Wastewater Standards
ASTM Specifications
Baltimore County Standard Specifications for Construction and Material

V. DESIGN FIGURES

- A. Check List – Water
- B. Sample Drawings

CHECK LIST – WATER

LOCATION _____
(Subdivision Name & Section)

DATE _____

CHECKED BY _____

- ___ 1. Recorded plat reference
- ___ 2. Street names and alignment
- ___ 3. Lot dimensions and lot numbers
- ___ 4. Owners & title references in all assessable areas up to 60' beyond end of main
- ___ 5. Road surface: symbol and label
- ___ 6. State Road labeled on plan, where such roads are shown
- ___ 7. Dimensions between street lines and curb lines
- ___ 8. Existing roads checked with Position Sheet for location of existing macadam, poles, etc.
- ___ 9. Arc Radii of curvatures along property lines if proposed main is crimped
- ___ 10. Established road grades checked against Highway Construction Plans for accuracy.
- ___ 11. Date of approval of Highway Construction Plans and file numbers
- ___ 12. If no road grading, cuts at each station in road center line to be indicated
- ___ 13. "Full Trench Compaction-See Specifications" indicated where required
- ___ 14. Existing utilities shown with proper symbols
- ___ 15. Show drawing numbers of all existing water, sewer, and storm drain plans
- ___ 16. Existing water, sewer, and drains checked against Record Drawings
- ___ 17. Distance of existing dead ends from street center line, property line, or macadam edge
- ___ 18. Show all existing utilities, including BGE, Verizon, cable, etc.,
- ___ 19. Engineer to contact BGE for necessary relocations of existing gas mains
- ___ 20. Proposed water accentuated in **bold**, heavy marking
- ___ 21. Drawing numbers of all proposed adjoining water plans indicated
- ___ 22. Other proposed utilities checked against construction plans of same
- ___ 23. Proposed water services to be minimum distance from proposed sanitary connections
- ___ 24. If no sewer planned, check lots for required minimum size
- ___ 25. If no drains planned, check preliminary drains study for recommendations
- ___ 26. Right-of-Way Reference
- ___ 27. Vicinity Map-North Arrow-Scale-Coordinate Ticks (3) - Datum
- ___ 28. Show on Vicinity Map (1"=500') all valves that must be closed to make necessary tie-ins
- ___ 29. Proper location and distribution of valves and hydrants according to design standards
- ___ 30. Mark limits of proposed paving under this contract
- ___ 31. Extension of main (at intersecting streets) to rear line of lots
- ___ 32. Distance of proposed main from macadam edge, road center line, or property line
- ___ 33. Distance of proposed water from proposed sewer: 10' horizontal or 6' vertical
- ___ 34. Size of proposed main indicated
- ___ 35. Proposed and/or existing curb and gutter-show symbol and label
- ___ 36. Traffic Type Meter Frame and Cover for Twin Meter Setting located in existing or future driveway
- ___ 37. Special Notes – Such as meter note, jacking note, etc.
- ___ 38. Bench Mark – BM No. (if any) description and elevation
- ___ 39. Contractor's work clearly stated as to limits in "Abandon existing water and transfer..." cases
- ___ 40. Meet all conditions for approval by Baltimore County DPW and Baltimore City DPW
- ___ 41. Restrictions, if any, as to number of connections in this particular Service Zone
- ___ 42. House service connections to be located at high end of lot frontage
- ___ 43. Clearly identify where restrained joints are necessary
- ___ 44. Valves to be shown on all house service connection 4" or larger
- ___ 45. If Public Works Agreement: no connections to lots not owned by developer
- ___ 46. Fittings on plan – symbol, size, and label
- ___ 47. Bill of Materials – quantity and size
- ___ 48. Crossing detail – crossovers numbered and computed
- ___ 49. Future crossing detail –profile and elevation values
- ___ 50. Is proposed system within Metro District? See Metropolitan District Extension Book
- ___ 51. Public Works Agreement Number in lower left-hand corner of drawing
- ___ 52. Up-to-date City and County signature blocks
- ___ 53. Key Sheet and Position Sheet identifications on all plans
- ___ 54. Title of Plan: Size, location of main – locale, subdivision name and election district
- ___ 55. Engineer's seal and signature
- ___ 56. Right-of-Way to be indicated on plan and clearly labeled as to *existing* or *future*
- ___ 57. Check with DPW Water Design Section for necessary corrosion study and/or design requirements
- ___ 58. Obtain road corings at 500' minimum intervals
- ___ 59. Road coring data included in contract documents

Table I Characteristics of displacement-type meters AWWA C700-95

Meter Size		Safe Maximum Operating Capacity		Maximum Pressure Loss at Safe Maximum Operating Capacity		Recommended Maximum Rate for Continuous Operations		Minimum Test Flow†		Normal Test Flow Limits†		Maximum Number of Disc Rotations or Piston Oscillations Per		
in.	(mm)	gpm	(m ³ /h)	psi	(kPa)	gpm	(m ³ /h)	gpm	(m ³ /h)	gpm	(m ³ /h)	10 gal	ft ³	(0.01m ³)
½	(13)	15	(3.4)	15	(103)	7.5	(1.7)	¼	(0.06)	1-15	(0.2-3.4)	875	657	(231)
½ x ¾	(13 x 19)	15	(3.4)	15	(103)	7.5	(1.7)	¼	(0.06)	1-15	(0.2-3.4)	875	657	(231)
⅝	(16)	20	(4.5)	15	(103)	10	(2.3)	¼	(0.06)	1-20	(0.2-4.5)	580	435	(154)
⅝ x ¾	(16 x 19)	20	(4.5)	15	(103)	10	(2.3)	¼	(0.06)	1-20	(0.2-4.5)	580	435	(154)
¾	(19)	30	(6.8)	15	(103)	15	(3.4)	½	(0.11)	2-30	(0.5-6.8)	333	250	(88)
1	(25)	50	(11.4)	15	(103)	25	(5.7)	¾	(0.17)	3-50	(0.7-11.4)	153	115	(40)
1½	(38)	100	(22.7)	15	(103)	50	(11.3)	1½	(0.34)	5-100	(1.1-22.7)	67	50	(18)
2	(51)	160	(36.3)	15	(103)	80	(18.2)	2	(0.45)	8-160	(1.8-36.3)	40	30	(11)

†See Sec. A.5.1.
 ‡See Sec. 4.2.8.

Table I Characteristics of compound-type meters AWWA C702-92

Meter Size		Safe Maximum Operating Capacity		Maximum Flow Rate for Continuous Duty		Maximum Allowable Loss of Head at Safe Maximum Operating Capacity		Normal Test Flow-Rate Limits		Minimum Test Flow Rates	
in.	(mm)	gpm	(m ³ /h)	gpm	(m ³ /h)	psi	(kPa)	gpm	(m ³ /h)	gpm	(m ³ /h)
2	(50)	160	(36)	80	(18)	20	(140)	2-160	(.45-36)	¼	(0.06)
3	(75)	320	(72)	160	(36)	20	(140)	4-320	(.90-72)	½	(0.11)
4	(100)	500	(110)	250	(55)	20	(140)	6-500	(1.4-110)	¾	(0.17)
6	(150)	1000	(220)	500	(110)	20	(140)	10-1000	(2.3-220)	1 ½	(0.34)
8	(200)	1600	(360)	800	(180)	20	(140)	16-1600	(3.6-360)	2	(0.45)
10	(250)	2300	(520)	1150	(260)	20	(140)	32-2300	(7.3-520)	4	(0.90)

Table I Characteristics of proportional fire service-type meters with check Valves (flow rates in gpm) AWWA C703-96

Meter Size	Normal Flow Range and Test Range	Minimum Flow Range and Test Range	Safe Maximum Operating Capacity SMOC	Contin- uous Duty Maximum Flow	Short- term Deluge Maximum Flow†	Flow Spread at Crossover Flow	Accuracy			
							Normal Flow Range	Minimum Flow Range	Change- over Range	Head Loss at SMOC
Type I Devices—Proportional Fire-Service Meters With Check Valve										
3	5-400	*	400	300	600	40	±3%	95%	85%	4 psi
4	5-700	*	700	500	1,000	60	±3%	95%	85%	4 psi
6	8-1,600	*	1,600	1,150	2,300	130	±3%	95%	85%	4 psi
8	10-2,800	*	2,800	2,000	4,000	210	±3%	95%	85%	4 psi
10	15-4,400	*	4,400	3,100	6,200	300	±3%	95%	85%	4 psi

*Minimum flow range to be as shown in the applicable AWWA standard for the bypass-meter employed.
 †The headloss at the short-term deluge maximum flow may be significantly higher than the headloss given for the safe maximum operating capacity in this table. Consult with the manufacturer for specific values.



DEPARTMENT OF PUBLIC WORKS
 WATER DESIGN STANDARDS

CHARACTERISTICS OF METERS

ISSUED: SEPTEMBER 2006
 REVISED: _____
 REVISED: _____

PLATE
W-D