CHAPTER IX

WATER MAINS AND RELATED FACILITIES

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ANNE ARUNDEL COUNTY DESIGN MANUAL

CHAPTER IX

WATER MAINS AND RELATED FACILITIES

I. GENERAL

A. Introduction

This Chapter of the Manual outlines the policies, minimum criteria and design procedures for the preparation of feasibility reports and construction plans and specifications for County maintained and on-site potable water system improvements.

B. Ownership and Responsibility

1. County-Maintained Facilities

The parts of the water supply system, which are considered the property, and responsibility of Anne Arundel County are the water mains, appurtenances and that portion of the building water services, which lie in the public rights-of-way. The water supply and distribution system for Anne Arundel County is designed and maintained by the Department of Public Works (DPW).

2. On-Site Facilities

The parts of the building water services, which lie within private property, are the responsibility of the owner and are constructed and maintained by the owner.

C. Definitions

Service Connections: Water mains connecting the distribution mains to individual homes, buildings or facilities for both consumptive use and fire protection up to a maximum of 75 feet.

Long Connections: Special service connections which are 75 ft. or more in length within the public right-of-way or easement.

Distribution Mains: Water mains connecting the transmission mains to the service connections. The distribution mains provide area wide fire protection. Generally, the distribution mains will be in a grid or branched configuration.

Transmission Mains: Large diameter mains connecting the treatment plant(s) with the storage facilities and the distribution mains.

Average Day Demand: The volume of water used in the year divided by 365.

Average Day Rate (Average Day): The average day demand volume divided by a one-day time period, expressed in gallons per minute (gpm) or million gallons per day (mgd).

Maximum Day Demand: The largest volume of water used in one day during the year.

Maximum Day Rate (Max. Day): The water used during the maximum day divided by a one-day time period expressed in gpm or mgd.

Peak Hour Demand: The largest volume of water used in one hour. The peak hour demand usually occurs during the day of maximum daily demand.

Peak Hour Rate (Peak Hour): The peak hour demand volume divided by 60 minutes, expressed in gpm; or multiplied by 24 hours, expressed as mgd.

Fire Flow: The rate of water flow, at a residual pressure of 20 psi and for a specified duration that is necessary to control a major fire in a specific structure.

II. DESIGN CRITERIA

A. General

The sizing of major components of the County water supply system such as transmission mains, major distribution mains (generally 12 inches diameter and larger), production wells, storage facilities, and booster pumping facilities are the responsibility of the DPW and beyond the scope of this Manual. If distribution mains are installed parallel to transmission mains, design documents shall be submitted to DPW.

The County water system master plan shows the existing and planned supply system components. The design professional should be familiar with and design in accordance with this document.

Construction of production wells is beyond the scope of this Manual, but is outlined in the County's "Standard Specifications For Production Wells" which may be obtained from the DPW. Size, capacity and aquifer to be accessed shall be determined by the using agency.

The design professional that is responsible for the extensions of mains shall follow the guidelines in this Manual for the derivation of design flows. The calculation of water demands will usually require extension of the average daily rate for the facility, application of a peaking factor to derive the maximum daily rate, then addition of the fire flow requirement. System losses have been accounted for in the peaking factors.

Generally, the design professional will be selecting distribution mains of 12-inch diameter and smaller, and often will be required to provide the minimum size mains listed later in this Chapter. No main shall be less than 6-inch diameter without DPW approval.

The water design criteria presented herein shall also apply to subdivisions and other developments. The developer should be familiar with the Anne Arundel County Code requirements for development in addition to these design criteria.

B. Pre-Design Meeting

Prior to commencing any design work on a Capital Project, a pre-design meeting will be held as provided in Chapter I, General Instructions. For Developer Projects, a pre-design meeting may be held at the request of the developer. These meetings will discuss, at a minimum, the following design parameters pertinent to this Chapter as well as items, which pertain to any other chapters, which will govern the design of the project:

- Sizing of major water supply components.
- Applicable County Codes for Plumbing, Development, etc.
- Route selection and location of the pipe in the public right-of-way.
- Interaction with, and crossings of, other known utilities, particularly if those utilities employ cathodic protection systems.
- Methods of crossing roads, railroads, and streams.
- Pipe material
- Pipe access
- DPW requirements for water pumping, treatment and storage facilities, if applicable.
- Identification by DPW of any storage facilities in the network to be affected by the project whose refill rate is more critical than the design flow rates.
- Developers shall deliver to Inspections & Permit a schematic design of the proposed development on a copy of the County's topographic survey.
- DPW will provide information on how existing central master system screen displays are to be updated for additional Programmable Logic Controllers (PLC's).
- DPW will advise what reports, if any, need to be updated by additional PLC's.
- DPW will provide manufacturers and model numbers of existing PLC and SCADA equipment and software.
- DPW will furnish information from preliminary RF path studies for PLC's.
- DPW will direct which communication protocol is to be used for additional PLC's.
- Design professional shall submit for County approval any PLC equipment and/or software.

C. Demands

1. Residential Demands

Studies have shown that the quantity of average daily water use and peaking factor for residential areas are related to lot size. This is due to increases in persons per dwelling unit, per capita consumption, and greater lawn sprinkling as the lot sizes increase. Appendix C and Master Plan for Water Supply and Sewerage System shall be used to derive residential demands and peaking rates.

2. Commercial and Industrial Demands

   The estimation of average daily water consumption and peaking factors for commercial and industrial demands are greatly dependent on the type of facility. With the exception of industries using process water, the fire demand generally is the major component of the design demand used to size distribution main extensions and service connections to buildings having sprinkler systems. The design professional shall refer to the County Plumbing Code for derivation of building design flows if the number of fixture units is known or may be estimated. When no interior plumbing information is available, use Appendix D. For undeveloped land, use Appendix E to derive commercial and industrial water demands according to zoning.

3. Fire Flow Rates

   The required fire flow rates shall be calculated using the Insurance Service Offices (ISO) method as outlined in their publication Fire Suppression Rating Schedule. The term used for fire flow in that publication is "Needed Fire Flow (NFF)." The ISO method is also presented in the National Fire Protection Association (NFPA) Fire Protection Handbook, latest edition, and the American Water Works Association (AWWA) Manual M31 Distribution System Requirements for Fire Protection, latest edition. Where specific building information is not available for use in the ISO method, use Appendix F.

   Recommended fire flow durations shall be as follows in Table IX-1 as presented in AWWA Manual M31:

TABLE IX-1 FIRE FLOW DURATIONS

Required Fire Flow (GPM)	Duration (HR)
2500 or less	2
3000 to 3500	3
4000 to 12,000	4

   Duration is generally limited to 4 hours for economic reasons. However, special cases may arise which require longer durations for fire flows greater than 4,000 gpm as listed in Table 5-3E of the NFPA Fire Protection Handbook. Such special cases shall be brought to the attention of the Deputy Director, Bureau of Utility Operations, DPW, for their review and recommendations.

   NFPA Standard 1142 "Water Supplies for Rural and Suburban Areas" may also be used by the design professional as a source of design information for less densely settled areas which according to planning and zoning records may remain less densely settled for the foreseeable future.

D. Hydraulic Computations

1. General

The hydraulic design of water mains shall be in accordance with Pipeline Design for Water and Wastewater, ASCE, 1992, or latest edition thereof, and the additional guidelines and criteria in this Chapter. Refer to Section III, Contract Drawings and Documents, to determine if hydraulic calculations are required. If hydraulic computations are required, the design professional shall first submit the design flows for the site to the DPW. The DPW will then supply the design professional with the residual pressure(s) or elevation(s) at a point(s) on the County's distribution system nearest the proposed site. The design professional will use this elevation to begin the hydraulic design of any distribution main extensions and onsite service connections.

2. Design Flows and Residual Pressures

Service connections, distribution mains and transmission mains shall be sized in accordance with the County's Water Supply and Sewerage Systems Master Plan as referenced by the County Code. The following three pressure requirements must be met within the distribution system:

- Maximum Day Demand - 40 psi minimum at the curb
- Peak Hourly Demand - 30 psi minimum at the curb
- Maximum + Fire Flow Demand - 20 psi minimum residual maintained at the curb

As a guideline, a list of maximum first floor elevations for each water pressure zone, which should ensure adequate water pressure within a normal single-family (2-story) dwelling, is shown in Appendix J. It shall be the design engineer's responsibility to verify adequate pressures.

In some locations, the main size will be determined by the flow rate required to refill a storage facility, which may be more critical than the above requirements. The DPW will identify this design condition if applicable.

First floor elevations of served facilities shall not exceed the tank overflow elevation minus 120 feet (i.e., maximum first floor elevation in Glen Burnie High Zone = 295' - 120' = 175' above sea level). If this situation is unavoidable, the subdivision shall either be connected to a higher pressure zone, have a new booster pump station constructed, or in an extreme case, have an individual facility booster pump system installed which will be maintained by the building owner.

3. Flow Velocities

   Although the flow velocities and direction may vary considerably in distribution mains, there are upper and lower velocity boundaries that indicate to the design professional that design weaknesses may exist. The following are useful guidelines:

   a. Velocities greater than 7-fps at design flow - This condition may produce large friction losses and high potential for valve and joint damage due to water hammer.

   b. Velocities less than 0.5-fps at design flow - This condition indicates that the main may be oversized. Future maintenance problems may result from siltation at valves and there may be water quality degradation.

4. Hazen-Williams "C" and Minor Losses

   The total head loss at the point of discharge for design flows shall be the sum of both friction and minor losses. The elevation difference between the source and discharge point shall be algebraically added to the total head losses.

   Head losses for new pipes shall be computed using the nomograph in Appendix H and the following coefficients:

TABLE IX-2 HAZEN-WILLIAMS "C" FACTORS

Type	Pipe Diameter	Hazen-Williams "C"
Service Connections		
Copper	3/4"-3"	130
PVC	3/4" or larger	130
DIP	3" or larger	100
Distribution Mains		
PVC	6"-16"	130
DIP	4"-8"	100
DIP	10"-12"	110
Transmission Mains		
All Material	16"-20"	120
All Material	24" - and larger	130

Minor losses due to fittings and valves shall be included as equivalent lengths of pipe, equivalent pipe diameters as presented in Appendix I, or as fractional losses

in velocity head as described in "Pressure Pipeline Design for Water and Wastewater", ASCE, 1992, or other hydraulics texts.

E. Distribution System Layout and Sizing

1. General

Extensions of distribution mains will normally be on a grid basis with interconnecting nodes at street intersections.

2. Residential Subdivision (New and Existing)

The water distribution system for residential areas where fire protection is to be provided shall meet the following criteria:

- Maximum length of dead end for water main sizes less than 10-inch in diameter shall be 600 feet and terminate with a fire hydrant.
- Fire hydrants shall be supplied by not less than a 6-inch diameter water main installed on a looped system or by not less than an 8-inch diameter water main if the system is not looped or the fire hydrant is installed on a dead-end main exceeding 300 feet in length.

3. Commercial and Industrial Areas

For Commercial and Industrial properties, water main shall remain private on the back side of the meter vault.

The water distribution mains for Commercial and Industrial areas where fire protection is to be provided shall meet the following criteria:

- Maximum length of dead end for water main sizes less than 10-inch in diameter shall be 600 feet and terminate with a fire hydrant.
- Detailed fire flow calculations shall be provided and used to determine necessary pipe sizing.

F. Service Connections

1. Location

Water house connections shall be built to the meter boxes 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 are to be served by the water line shall be provided with a metered connection to the property line and shown on the contract drawings provided that the lots are within County service area. The Arundel County Code defines an "unimproved" lot as a lot on which no part of principal use is located. Service connections for these lots shall be designed where and as directed by DPW.

Single service connections shall be indicated schematically on the drawing(s) 15 feet from the side property line on the high end of the lot. Separate meters for irrigation per Code 13-5-805 (g) shall only be permitted for nonresidential properties. The exact location will be fixed in the field after a conference with the property owner. Twin services shall be placed on the property line separating two houses in single family, attached or detached house subdivisions. Service connections to townhouses shall be dimensioned from the property lines on the drawings.

In the event extenuating circumstances lead to a request for water service connections that are proposed to traverse County rights-of-way, a request for a long connection, or a request for a long connection in lieu of an extension, a formal written request with details must be submitted per the modification process outlined in Article 17-2-108 of the County Code for development projects. For capital projects, it must be submitted to DPW for approval.

Service connections longer than 75 feet will only be considered for approval when no additional connections are anticipated upstream of the requesting or petitioning lot, and it is anticipated the water line will not be extended in the future. Normally, this situation will only exist in cul-de-sacs or dead-end streets where, due to topography, the street cannot be extended. The decision to provide a connection longer than 75 feet or extend the main line will be handled on an individual basis and must be approved by DPW. Connections within private right-of-way or private easements are subject to the County Plumbing Code. For Plumbing work, the County adopts the 2018 International Plumbing Code published by the International Code Council.

Where water utilities are extended to accommodate development, they shall be extended across the full frontage of the property being serviced. Water main extensions less than 4 inches in diameter will not be permitted and will not be considered as long connections.

2. Sizing

The minimum size for any service connections shall be 1 ½ inch diameter with a 1 inch meter. Reduced service sizing is possible if the applicant enlists the services of a Professional Fire Protection Engineer (FPE) to evaluate and size the water service and meter to accommodate both domestic and sprinkler demands. The FPE shall certify, sign and seal the computations which must be approved by Inspections and Permits' Fire Protection Engineers. Reduced service sizes shall be limited to ⅝ inch and ¾ inch meters only. Connections shall be sized based on the County Plumbing Code. Appendix G is a table for selection of the meter size.

The minimum size for existing homes that do not require fire suppression shall be at least ¾ inch. If dwelling is increased by more than 50% in square footage the minimum size required shall be 1 ½ inch.

3. Cover

   Cover over service lines shall be as indicated in the Standard Details measured from finished grade.

4. Clearances

   Water house services shall be placed a minimum of 7 feet horizontally from sewer house connections and a minimum of 1 foot clear above the sewer house connection. If ductile iron or PVC rubber gasketed joint pipe is used for the sewer connections, the water connections may be placed not less than 1.5 feet clear horizontally and 1 feet clear above sewer services.

5. Appurtenances

   a. Meters and Vaults: In new and existing subdivisions with curbed streets, meter boxes shall be located 30 inches from back of curb for standard straight-faced curbs and 36 inches behind the flow line of the gutter-pan for standard mountable curbs and gutters. In existing developed areas, without curbed streets, meter boxes shall be located 36 inches from the property line in the public right-of-way. In roads with a drainage ditch, the meter box shall be located 36 inches from the edge of the ditch between the ditch and property line (See Standard Detail W/20 in Section IV Water Mains). Meter box installation shall be as indicated in the Standard Details. Meters shall be sized in conjunction with the sizing of service connections as provided in Appendix G.

      Meter types for Commercial, Industrial, and Institutional applications shall be determined by the DPW. The sizing and vault piping arrangement for Commercial, Industrial, and Institutional meters shall be installed per Standard Details.

   b. Valves: A valve or curb stop shall be provided on the water main side of each meter installation as indicated in the Standard Details.

   c. Backflow Prevention Device: Reduced pressure backflow prevention devices where required by the Plumbing Code, shall be located on the service connection ahead of any outlet. A dual cartridge check valve is required in the meter vault immediately after the meter for all domestic service connections. Refer to AWWA Manual M14, “Backflow Prevention and Cross Connection Control: Recommended Practices”, 2015, for additional design criteria and Standard Details For Construction Section IV – Water Mains.

G. Backflow Prevention Device

   Reduced pressure backflow prevention devices where required by the Plumbing Code, shall be located on the service connection ahead of any outlet. A dual cartridge check valve is required in the meter vault immediately after the meter for all domestic service connections. Refer to AWWA Manual M14, “Backflow Prevention and

Cross Connection Control: Recommended and Backflow Prevention", 19752015, for additional design criteria.

1) The backflow preventers shall be located above ground in the facility or structure it is to serve. The backflow preventer shall be installed in accordance with the County Plumbing Code.

2) If the backflow preventer cannot be located in the facility it is to serve, it shall be located in an above ground vault which can be completely drained by gravity through a pipeline. The vault drainage pipe shall not be subject to backups and the discharge point shall preferably be visible such that personnel in the area will be able to detect a discharge from the relief valve. Temperature control shall be added to avoid freezing of lines.

3) If the backflow preventer cannot be located as described in 1) and 2) above, the design professional, as a last resort, shall use the location described in 1) or 2) with relief valve discharge piping extended above ground.

A basket strainer with blow-off shall be provided upstream of reduced pressure backflow preventers. Where fire fighting capability (sprinkler systems, fire hydrants) is required or potentially required downstream, an Underwriter's Laboratory strainer listed for fire lines shall be used in accordance with the Standard Specifications. For non-fire service, the design professional may, with DPW approval, amend the Standard Specification for strainers to accommodate differing downstream requirements. The design professional shall consider head losses through the strainer and backflow preventers in his/her design. Temperature control shall be added to avoid freezing of lines.

With respect to fire lines, the design professional is reminded that the National Fire Protection Association recommends the first valve on a fire line on private property be an indicating valve. The design professional must, therefore, consider incorporating indicating valves in lieu of, or in addition to, the valve required for backflow preventers.

H. Distribution Mains

1. Location

In new subdivisions and in existing developments with curbs, water mains shall be constructed a minimum of 7 feet from the centerline of the street right-of-way generally on the side of the street toward high ground (on opposite side of street from the sanitary sewer). Mains shall be located within the pavement area, wherever possible, but no less than 5 feet from face of curb or proposed curb. See Standard Reference Drawing Nos. G-8 and G-9 in Appendix B of Chapter I, General Instructions, for normal utility locations. Water mains located between

houses shall have a minimum easement width of 20 feet that is centered on the property line.

In existing developments without curbs, the water main location shall generally be located 2 feet within the limits of pavement on the opposite side of the street from the sewer, except that the main shall not be constructed under a future curb. The location of other existing and proposed utilities shall be fully considered.

In parks and public rights-of-way where location of the water main would require removal of trees, the design professional shall obtain a Tree Care Permit from the Maryland Department of Natural Resources Forest Service. If within the Chesapeake Bay Critical Area Buffer, Forest Conservation Easements, or within Bog Protection Areas, a Standard Vegetation Management Plan (VMP) form must be submitted to Anne Arundel County Department of Inspections and Permits / Forestry Program for approval prior to beginning work.

Distribution mains may be designed on a curved alignment to reduce the number of bends. Along curves, the water main may be deflected at each joint within the limits given in the Standard Details W/6 and W/7.

2. Sizing

   Distribution mains shall be sized to provide the required design flow rate and residual pressures as detailed in Section II of this Chapter and Appendix F.

3. Cover

   Normal cover over distribution mains shall be 4'-0" or a maximum cover of 9'-0" will be allowed.

   In new subdivisions, cover shall be measured from final grade of the street.

   In existing roads or ungraded streets, a future profile grade shall be obtained from the DPW. If such profile grade is not available, the design professional shall submit a proposed profile grade for approval by the DPW. If future profile grade is at or below existing surface, cover shall be measured from the future profile grade; if the future profile grade is above the existing surface, cover shall be measured from the existing surface.

   In areas outside of existing or planned streets, cover shall be measured from existing grade. The design professional shall thoroughly investigate and make suitable allowances for likely changes to existing topography. Such changes include future erosion of streambeds or grading of lots.

4. Clearances

   a. General: Clearances between water mains and other utilities shall be measured between the outside of pipes.

Water mains shall have a minimum clearance of 18 inches above a sanitary sewer if the two are crossing at nearly right angles.

Where sanitary sewers and water mains are generally parallel and less than 10 feet apart horizontally, water mains shall be 6 feet clear above sewers. Where more than 10 feet apart, water mains shall be above sewers.

The design professional shall investigate the possibility of stray current transfer at or near the point where the two pipelines will cross based on the results of the soil tests and whether or not the existing utility is cathodically protected. If the likelihood exists for stray current transfer, the design professional shall provide a resistive bond connection between the proposed distribution main and the existing utility and a cathodic protection system to protect both pipes.

b. Interactive Considerations: In general, existing utilities have prior rights to maintain their location. The existence and location of such utilities must be considered when designing new distribution mains. Design professionals shall investigate clearance between distribution mains and other utilities, both existing and future, and whether or not the existing utilities are protected from corrosion by cathodic protection systems. The clearance to other utilities shall be considered when designing a cathodic protection system (if required) for a new distribution main or if the new distribution main might cause interference with an existing cathodic protection system. Water mains shall have a minimum clearance of 1 foot where crossing other utilities. Water mains shall also have a minimum horizontal separation of 10 feet to a sanitary sewer, whenever possible, where the two lines are parallel.

   Where specified clearance cannot be obtained between sewer and water lines in a new subdivision, or in locations where the sewer is built along streets having existing water mains, the sewers shall be designed with concrete encasement or other watertight carrier pipe for the width of the utility trench as provided for in Chapter VII, Sanitary Sewers, of this Manual.

c. Underwater Water Main Crossings (15' and wider): Minimum of 4 feet cover. The main shall be of special construction with flexible watertight joints. A fire hydrant and valve shall be placed at each end of the crossing and permanent taps provided at each end for testing purposes. In addition, the valves shall be easily accessible and not subject to flooding. The valves shall be in watertight manholes.

   The water main should be installed as nearly horizontal as possible.

d. County Code Article 170-3-505 requires that residential lots shall be of sufficient size to provide a 30-foot setback between a dwelling, excluding a deck, and an easement, right-of-way, or area used or proposed to be used for an underground high-volume or high-pressure transmission main or transmission line.

5. Appurtenances

   a. Valves and Vaults: New mains 6-inch to 12-inch shall have valves of the same size as the main. Valves shall be resilient seated gate valves and shall be installed in the vertical position only. For larger valves on existing mains where topographic constraints do not allow for a vertical installation and valves are installed horizontally, a clean-out port for clearing the valve seat of debris shall be provided as part of the valve.

   Valves shall be installed on the loop or network at such places as to isolate the branch sections as may be necessary. Refer to Table IX-3 to determine the maximum spacing of valves. Valves shall be installed on all fire hydrant leads as close to the water main as practical. 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 practical to the larger main, except valves at intersections shall be placed on projection of street right-of-way lines.

Table IX-3 Spacing of Valves

Diameter Valves	Maximum Spacing (feet)
6-inch to 12-inch (Multi-Family Residential Use)	every 800 feet
8-inch to 12-inch (Single Family Residential Use)	every 1000 feet
8-inch to 12-inch (Commercial Areas)	every 500 feet
8-inch to 12-inch (Other)	every 1200 feet
14-inch to 16-inch	every 1200 feet
20-inch	every 2,000 to 2,500 feet
24-inch to 48-inch	every 2,500 feet
larger than 48-inch	as directed by DPW

   Refer to the Standard Details for valve vault and road box dimensions.

   b. Fire Hydrants: All hydrants shall be a minimum of 6-inch diameter. Hydrants on large mains shall be 8-inch if directed by the DPW. All fire hydrant leads shall be DIP. Where 8-inch fire hydrants are specified, the design professional shall submit to the DPW a 1 in. = 200 ft. scale map showing location of 8-inch fire hydrants for transmittal to the Anne Arundel County Fire Marshal. The connection from the main to the hydrant shall be the same diameter as the nominal inside diameter of the hydrant.

      - Spacing of hydrants shall be in accordance with the Insurance Services Office (ISO) “Fire Suppression Rating Schedule”, latest edition, or the County Fire Marshal Code, whichever is more stringent. Refer to Table IX-4 below for fire hydrant spacing requirements, as measured along a Fire

Department access road. Hydrants shall be located at street intersections wherever possible.

Table IX-4 Spacing of Fire Hydrants

Areas	Max Spacing	Coverage Requirements
Residential areas (lots 20,000 ft^2 and larger)	1000 ft	Shall be within 500 feet of the center of lot
Residential areas (lots less than 20,000 ft^2)	750 ft	Shall be within 500 feet of the center of lot
Residential areas (townhouse or garden apartments - 3 story or less)	500 ft	Shall be within 300 feet of any dwelling
All other occupancies (i.e. commercial and industrial, including high rise or elevator type apartments)	300 ft	No portion of the exterior perimeter of any new building or addition shall be more than 400 feet from a hydrant as measured along an approved route

- Hydrants not at intersections shall be located in relation to property lines in order to avoid interference with driveways. Hydrants shall be located to provide vehicular clearance from the street and pedestrian safety in accordance with the Standard Details. Hydrants shall be located within 8 feet of the finished curbing on the end of the paved surface and located not less than 40 feet from buildings. Elevations shall be such as to protect the breakaway characteristics of the hydrant.
- Hydrants shall be placed at the end of dead-end lines 6-inches in diameter and larger.
- Hydrants shall maintain a 36” clearance in all directions.
- Hydrants shall not be obstructed from view along the fire department access roadway.
- NO PARKING shall be permitted adjacent to fire hydrants 15’ in each direction and shall be marked on proposed plan.

c. Tapping Sleeves and Valves: Tapping sleeves and valves on water mains to serve as line valves shall be used for all connections 8 inch and larger in diameter to any existing main 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 but the tapping cutter shall be ¼ inch or more undersized. Tapping sleeves shall be furnished, installed, and tested by the contractor. Use of mechanical joint sleeves will be permitted only upon written authorization of the DPW and will be considered only where pipe being tapped is new ductile iron pipe. Valve boxes or vaults for tapping sleeves shall be sized in accordance with the Standard Details. Valves for tapping service shall meet all the requirements for gate valves (Section 02552.02.C.9), including stainless steel fasteners and valve bolts (316 SS). In addition, the body seat rings shall have clear inside openings sufficient to pass a cutter of full diameter and equal to the nominal size of the tapping valve.

Tapping sleeves shall be 316 stainless steel type with full 360° gasket. Tapping valves for ductile iron pipe shall have flange by mechanical type ends unless otherwise shown on the Plans. All tapping sleeves shall be furnished with an outlet for testing. Tapping sleeves for prestressed concrete pipe shall be furnished and installed in accordance with the pipe manufacturer's recommendations. Tapping sleeves shall be manufactured by JCM Industries or approved equal.

d. Blow-off Hydrants and Air Release Valves: A temporary hydrant may be installed where a main will be extended in a reasonably short time. Air release valves will generally not be required for distribution mains. Where required, air release valves shall be installed in accordance with the Standard Details.

6. Materials

All distribution mains shall be ductile iron or PVC with standard mechanical joints or push-on joints. Ductile iron pipe, fittings and linings shall meet the requirements of AWWA Standards, Section C153. PVC pipe and fittings shall meet the requirements of AWWA Standards, Section C900. Other materials may be used if approved by the DPW. At bridge crossings, steel pipe shall be used and shall have a fusion bonded epoxy lining in accordance with AWWA Standard C213. Steel pipes 16 inches in diameter and smaller shall also have a frost proof covering. Steel pipe, fittings, coatings and linings shall meet the requirements of AWWA Standards, Section C200. Expansion joints, insulated couplings, and rollers shall be provided as required on bridges.

I. Transmission Mains

1. Location

The approximate location of transmission mains shall be based on a computerized network analysis by the DPW. This analysis shall indicate the beginning and ending points of the main and the major distribution system intersecting nodes. The design professional shall select an alignment which satisfies the approximate location as determined in the DPW analysis while taking into consideration length of pipe, number and type of fittings, public or private property, construction and maintenance access, future road widening, horizontal and vertical alignment changes, flood prone areas, subsurface conditions, and existing and future utility interferences.

2. Sizing

The size of transmission mains shall be based on the computerized network analysis by the DPW.

3. Cover

   Normal cover for transmission mains shall be 4 feet, except where existing utilities are crossed, where the minimum will be 3 feet Maximum cover will be 9 feet, except where authorized by the DPW.

4. Clearances

   See Section II.F.4. of this Chapter.

5. Hydraulics

   System hydraulic gradient, static and residual pressures, velocities, and flow direction will be provided by the DPW. The design professional, if requested by the DPW, will examine the potential for water hammer in transmission mains. In most cases, the water hammer analysis will be limited to pipelines of finite length for line rupture and sudden valve closure. The computation methodology is detailed in "Pressure Pipeline Design for Water and Wastewater", ASCE, 1992.

6. Appurtenances

   a. Valves and Vaults: All gate valves 16 inches in diameter and larger shall be placed in a standard concrete vault in accordance with the Standard Details and Specifications. Valves shall be resilient seated gate valves and shall be installed in the vertical position only. For larger valves on existing mains where topographic constraints do not allow for a vertical installation and valves are installed horizontally, a blow-off stack clean-out port for clearing the valve seat of debris, shall be provided as part of the valve.

   b. Air and Vacuum Release Valves: The proper ventilation of transmission mains is often overlooked by design professionals. Trapped air pockets can significantly reduce the capacity of the mains as well as cause increased pumping heads and corresponding higher pumping costs. The following guidelines shall be used to locate air and vacuum release valves:

      - Peaks in profiles
      - Abrupt increase in downward slope.
      - Abrupt decrease in upward slope.
      - Long ascents - 1500 feet to 3000 feet Intervals along the upward sloping profile.
      - Long descents - 1500 feet to 3000 feet Intervals along the downward sloping profile.
      - Long horizontal profiles (zero slope) - 1500 feet to 3000 feet intervals. Ideally, long horizontal lines should be avoided in profiling a water main.
      - Pumps - on the discharge side of the pump having suction lift as close to the check valve as possible.
      - Valves - high point of large valves or bypass piping and downstream of large pressure reducing valves.

- Provide for the proper venting of air and vacuum release valve vaults. Minimize the number of air and vacuum release valves required since these valves are susceptible to problems in operation and maintenance.
- Blow-off hydrant - A blow-off hydrant shall be installed at the low point of the main.

c. Pipe Access: Where greater than 2000 feet of 30 inches or larger diameter pipe is proposed, the DPW will determine the necessity of pipe access. The DPW will advise the design professional of its requirements for pipe access at the pre-design meeting.

7. Materials

The pipe material for transmission mains shall be selected based on its corrosion resistance, strength against internal and external pressures, hydraulic characteristics, installation conditions, and economics. Transmission mains may be constructed of ductile iron, PVC or steel. Pipes to be certified to NSF/ANSI 61 and NSF/ANSI 372 requirements.

For more detailed information refer to the following AWWA Manuals:

- M11 - Steel Water Pipe
- M23 - PVC Pipe

J. Structural Considerations

1. Pipe Bedding

In all cases, proper bedding shall be provided for pipes where pipes are to be placed in fill. Pipe infill material may be required to be placed on timber pile bents unless special measures satisfactory to the DPW are taken to consolidate the fill.

2. Buttresses and Anchors

At all fittings, which achieve a change in pipeline direction, such as tees, fire hydrants, bends and dead ends, thrust restraint using concrete buttresses is necessary. The design professional shall decide which system is appropriate for each particular situation based on an analysis of such factors as soil conditions, clearance requirements, constructability, existing and future utility excavations, future expansion and cost.

Under normal soil conditions, fittings up to 36 inches in diameter shall be buttressed or anchored as shown in the Standard Details. In the event that fittings larger than 36 inches in diameter are being designed, or the soils will not bear 3000 psf, the design professional shall design buttresses or anchorages appropriate to the situation.

3. Restrained Joints

The joint restraint may be either harnesses, mechanical joints with restraint glands, or a proprietary restraining type joint furnished by the pipe manufacturer for mains up to 16-inch diameter. Proprietary type joint restraint systems and restrained joint types for larger mains shall be approved by the DPW prior to proceeding with design. Retainer rings, joints, bolts, nuts, and gaskets shall be rated for the size of pipe and pressure specified and shall meet all applicable requirements of ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11. The design shall account for test pressures, soil bearing capacity and frictional resistance, and the effect of groundwater. The design methods for restrained joint systems are detailed in "Thrust Restraint Design for Ductile Iron Pipe", 2016, by the Ductile Iron Pipe Research Association. Design calculations for length of restrained sections shall be submitted for review. Required length of restrained pipe installation shall be clearly noted on the pipeline profiles.

4. Dead-End Mains

Dead-end mains shall be avoided to the extent possible by providing looping connections to existing distribution mains. Where dead ends cannot be avoided, length of dead-end pipe section shall be minimized. All such dead ends shall include a blow-off hydrant or other approved mechanism to permit periodic flushing of the main. Dead ends shall be restrained by concrete thrust blocks. Restraint design shall be in accordance with "Thrust Restraint Design for Ductile Iron Pipe", 2016, by the Ductile Iron Pipe Research Association, accounting for the soil conditions, groundwater, cover, and system pressure. Design calculation shall be submitted for review and the required length of restrained joint pipe installation shall be noted on the pipeline profiles.

The required minimum length of restrained joints in the Table IX-5 below can be followed where specific conditions as noted are met, and where approved by the Engineer.

TABLE XI-5 Restrained Joints for Dead-End Installations
(where approved by the Engineer)

Nominal Pipe Diameter	Minimum Restrained Length (FT)[1]
6	74
8	95
10	115
12	135
16	174
18	192
20	211
24	246

Maximum system pressure of 100 psi, minimum 4 feet of cover, ANSI A21.50 Type 2 laying conditions, soil parameters corresponding to Silt 1 in Table 3 of Thrust Restraint

Design for Ductile Iron Pipe", 2016, by the Ductile Iron Pipe Research Association, groundwater below pipe trench depth, and no polyethylene wrap on the pipe.

5. Jacking and Tunneling

   Where mains are being designed to cross railroads, state highways, or other roads, on which service cannot be interrupted, the water mains shall be installed in a sleeve, tunneled, or jacked under the road or railroad. The sleeve size and material and the method of tunneling or jacking shall be approved by the owner of the road or railroad being crossed.

   The sleeve diameter shall be sufficient to permit the proper positioning of the water main within the sleeve. Water mains installed in sleeves shall have restrained joints throughout the length of the sleeve. The annular void between the main and the sleeve shall be completely filled with non-corrosive grout or other approved material, or the pipe shall be supported through the sleeve by casing spacers. Spacers shall be designed to support the pipe and contents, minimum of two spacers per pipe segment. Spacer shall provide electrical insulation between the casing and carrier pipe.

   Water mains installed in sleeves shall be equipped with sufficient valves to shut-off all flow through the sleeved section. In the case of a dead end main, one valve upstream will be sufficient; in other cases, a valve at each end is required.

6. Directional Drilling/ Microtunneling

   Where mains are being designed to cross environmentally sensitive areas, waterways, cultural or historical preservation areas, etc., the design professional shall consider the use of directional drilling or microtunneling. The pipe material shall be acceptable for potable water service and shall meet all pertinent AWWA Standards. The DPW shall approve the use of the selected pipe material.

   Directionally drilled, microtunneling, and jack and bore sections of water mains shall be equipped with isolation valves at both upstream and downstream of sections installed by any method described above to interrupt and redirect flows and allow future replacements, repairs, and maintenance.

   The design professional shall support the selection of directional drilling or microtunneling with a report addressing the criteria presented in Chapter I, General Instructions, Section II.

7. Design Loads and Pipe Design

   In cases where deemed necessary by the DPW, the design professional shall submit all calculations necessary to support the selection of the type and class of pipe indicated on the contract drawings.

   The calculations may account for the following:

- Vehicle or railroad loads (H-20, E-80, etc.).
- Pipe loading factors (Dead, live, impact).
- Internal pressure (Static, dynamic, surge).
- Trench configuration.
- Pressure balance system for earth and slurry pressure.

8. Curves and Deflections

   Gradual changes in pipeline direction may be achieved by joint deflection. The Standard Details provide tables of allowable joint deflection and minimum achievable radii for different sizes and joint types of ductile iron pipe.

K. Testing and Disinfection

The contract documents shall provide for the disinfection and hydrostatic testing of newly constructed mains as described in the County's Standard Specifications. Hydrostatic tests shall be performed for pressure rating conformance and leakage.

L. Abandonment Procedures

Abandoned service connections shall be cut and capped, corporation stop shall be turned off at the service main and encased in concrete provided the curb stop or connection is not compromised. The meter shall be removed and returned to the County. Distribution mains that are to be abandoned shall be capped at the point of abandonment. It is not necessary to plug the pipe on each side of any existing valves. Instead, the valves, valve vaults, and hydrants shall be removed and salvaged if their reuse appears practicable. Any necessary buttresses or anchorages required shall be designed by the design professional or constructed in accordance with the Standard Details.

M. Potable Water Related Facilities

1. General

   A detailed presentation of design criteria for pumping, treatment, and storage facilities is beyond the scope of this Manual. The DPW will specify the exact requirements to be met by the design of these facilities at the pre-design meeting.

2. References

   The design professional may find the following references useful:

   a. "Water Quality and Treatment: A Handbook on Drinking Water", 2011, AWWA. This publication presents design criteria for use in design of treatment plants.

b. "Handbook of Public Water Systems", HDR Engineering, New York, 2001. This book presents suitable criteria for use in the design of distribution, pumping and storage facilities.

3. Production Wells

The design professional is directed to Section 02555 "Production Wells" of the County's Standard Specifications for Construction, and the following:

a. General well appurtenances - The following well appurtenances are required:

1) A sanitary seal shall be provided on the top of the well casing.

2) A properly screened vent with the end elbowed downward shall be provided for the well casing.

3) A sampling tap shall be provided for raw water sampling which discharges in a downward direction and away from the well casing.

4) Adequate control switches, etc., for the pumping equipment shall be provided.

5) A water meter is required to determine water production for each well and the meter shall be located upstream of the well blow-off.

6) The well casing shall extend at least 12 inches above the concrete floor or apron surrounding the well.

7) Adequate support for the well pump and drop pipe shall be provided.

8) Each well casing shall be equipped with a drawdown gauge, airline, and appurtenances for measuring the change in the elevation of the water level in the well.

b. Drilled wells with extended shaft turbine (column) pumps shall:

1) Have the casing extend 12 inches above the floor, and be equipped with a flange or suitable sanitary seal,

2) Have the casing firmly connected to the pump structure or have the casing inserted into a recess extending at least one inch into the base of the pump if a watertight connection is not provided,

3) Have the base of the pump not less than 12 inches above the pump room floor or apron,

4) Have the pump foundation and base designed to prevent water from coming into contact with the joint between the casing and the prime mover.

c. Submersible pumps: Where a submersible pump is used, the top of the casing shall be effectively sealed against entrance of water under all conditions of vibration or movement of conductors or cables and shall have a gooseneck vent with a screen covered opening.

d. Discharge piping: The discharge piping shall be provided with separate means to pump (blowoff) water of unsatisfactory quality to a point away from the groundwater source, but shall not be directly connected to a sewer. The discharge line shall:

1) Have control valves located above the pump floor,

2) Be protected against freezing,

3) Be valved to permit testing and control of each well,

4) Have watertight joints,

5) Have all exposed valves protected,

6) Have erosion protection at the point of waste discharge.

e. General well pump house construction requirements:

1) The well pump house floor or apron surrounding the well shall:

a) Be of good quality concrete with adequate reinforcement,

b) Be a minimum of six inches in thickness,

c) Extend a minimum of three feet in all directions from the well,

d) Slope at least 1/4 inch per foot towards a screened four-inch floor drain to atmosphere.

2) Well houses or well pump stations in pits are prohibited.

4. Potable Water Storage Facilities

a. General: The materials and designs used for finished water storage structures shall provide stability and durability as well as protect the quality of the stored water. Steel and concrete structures shall follow the most current available American Water Works Association standards concerning steel and concrete tanks, standpipes, reservoirs, and elevated tanks except as may be modified herein. Pipes shall be certified to NFS/ANSI 61 and NFS/ANSI 372 requirements.

1) Location of finished water storage facilities

a) The bottom of ground level reservoirs, storage tanks, and standpipes should be placed at the normal ground surface.

b) Where the bottom must be below normal ground surface, it shall be placed above the groundwater table. Sewers, drains, standing water, and similar sources of contamination shall be kept at least 50 feet from the reservoir. AWWA approved water pipe, pressure tested in place without leakage, shall be used for gravity sewers at lesser separations.

c) The top of all storage facilities shall not be less than two feet above the normal ground surface and shall be above the 100-year flood level.

d) The site should be large enough to permit construction of the facility and have a right-of-way to the nearest public road.

2) Obstructions to air navigation

a) For structures within a 4 nautical mile radius of BWI Airport, the filing of a building permit application with County Office of Planning and Zoning (OPZ) will automatically trigger a review by the Maryland Aviation Administration (MAA). To discuss a proposed structure prior to design or submittal, the design professional should contact the MAA, Third Floor, Terminal Building, Box 8766, Baltimore/Washington International Airport, Maryland 21240, telephone 410-859-7692.

b) For structures within a 4 nautical mile radius of any other public-use airport, the design professional shall be governed by the latest revision of COMAR Paragraph 11.03.05.05; shall contact the MAA Office of Regional Aviation Assistance, telephone 410-859-7064; and shall complete Federal Aviation Administration (FAA) Form 7460-1 as required by Part 77 of the Federal Air Regulations and deliver the completed form to the MAA as specified in paragraph a), above.

3) Information to be furnished by the DPW to the design professional at the pre-design meeting shall include the information outlined in the AWWA Standards for each respective type of structure, process, or material as follows:

a) Welded steel tanks - AWWA D100, Forward, Paragraph III.A.1 or III.A.2., as appropriate.

b) Bolted steel tanks - AWWA D103, Forward, Paragraphs III and V.

c) Circular prestressed concrete tanks - AWWA D110, Forward, Paragraphs III.A. and III.B.; and AWWA D115, Forward, Paragraphs III.A. and III.A.1.

d) Coating steel tanks - AWWA D102, Forward, Paragraph III.A.

e) Flexible-membrane-lining and floating-cover materials - AWWA D130, Forward, Paragraph III.A.

f) Automatically Controlled, Impressed-Current Cathodic Protection for the Interior Submerged Surfaces of Steel Water Storage Tanks - AWWA D104, Foreward, Paragraph II.B.

4) Safety - The safety of employees shall be considered in the design of the storage structure. As a minimum, such matters shall conform to pertinent building codes, laws, and regulations of the area where the reservoir is constructed.

a) Ladders, ladder guards, painter's railings, and safe location of entrance hatches shall be provided.

b) Elevated tanks with riser pipes over eight inches in diameter shall have protective bars over the riser opening inside the tank.

c) Ladders must meet the minimum requirements of OSHA 29 CFR Part 1910. The DPW shall advise the design professional if cages, rest platforms, roof ladders or other safety appliances must meet any local or state requirements which exceed OSHA 29 CFR Part 1910.

d) Lighting, pumps, and cathodic protection system equipment shall meet the requirements of the National Electric Code.

e) For the design of new steel tank structures, and tank upgrade projects for coating and other improvements, the designer shall incorporate sufficient Rigging Port Tie-Offs on the top of steel tank structures to allow tank coating operations access to correctly located and appropriately spaced 'lug' points for safe rigging of scaffold systems and personnel safety lines, including for future maintenance needs. The port tie-offs should be located circumferentially near to the side walls to allow rigging access to the side walls, and be spaced appropriately across the tank top surface both circumferentially and radially to allow rigging access to the top and bottom surfaces. The structural designer shall include the port tie-offs into the design; and/or include them as a Contingent Bid Item with a sufficient quantity, unit cost, and detail shown on the design drawings.

5) Grading - The area surrounding a ground level structure should be graded in a manner that will prevent surface water from standing within 50 feet of the structure.

6) Drainage for roof or cover - The roof or cover of the storage structure should be well drained, but downspout pipes shall not enter or pass through the reservoir.

7) Drains

a) No drain on a water storage structure shall have a direct connection to a sewer or storm drain.

b) All finished water storage structures shall be equipped with separate drains discharging to the atmosphere. Drainage of finished water storage structures to the distribution system through inlet/outlet piping shall not be allowed.

8) Freezing - All finished water storage structures and their appurtenances, especially the riser pipes, overflows, and vents, shall be designed to prevent freezing which will interfere with proper functioning. Particular attention shall be given to the water pressure sensing lines inside unheated tank structures. These pipes shall be heat traced and insulated. All pipe clamp support devices connecting the pipe to the tank structure shall have insulated thermal breaks. All pipe insulation seams shall be sealed, both longitudinal seams, and butted ends. For allowable pipe insulation material, include appropriately rated AP/Armaflex insulation.

9) Internal catwalk - Every catwalk over finished water in a storage structure shall have a solid floor with raised edges so designed that shoe scrapings and dirt will not fall into the water.

10) Containment, Scaffold & Rigging System. The designer's bid documents shall require the contractor to submit a Containment, Scaffold & Rigging Plan. The plan shall be reviewed by the Engineer with No Exceptions Taken prior to, and as a condition to, field installation of the containment, scaffold and/or rigging system. The containment system shall follow SSPC guidelines per "Technology Guide No. 6 Guide for Containing Surface Preparation Debris Generated During Paint Removal Operations" for Class 2A abrasive blast cleaning, unless otherwise specified by the designer. The submittal shall include a letter, and appropriate structural analysis, certifying the structural integrity and safety of the proposed systems, signed and sealed by a professional engineer in the State of Maryland.

11) Coating System Certification & Warranty. A requirement shall be included for the contractor to submit to the Engineer a letter, signed and dated from both the coating contractor and the coating manufacturer, certifying the proposed coating system(s) for the project are applicable to the tank conditions, and will provide the specified warranty. The Coating Warranty shall commence on the Conditional Acceptance date. The 3-year warranty inspection shall occur prior to expiration of the 3-year warranty period to allow sufficient time to address repairs needed. All coating shall be NSF ANSI 61 listed or certified.

b. Storage Tanks:

1) Definition - In this Design Manual, the word "Tank" shall be taken to mean a standpipe, reservoir, or elevated tank.

2) Guidelines for evaluation of steel vs. composite tanks, pedestal spheroids, fluted column type only;

a) Economic Considerations:

(1) Establish preliminary design parameters:

(a) Capacity within operating range
(b) Maximum operating range
(c) Overflow elevation
(d) Existing ground elevation
(e) Final ground elevation

(2) Obtain from manufacturers

(a) Construction cost for the tank to be completely erected on a furnished foundation.
(b) Approximate tank bowl dimensions, material type and plate thickness, and approximate weight.
(c) Approximate pedestal dimensions, material type, thickness, and weight.
(d) Potential roof mounted structures (antennas, microwave dishes, etc.)

(3) Determine subsurface conditions at proposed site.

(4) Estimate foundation requirements for each tank and prepare construction cost estimates.

(5) Determine recoat interval for steel surfaces, interior and exterior, and estimate the cost.

(6) Determine cleaning/sealing interval for concrete pedestal.

(7) Perform Present Worth analysis using initial total construction cost, tank plus foundation, and estimated recoat/cleaning costs. Minimum time period for analysis should be 20 years. Time period selection is based on maintenance intervals that result in the same time frame (i.e. - repaint every 15 years, clean/seal every 20 years, time period = 60 years).

b) Non-Economic Considerations:

(1) National Standards available to govern design, fabrication, and erection.

(2) Number of tanks designed, fabricated, and erected by at least two manufacturers for each tank type over the past 10 years.

(3) Number and type of failures (bowl, pedestal, or foundation) experienced over the past 10 years for tanks and manufacturers in (2) above.

3) Welded steel tanks - Design shall follow the provisions of AWWA Standard D100, "Welded Steel Tanks for Water Storage" modified as follows:

a) Tanks should be designed for Seismic Zone 0.

b) All permanent attachments to the tank shall be made prior to the hydrotest.

c) The alternative design basis presented in AWWA D100 will not be used unless approved by the DPW.

d) Aluminum dome roofs shall be used only by approval of the DPW.

e) Tanks shall be provided with remote level sensing and recording equipment with telemetry to the Emergency Dispatch Center in accordance with Section II.M., Programmable Logic Controllers, of this Chapter.

f) The design professional will specify that the Contractor will furnish, at a minimum, the information listed in AWWA D100, Forward, Paragraph III.B.1. or III.B.2. as appropriate.

g) Silt stops are not required for welded steel tanks.

h) Disinfection will be performed by the contractor in accordance with Section II.L.4.e. of this Chapter.

4) Circular prestressed concrete tanks - Design shall follow the provisions of AWWA Standard D110, "Wire - and Strand-Wound, Circular, Prestressed Concrete Water Tanks", or AWWA Standard D115, "Circular Prestressed Concrete Water Tanks with Circumferential Tendons", modified as follows:

a) Tanks should be designed for Seismic Zone 0.

b) Bearing pads used in wall-to-floor and wall-to-roof joints shall be neoprene.

c) Sealant for steel diaphragm joints shall be epoxy.

d) The floor design will be determined by prevailing site foundation conditions.

e) Silt stops are not required on circular prestressed concrete tanks.

f) Provide wash down piping from the supply system with a valved hose connection inside the tank.

g) Provide a tank drain line valved outside the tank.

h) Provide underdrains if necessary to prevent hydrostatic uplift of an empty tank.

i) Tanks shall be provided with remote level sensing and recording equipment with telemetry to the Emergency Dispatch Center in accordance with Section II.M, Programmable Logic Controllers, of this Chapter.

j) Shotcrete shall have a broomed finish.

k) The DPW will advise the design professional at the pre-design meeting if architectural treatments are desired on the exterior of the tank.

l) The design professional will specify that the Contractor will furnish, at a minimum, the information listed in AWWA D110, Forward, Paragraph III.B., or in AWWA D115, Forward, Paragraphs III.A. and III.A.1. as appropriate.

m) Disinfection will be performed by the contractor in accordance with Section II.L.4.e. of this Chapter.

c. Coatings and linings for steel tanks - Selection of coating and lining systems for steel tanks shall follow the provisions of AWWA Standard D102, “Coating Steel Water Storage Tanks”, modified as follows:

1) Use outside coating system No. 6, except the dry film thickness (DFT) of the system selected should be a minimum of 9 mils.

2) Use inside coating system No. 2, Paint 2, except the dry film thickness (DFT) of the system selected should be a minimum of 13 mils.

3) Roller application is the preferred method of application.

4) Dry film thickness (DFT) is the preferred method to determine acceptability.

5) The design professional shall specify that the contractor submit an affidavit of compliance that all materials and work comply with the applicable requirements of AWWA Standard D102.

6) The design professional shall list in the project specifications all federal, state, and local regulations regarding environmental issues.

7) The design professional shall specify that the contractor will furnish for approval submittals for the coatings manufacturer, application method, materials, and material safety data sheets.

d. Cleaning: All finished water storage facilities shall be cleaned to remove all dirt and loose materials prior to disinfection of the structure. Only potable water shall be used to clean and rinse the water storage facilities. All equipment including brooms, brushes, spray equipment, and workmen's boots shall be disinfected before they are used to clean the storage facilities.

e. Disinfecting and Testing:

1) Disinfection - All potable water storage facilities shall be satisfactorily disinfected in accordance with AWWA Standard C652-19, Chlorination Method 1, using calcium hypochlorite, prior to being placed in operation. The disinfection of the storage facilities shall be repeated until it is determined, by bacteriological testing, that the water is free of coliform bacteria.

2) Testing - Testing of the water following disinfection shall be performed in accordance with AWWA Standard C652-19.

f. Cathodic Protection - Design shall follow the provisions of AWWA Standard D104-17, "Automatically Controlled, Impressed Current Cathodic Protection for the Interior Submerged Surfaces of Steel Water Storage Tanks", modified as follows:

1) The design professional shall retain the services of a NACE International (National Association of Corrosion Engineers) certified corrosion engineer to design the cathodic protection system for Galvanic Anode Cathodic Protection.

2) The design professional shall specify that the contractor shall furnish an affidavit of compliance for all applicable provisions of AWWA D104-17.

3) The design professional shall use the Type A - IR drop-free potential measurement system.

4) Long life anodes with a minimum life of 50 years shall be specified.

5) The anode suspension system shall be a buoyant spider-type rope system with a design life of 50 years, minimum.

g. Flexible membrane lining and floating cover materials - Design shall follow the provisions of AWWA Standard D130, "Flexible-Membrane-Lining and Floating-Cover Materials for Potable Water Storage", modified as follows:

1) The design professional shall specify that the contractor furnish an affidavit of compliance for all installed materials.

h. Distribution Storage - The applicable design standards of Section II.L.4., of this Chapter shall be followed for distribution storage.

1) Pressure variation - The maximum variation between high and low water levels in finished water storage structures which float on a distribution system should not exceed 30 feet. Large diameter, shallow depth reservoirs are preferable over small diameter, deep depth reservoirs.

2) Level controls - Adequate controls shall be provided to maintain levels in distribution system storage structures at all times.

a) A telemetering system and recording equipment should be provided, to the Emergency Dispatch Center, for the transmission and recording of storage levels in the distribution system, in accordance with Section II.M. of this Chapter.

b) Altitude valves or equivalent controls may be required for subsequent structures on the system.

c) Overflow, low level and pump malfunction warnings or alarms should be transmitted to the Water Supply Command Center.

3) Pressure tanks - Pressure tanks shall not be used for distribution storage systems. Pressure tanks may be used for small community systems if approved by the DPW.

5. Water Pumping Stations

a. Location - The water pumping station shall be located so that the proposed site will meet the requirements of the sanitary protection of the water quality and the hydraulics of the system, and be protected against interruption of service by fire, flood, or any other hazard. The water pumping station shall be:

1) The finished grade of the site shall be elevated to a minimum of two feet above the 100-year flood elevation or protected to such elevation,

2) Accessible at all times unless permitted to be out of service for a period of inaccessibility,

3) Graded around the station so as to lead surface drainage away from the station,

4) Protected to prevent vandalism and entrance by animals or unauthorized persons,

5) Located with respect to availability of a power or a fuel supply. The design professional shall consider the availability of electrical power from more than one source. The County DPW will, at the pre-design meeting, direct whether a standby power source is required.

b. Capacity:

1) Pumping capacity shall exceed the maximum daily water demand of the system as determined in Section II.C. of this Chapter.

2) Pressure requirements shall be determined in accordance with Section II.D.2. of this Chapter.

c. Building: For design of the structure, the design professional is directed to Chapter XI, "Buildings - General", of this Manual. All paints, coatings, sealers and liners to be specified for the water pumping station shall be approved for use in potable water.

d. Water pumping stations associated with surface water sources, treatment facilities, and finished water shall generally conform to the guidelines presented in Chapter XI, "Buildings - General", of this Manual, and the following:

1) Have adequate space for the installation of additional units if needed, and for the safe servicing of all equipment,

2) Be of durable construction, fire and weather resistant, and with outward opening doors,

3) Have the floor elevation at least six inches above the finished grade if possible,

4) Have the underground structure waterproofed,

5) Have all floors drained without impairing the quality of water being handled. If equipment is contained on the floor, the floor shall slope at least 1/8 inch in every foot to the point of discharge,

6) Provide suitable outlet for drainage from pump glands without discharging onto the floor.

e. Suction well - Suction wells shall:

1) Be watertight,

2) Have floors sloped to permit removal of water and entrained solids,

3) Be covered or otherwise protected against contamination, including contamination by pump lubricants, and

4) Provide two pumping chambers or other means to allow the suction well to be taken out of service for inspection, maintenance, or repair.

5) Be designed in accordance with Hydraulic Institute standards regarding suction well and pump intake design recommendations.

f. Equipment servicing in pump stations:

1) Provide craneways, hoist beams, eyebolts, or other adequate facilities for servicing or removal of pumps, motors, or other heavy equipment.

2) Provide walkways to lubrication points of equipment if these are located at intermediate points between floors.

3) Provide openings in floors, roofs, or wherever else needed for removal of heavy or bulky equipment.

4) Provide convenient tool boards or other facilities as needed for proper maintenance of the equipment.

g. Stairways and ladders - Stairs are preferred in areas where there is frequent traffic or where supplies are transported by hand. They shall have risers not exceeding 9 inches and treads wide enough for safety. Where ladders are used, intermediate landings should be provided if the vertical distance exceeds 10 feet. Stairways and ladders shall:

1) Be provided between all floors, in pits or compartments which must be entered, and

2) Have handrails on both sides, and treads of nonslip material.

h. Heating: In water pumping stations not occupied by personnel, only enough heat needs to be provided to prevent freezing of equipment or the treatment process. Provision shall be made for adequate heating for the comfort of the operator and the safe and efficient operation of the equipment.

i. Ventilation - Ventilation shall comply with existing state and local codes. Adequate ventilation shall be provided for all pumping stations. Forced draft ventilation of at least six changes of air per hour (continuous operation) shall be provided for:

1) All rooms, compartments, pits and other enclosures below the grade floor, and

2) Any area where an unsafe atmosphere may develop or where excessive heat may build up.

j. Dehumidification: In areas where excess moisture could cause hazards to safety or damage to equipment, means for dehumidification shall be provided.

k. Lighting: Water pumping stations shall be adequately lighted throughout. All electrical work shall conform to the requirements of the National Electric Code and any County modifications thereto, and the International Energy Conservation Code, 2018, or latest revision thereof.

l. Pumps - At least two pumping units shall be provided. If only two units are provided, each shall be capable of delivering the peak demand. If more than two units are installed, they shall have sufficient capacity so that if any one pump is out of service, the remaining pumps are capable of carrying the peak demand. The pumping units shall:

1) Have ample capacity to supply the peak demand without overloading,

2) Be driven by a prime mover able to operate against the maximum head and air temperature which may be encountered,

3) Have maintenance parts and tools readily available.

4) Be served by control equipment that has proper heater and overload protection for the air temperature encountered.

5) Be selected and sized for energy efficient operation.

m. Suction lift: If suction lift is necessary, provision shall be made for priming the pumps. Suction lift should be less than 15 feet.

n. Priming: Priming water must not be of lesser sanitary quality than that of the water being pumped. Means shall be provided to prevent back siphonage. When an air-operated ejector is used, the screened intake shall draw clean air from a point at least 10 feet above the ground or other source of contamination, unless the air is filtered by an apparatus approved by the County DPW. Vacuum priming may be used.

o. Automatic Remote Controlled Stations: All automatic stations should be provided with a programmable logic controller (PLC), in accordance with Section II.M. of this Chapter, which will report to a facility staffed 24 hours per day when the station is out of service. All remote-controlled stations shall be electrically operated and controlled and shall have a signaling apparatus of proven performance. Installation of electrical equipment shall conform with the National Electric Code and any County modifications thereto.

p. Valves: Pumps shall be adequately valved to permit satisfactory operation, maintenance, and repair of the equipment. If foot valves are necessary, they shall have a net valve area of at least 2 1/2 times the area of the suction pipe and they shall be screened. Each pump shall have a positive acting check valve on the discharge side between the pump and shutoff valve.

q. Piping - In general, piping shall:

1) Be designed so that the friction losses will be minimized,

2) Not be subject to contamination,

3) Be sloped to drain.

4) Have adequate cleanouts,

5) Have watertight joints,

6) Be protected against surge or water hammer,

7) Be such that each pump has an individual suction line or the lines shall be so manifolded that they will insure similar hydraulic and operational conditions, and

8) Have proper legends to identify the contents of the pipes.

r. Gauges and meters - The station should have indicating, totalizing, and recording metering of the total water pumped. Each pump shall:

1) Have a standard pressure gauge on its discharge line,

2) Have a compound gauge on its suction line,

3) Have recording gauges in the larger stations as required by the County DPW.

s. Pump shaft water seals - Pump shaft water seals shall not be supplied with water of a lesser sanitary quality than that of the water being pumped. Where pumps are sealed with potable water and are pumping water of lesser sanitary quality, the seal shall:

1) Be provided with a break tank open to atmospheric pressure, and

2) Have an air gap between the feeder line and spill line of the tank, at least two inches or two pipe diameters, whichever is greater.

t. Controls: Pumps, their prime movers, and all accessories, shall be controlled in such a manner that they will operate at their rated capacity without overloading. Where two or more pumps are installed, provision shall be made

for proper alternation. Alternation may be automatic or manual. Provision shall be made to prevent operation of the pump during the backspin cycle. Electrical controls should be located above grade. Equipment shall be provided, or other arrangements made, to prevent surge pressures from activating controls, which switch on pumps or activate other equipment outside the normal design cycle of operation.

u. Power: When power failure would result in cessation of the minimum essential service, the power supply shall be provided from at least two independent sources or an auxiliary source shall be provided.

v. Water prelubrication: When automatic prelubrication of pump bearings is necessary, and an auxiliary power supply is provided, the prelubrication line shall be provided with a valved by-pass around the automatic control.

6. Booster Pumps

a. Booster pumps, except those connected to supply mains not containing service connections and except those taking suction directly from storage facilities, shall be located or controlled so that:

1) They will not produce negative pressure in their suction line,

2) The intake pressure shall be at least 20 psi when the pump is in normal operation,

3) An automatic pressure cutoff or a pressure-regulating valve shall be provided to prevent suction line pressure from dropping to below 10 psi,

4) Automatic or remote-control devices shall have a range between the start and cut off pressure which will prevent excessive cycling, and

5) A bypass is provided.

b. Inline booster pumps: In addition to the other requirements of this section, inline booster pumps shall be accessible for servicing and repairs.

7. Extended Shaft Turbine (Column) and Submersible Pumps

The design professional shall determine column-friction loss, discharge head loss, pump horsepower required to overcome mechanical friction, line-shaft selection and pump testing and specifications in accordance with the criteria presented in AWWA E100 - Pumps. Pump materials should be selected based on water source alkalinity and abrasiveness. When comparing extended shaft turbine and submersible pumps for selection of a pump type for a well, the design professional should consider the following:

a. Extended Shaft Turbine Pump:

1) Generally more cost effective in wells less than 500 feet deep.

2) Higher first cost.

3) Motors (prime mover) more accessible for repair.

4) Line shafts must be machined to close tolerance to eliminate vibration.

5) Line shafts must be supported by bearings every 10 feet.

6) Consider the use of an open line-shaft to reduce initial and maintenance costs. When worn, line shaft sections can be reversed to extend shaft life.

7) Line-shaft bearing retainers cause turbulence in the column, which promotes corrosion.

8) Line-shaft bearing retainers are held in place by the column couplings. If the bearing retainers and column couplings are dissimilar metals, corrosion and water leakage, aided by turbulence at the bearing retainers, occur at the column couplings which can ultimately lead to failure of the well column and line shaft.

9) Refer to Section II.L.3.b. of this Chapter for additional design criteria.

b. Submersible Pumps:

1) Generally more cost effective in wells over 500 feet deep.

2) Replacement and repair costs and power cable are more costly.

3) Submersible pumps may be more suitable for use in or near residential areas because they are quieter.

4) There must be sufficient flow-by of water past the pump motor to cool it sufficiently. This is especially important if the motor is located at the bottom of a well where most of the inflow to the well is above the motor.

5) Refer to Section II.L.3.c. of this Chapter for additional design criteria.

N. Programmable Logic Controllers

1. General

Programmable logic controllers (PLC's) shall be specified for water mains and/or pumping stations when directed by the County. The County will provide the design professional with information on how the existing central master system screen displays are to be updated, what reports, if any, need to be updated by information received from the additional PLC's, current manufacturers and model numbers of

equipment and existing software in use by the County. All equipment and software must be compatible with the County's existing SCADA system.

2. RF. Path Study

   The design professional shall perform an RF. path study as part of the project design effort. The RF. path study is used to verify communications reliability between the proposed PLC location and the existing control master unit or the nearest radio communications hub. The County will furnish the design professional with any information, which it has acquired from its preliminary County-wide RF. path studies, which may be applicable to the project.

3. Telemetry

   Where the RF. path study indicates it is feasible, spread spectrum radio will be used to transmit signals between the PLC's and the Water Supply Command Center. Where spread spectrum radio cannot be used, communications shall be via the use of leased telephone lines.

4. Screen Displays

   The design professional shall specify that it is the contractor's responsibility to provide screen displays to the existing human-machine interface (HMI) computers, which meet the County's requirements. The County will provide direction to the contractor regarding the graphics required for the screen displays.

5. Communications Protocols

   The PLC shall utilize either the Modbus or the DF-1 protocols as directed by the County. Communication baud rates shall be matched with the existing SCADA system communication rates.

6. PLC Equipment

   PLC equipment currently approved by, and in use in the County includes Modicon and Allen Bradley. The design professional should specify either of these manufacturers or an approved equal. Other manufacturer's equipment must be compatible with the existing Allen Bradley SCADA system communication protocols used by the County and must be approved by the County.

O. Corrosion Protection

1. Design professionals shall obtain soil samples and review the analyses of the samples with the DPW. If proposed pipes will be below or near the water table, the test borings shall be observed for a fluctuating water table. Soil samples shall be tested for pH, resistivity and chlorides, and organic soils shall be tested additionally for sulfides and sulfates.

2. If soil tests or inspection of existing utilities in the project area reveals evidence of or potential for corrosion, the DPW shall be notified of the condition. Should the DPW deem it necessary, the design professional shall design suitable trench backfill, coating and/or cathodic corrosion protection measures using AWWA standards and practices for the pipe material selected.

3. In all cases, proper bedding shall be provided for pipes. Pipes shall not be placed on undisturbed earth.

4. Backfill which will not damage pipe coatings shall be specified.

5. If a new water main crosses or parallels another utility line which is protected by a cathodic protection system, the design professional is responsible for contacting the other utility and working with its corrosion engineer to design the water main so as to protect the water main from the influence of the other utility's cathodic protection system and to mitigate any adverse impact which the water main may cause to the existing utility's cathodic protection system.

P. Repaving of Roads

Repaving of roads for trench repair shall be in accordance with Anne Arundel County Standard Detail W/1 or Subsection K of Chapter III, Section II, Design Criteria, whichever is more stringent.

III. CONTRACT DRAWINGS AND DOCUMENTS

A. Reports

For mains larger than 12 inches in diameter, a design report shall be submitted in accordance with Chapter I, General Instructions. The report shall include a sketch of the preliminary layout and a summary of the design data.

B. Design Computations

The design professional shall submit design data and calculations for all water projects. The computations shall be in the format presented in Chapter I, General Instructions, of this Manual.

The design data and computations shall include: average and peak demands, fire demand, and future requirements.

Design computations for all special structures shall be submitted. Where information pertinent to design, such as borings, has been collected, this information shall be submitted to the DPW. The locations of borings shall be shown on the plan drawings and the boring logs shall be included in the Contract Special Provisions.

C. Specifications

Contract specifications shall be prepared per Chapter I, General Instructions.

D. Contract Drawings

1. General

Format, size, drafting standards, etc., for contract drawings shall be in accordance with Chapter I, General Instructions. The scale of water plans shall be 1" = 40' or larger. Water main contract drawings may also include sanitary sewers in part of the contract. Block-type plans showing more than one street shall be used where appropriate. The drawing numbers of plans and of other utilities being prepared at the same time shall be listed on the drawings. Job order and contract numbers of prior adjacent water projects shall be obtained from the DPW and shown on the plan drawings. If a route-type plan is appropriate, the plan shall be at the top of the drawing. All applicable items shown on the drawing check list shall be clearly shown on the contract drawings using appropriate symbols and line weights shown in Chapter I. One copy of the checklist shall be submitted along with the final contract drawings.

2. Horizontal Location

Generally, water mains and structures within streets and adjacent developed areas shall be located in plan by dimensions from property markers or other well-defined physical features and by coordinates as stated in Chapter I. However, in areas where physical features are not available, and to facilitate GIS data base development, all significant system features should be coordinated including all transmission mains, valves, hydrants, vaults and fittings based on the Anne Arundel County coordinate system.

3. Profiles

Profiles shall be shown for all water mains in any location.

The profile shall be shown under the plan except where a block-type plan is used. Where a block-type plan is used, profile shall be shown on separate sheets.

The scale of profiles for water mains shall match the scale of the plan view horizontally and one-tenth the horizontal scale vertically. Profiles shall show all crossings of other utilities and clearance dimensions. 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.

4. Ground Over/Under Water Main

   Actual proposed or existing grade over the centerline of the water main shall be shown. Where mains are located in proposed paving or graded areas, existing ground over the centerline of the main shall also be shown.

   Where water main is to be constructed in fill, a profile of the undisturbed earth (at main location) shall also be shown.

   Other existing and proposed utilities shall be accurately and clearly shown in plan and profile according to the standard symbols in Chapter I, General Instructions. Structures or details not included in the Standard Details shall be clearly detailed on the contract drawings, preferably where the detail is used in plan.

E. Cost Estimates

   The design professional shall submit an estimate of project construction costs for each contract, including contingent items if requested by the DPW. The cost estimate shall be prepared as described in Chapter I, General Instructions.

IV. APPENDIX

A. References

B. Utility Design Water Check List

C. Water Demand by Zoning Classification (Residential Districts)

D. Water Demand by Zoning Classification (Non-Residential and Mixed Use Districts)

E. Flow Estimates for Capital Facility Connection Charges

F. Fire Flow Rates

G. Guidelines for Sizing Building Services and Meters

H. Nomograph for Pipes Flowing Full, Hazen-Williams

I. Minor Losses of Head in Equivalent Pipe Diameters

J. Maximum First Floor Elevations for Each Water Pressure Zone

References

American Society of Civil Engineers, "Pressure Pipeline Design for Water and Wastewater, Second Edition," ASCE, 345 East 47th Street, New York, NY, 1992.

American Water Works Association (AWWA), 6666 W. Quincy Avenue, Denver, CO 80235:

Cross Connection and Backflow Prevention, AWWA, 1974.

"M6 Water Meters-Selection, Installation, Testing, and Maintenance, Fifth Edition," AWWA, 2012.

"M9 Concrete Pressure Pipe, Third Edition," AWWA, 2008.

"M11 Steel Water Pipe, Fifth Edition," AWWA, 2019.

"M14 Backflow Prevention and Cross-Connection Control: Recommended Practice, Fourth Edition," AWWA, 2015.

"M23 PVC Pipe, Design and Installation, Third Edition," AWWA, 2020.

"M31 Distribution System Requirements for Fire Protection, Fourth Edition," AWWA, 2008.

"M27 External Corrosion Control for Infrastructure Sustainability, Third Edition," AWWA, 2013.

"M41 Ductile Iron Pipe and Fittings, Third Edition," AWWA, 2009.

"M58 Internal Corrosion Control in Water Distribution Systems, Second Edition," AWWA, 2017.

"Water Quality and Treatment: A Handbook on Drinking Water, Sixth Edition," ASCE, AWWA, and McGraw-Hill, 2011.

Anne Arundel County, "Standard Details for Construction," 2023.

Anne Arundel County, "Standard Specifications for Construction," 2023.

Ductile Iron Pipe Research Association (DIPRA), "Thrust Restraint Design for Ductile Iron Pipe, Seventh Edition," DIPRA, 245 Riverchase Parkway East, Suite 0, Birmingham, AL 35244, 2016.

HDR Engineering, "Handbook of Public Water Systems, Second Edition," John Wiley & Sons, 2001.

Insurance Services Office, Inc. (ISO) "Guide for Determination of Needed Fire Flow, Sixth Edition," ISO, New Jersey, 2014.

UTILITIES DESIGN

WATER CHECKLIST

The following checklist is provided to assist the design professional in developing complete plans to expedite review by the Department. This checklist is based on the Anne Arundel Department of Inspections and Permit Water and Sewer Checklist revised 2017. All final water and/or sewer plans for County capital projects submitted for review are to include a copy of the checklist(s) signed by a registered professional engineer in responsible charge with the firm. Submittals not including the checklist will be returned without review, comments, or approval.

Compliance with the checklist, however, in no way is meant to relieve the design professional of responsibility for project design.

LOCATION: _____

DATE: _____

CHECKED BY: _____

I. Cover Sheet

1. Title Block (Anne Arundel County Office of Planning and Zoning title block required on all sheets)
    i. Name of Project or Subdivision.
    ii. Anne Arundel County Project and Account Numbers.
    iii. Grant Number.
    iv. Sheet Title.
    v. Date.
    vi. Tax Map, Block, and Parcel.
    vii. Assessment District.
    viii. Zoning.
2. Vicinity Map
    i. Minimum 4”x4”
    ii. Located in upper right-hand corner of title sheet.
    iii. Oriented with North to the top.
    iv. Scale shown (1”=2000’).
    v. Roads labeled.
    vi. Site shaded and labeled.
3. Location Plan
    i. Scale 1”=200’.
    ii. North arrow shown.
    iii. Existing and proposed water and sewer lines shown and labeled.
    iv. Existing and proposed manholes shown and labeled.

v. Existing and proposed fire hydrants shown and labeled.
vi. Fire hydrant coverage shown.
vii. Coverage of individual plan sheet delineated.
viii. All road names shown.

4. Index of Drawing Table
    i. All drawing titles are shown in table and labeled accordingly.
5. General Notes
    i. Appropriate General Notes included for project type
    ii. Project specific notes added.
    iii. Agency titles and phone numbers correct.
    iv. Pipe material and material class correct.
6. Benchmark
    i. Number
    ii. Description and elevation,
    iii. Vertical Control NAVD 1929 or VAD 1988, consultant must indicate which is used.
    iv. Horizontal Control NAD83.
7. Bill of Materials
    i. Show quantity, type, and size of all mains and appurtenances.
8. Signature block with design consultant information
9. Legal name, address, and telephone number of the owner, developer, applicant, and design consultant

II. Plan Sheets

1. Recorded plat reference.
2. Street names and alignment.
3. Lot dimensions, lot numbers, and street address numbers.
4. Adjacent owners and tax account numbers in all areas up to 60 feet beyond end of main.
5. Legend including all line types used on plans.
6. Road surface: symbol and label.
7. State Road labeled on plan, where such roads are shown.
8. Dimensions between street lines and curb lines.
9. Arc Radii of curvatures along property lines if proposed main is crimped.
10. Crimp radius, beginning and ending stations, and offsets for curved water lines are shown.
11. “Full Trench Compaction” - Special bedding requirements indicated where required.
12. Existing utilities in proper symbols.
13. Show drawing numbers of all existing sewer plans.

14. Label all existing water, sewer and storm drains with appropriate County Public Drawing numbers.
15. Coordinates and bearings shown along centerline of water line.
16. Distance of existing dead ends from street center line, property line or macadam edge.
17. Dead end water mains do not exceed maximum length for size.
18. Check with gas, electric and telecommunication for existing utilities in all traveled roads.
19. Engineer to contact gas, electric and telecommunication for necessary relocations of existing utilities.
20. Proposed utilities in pencil, water accentuated by bold, heavy marking.
21. Drawing numbers of all proposed adjoining water plans.
22. Other proposed utilities checked against construction plans of same.
23. Proposed water services to be at least 10 feet minimum distance from existing or proposed sanitary connections.
24. Size and type of pipe shown in accordance with Design Manual.
25. Right-of-way/Easement reference.
    i. Bearings and distance shown.
    ii. Labeled public or private.
    iii. Labeled existing (include liber/folio) or proposed.
26. North Arrow, scale, and coordinate ticks (3).
27. Scale 1”=40’ (alternate scale must be approved in advance by OPZ).
28. Plan shown above profile on same sheet; if block plan provided with profiles on separate sheet, plan view shall indicate where each profile can be found.
29. Call out all valves that must be closed to make necessary tie-ins.
30. Proper location and distribution of valves and hydrants.
31. Mark limits of proposed or existing paving under this contract.
32. Blow-off or fire hydrant located at the end of each line, teed off five feet prior to end cap.
33. Minimum water main size - 4 inches.
34. Minimum water main size with fire hydrant - 8 inches.
35. Mains extended to limits of property (along frontage or through easement on site).
36. Fire hydrants located at road intersection where possible, and not end of cul-de-sac.
37. Fire hydrants spacing meets Fire Code requirements.
38. Three (3) valve shut-off provided to eliminate flow to a hydrant.
39. Extend main (at intersecting streets to rear line of lots).
40. Distance of proposed main from macadam edge, road center line or property line.
41. Distance of proposed water from proposed sewer: minimum 10 feet horizontal.
42. Size of proposed main indicated.
43. Adequate cover over pipe is provided.
44. Proposed and/or existing curb gutter - show symbol and label.

45. Traffic type meter frame and cover for setting located in existing or future driveway or roadway.
46. Special notes -- Such as meter note, jacking note, etc.
47. Benchmark - B. M. No. (if any) description and elevation.
48. Contractor's work clearly states as to limits in "Abandon existing water and transfer...." cases.
49. Restrictions, if any, as to number of connections in this particular Service Zone.
50. Twin service connections used where feasible.
51. Service connections larger than ¾ of an inch identified.
52. Service connections 4-inches and larger identified by type of service, i.e., combined, fire, domestics, separate fire and domestic, with appropriate std. detail called out where appropriate.
53. Service connection to be located at low end or middle of lot frontage, 15 feet from property line unless twin connections to be used.
54. Service connection shown for all lots.
55. Meters specified for each service connection.
56. Meters adequate size for proposed water meter/vault.
57. Easement provided where water meter is not located within road right-of-way.
58. Water profile scale 1"=40' horizontal and 1"=4' vertical
59. All fittings shown on plan and profile (symbol, size, and label).
60. Bill of materials -- quality and size (construction cost estimate).
61. Crossing detail -- crossovers numbered and computed.
62. Future crossing detail -- profile and elevation values.
63. Key sheet and position sheet identification on all plans.
64. Minimum right-of-way easement – 15 feet.
65. Right-of-way to be indicated on plan and clearly labeled as to existing or future.
66. Erosion Control Plan provided.
67. Engineer's seal and signature.

III. Specifications

1. Special provisions – All County capital projects and subdivision projects involving construction mechanical equipment such as weather booster station.
2. Project Name, County Contract Number, and engineers seal shown on cover sheet.
3. Index – all appropriate sections have been included.
4. Proposal form – submitted in duplicate.
5. Proposal form – quantities for contingent items based on engineered estimate.
6. County sign – all County projects.
7. Special provisions – minimize repetition of Standard Specifications and Standard Details.
8. Special provisions – summary of shop drawings, certification, catalog cuts, and other submittals required.

9. Special provisions – materials testing by independent agent through County inspection contract.
10. Inspection trailer, utilities and telephone service provided.
11. Testing and turnover procedures – separate section where appropriate.
12. Training requirements – separate section where appropriate.
13. Traffic Control Plan – all projects involving existing County roads.
14. List of changes to County Standard Specifications

IV. Miscellaneous

1. Quality Control
    i. Information shown in computations is the same as on plans
    ii. Corresponding information on plan view is same as on profile.
2. Plat
    i. Check easements/right-of-way shown on plans are shown on applicable plats.
3. Traffic Control Plan
    i. See Section VIII of the Standard Details for Construction.

Appendix C

Water Demand by Zoning Classification
(Residential Districts)

Zoning	Projected Population per Acre	Projected Dwelling Units per Acre	Projected Avg. Flow per Acre @ 100 gpd	Maximum Day Peaking Factor *	Maximum Day Demand gpd/DU *	Maximum Hr. Peaking Factor *
RA	0.54	0.1	54	2.7	-	3.8
RLD	0.54	0.2	54	2.7	-	3.8
R-1	2.59	1	259	2.7	699	3.8
R-2	4.71	2.5	471	2.7	509	3.8
R-5	8.96	3.5	896	2.4	614	3.5
R-10	18.81	10	1,881	2.4	451	3.5
R-15	25.88	15	2,588	1.9	410	3.3
TC	21.66	12	2,166	1.9	343	3.3
R-22	30.68	22	3,068	1.6	223	3.1

* For reference only. Maximum Day and Hour Peaking Factors differ by water pressure zone.

Appendix D

Water Demand by Zoning Classification (Non-Residential and Mixed Use Districts)

Zoning	Projected Avg. Flow per Acre	Maximum Day Peaking Factor *	Maximum Day Demand GPD/DU *	Maximum Hour Peaking Factor *
C1	1,300	1.4	1,820	2
C2	500	1.3	650	1.6
C3	1,300	1.4	1,820	2
C4	1,300	1.4	1,820	2
MA1	1,300	1.4	1,820	2
MA2	1,300	1.4	1,820	2
MA3	1,300	1.4	1,820	2
MB	1,300	1.4	1,820	2
MC	1,300	1.4	1,820	2
MXD-R	3,000	1.4	4,200	2
MXD-C	3,000	1.4	4,200	2
MXD-E	3,000	1.4	4,200	2
MXD-T	3,000	1.4	4,200	2
OTC districts	3,000	1.4	4,200	2
SB	1,300	1.4	4,200	2
W1	500	1.3	650	1.6
W2	500	1.3	650	1.6
W3	1,000	1.1	1,100	1.4

* For reference only. Maximum Day and Hour Peaking Factors differ by water pressure zone.

Appendix E

FLOW ESTIMATES FOR CAPITAL FACILITY CONNECTION CHARGES

Revised January 2023

DESCRIPTION OF FACILITY	AACO STANDARD
Adult Day Care	15 gpd/person
Assisted Living	75 gpd/person
Bar (no food service)	5 gpd/seat
Camps Day Camps (no meals served)	15 gpd/person
Camps Day Camps (meal served)	25 gpd/person
Car Wash (Rollover - Automated Self Service)	4,200 gpd/bay
Car Wash (Tunnel - Conveyer with Attendants)	7,400 gpd/bay
Car Wash (Wand - Handheld Self Serivce)	400 gpd/bay
Children Day Care	15 gpd/person
Church (NO CCC's -- FLOW ONLY) Add for ancillary services	4 gpd/seat
Commercial Auto Dealership	0.078 gpd/sq ft
Commercial Bakery	0.15 gpd/sq ft
Commercial Banks	0.04 gpd/sq ft
Commercial Barber Shops	0.20 gpd/sq ft
Commercial Beauty Salons	0.35 gpd/sq ft
Commercial Carry Out (no seating)	0.20 gpd/sq ft
Commercial Convenience Stores	0.18/gpd/sq ft
Commercial Department Store w/ Lunch Counter	0.08 gpd/sq ft
Commercial Department Store w/o Lunch Counter	0.04 gpd/sq ft
Commercial Drug Stores (not to exceed 2 EDU's)	0.13 gpd/sq ft
Commercial Garage (Auto-Truck Repair)	0.014 gpd/sq ft
Commercial Hotels/Motel/Extended Stay (add for restaurant)	120 gpd/unit
Commercial Laundries & Cleaners	0.31 gpd/sq ft
Commercial Laundromats	2.33 gpd/sq ft
Commercial Laundromats	185 gpd per washer
Commercial Medical Office Building	0.13 gpd/sq ft
Commercial Mixed or Uncertain Under One Roof	0.18 gpd/sq ft
Commercial Office Buildings	0.09 gpd/sq ft
Commercial Real Estate Inc.	0.09 gpd/sq ft
Commercial Retail Stores (stand-alone pad)	0.05 gpd/sq ft
Commercial Service Stations	0.18 gpd/sq ft
Commercial Shopping Centers/Strip Malls Under One Roof	0.18 gpd/sq ft
Commercial Supermarkets	0.20 gpd/sq ft
Commercial Warehouses	0.015 gpd/sq ft
Country Club/Pool House (add for restaurant) Total Each Fixture Below:	
Baths	300 gpd/bath
Showers	500 gpd/shower
Sinks	50 gpd/sink
Toilets	150 gpd/toilet
Urinals	100 gpd/urinal
Dance Hall/Night Club (add for food service)	5 gpd/seat
Doctor's Office	0.62 per sq. ft.
Dwellings Apartments	200 gpd/unit
Dwellings Single Family Townhomes	250 gpd
Dwellings Single Family (Separate)	250 gpd

Revised January 2023

DESCRIPTION OF FACILITY	AACO STANDARD
Factories/Manufacturing Plant exclusive industrial wastes	35 gpd/person/shift
Fire House	60 gpd/person/shift
Fraternal Service Organization (includes Elks, Knights of Columbus)	0.14 gpd/sq ft
Funeral Home	500 gpd
Group Homes	75 gpd/person
Health Club with Pool	
Showers	455 gpd/shower
Sinks	30 gpd/sink
Toilets	100 gpd/toilet
Urinals	65 gpd/urinal
Health Club without Pool	
Showers	325 gpd/shower
Sinks	30 gpd/sink
Toilets	100 gpd/toilet
Urinals	65 gpd/urinal
Hospitals	350 gpd/bed
Library	0.10 gpd/sq ft
Marinas	25 gpd/slip
Mobile Home Parks	200 gpd/space
Nursery School	4 gpd/child
Nursing Homes	125 gpd/bed
Post Office - Community (Not to exceed 2 EDU's)	0.089 gpd/sq ft
Post Office/Bulk Mail or Package Distribution Center	0.015 gpd/sq ft
Prison/Jail	125 gpd/bed
Public Parks Total Each Fixture Below:	
Faucets	15 gpd/faucet
Flush Toilets	35 gpd/toilet
Showers	100 gpd/shower
Urinals	10 gpd/urinal
Restaurants Conventional (includes bars where food is served)	25 gpd/seat
Restaurants, Fast Food	17.5 gpd/seat
Restaurants, Outdoor seating	8 gpd/seat
Schools, Boarding	100 gpd/student
Schools, Colleges	15 gpd/student
Schools, Elementary School	6 gpd/student
Schools, Middle School	8 gpd/student
Schools, High School	20 gpd/student
Sports Arena (add for food service)	5 gpd/seat
Surgical Centers	0.18/gpd/sq ft
Swimming Pools, Private community/hotel only - Additionally Total Each Fixture Below	500 gpd
Baths	300 gpd/bath
Showers	500 gpd/shower
Sinks	50 gpd/sink
Toilets	150 gpd/toilet
Urinals	100 gpd/urinal
Swimming Pools, Public (based on pool capacity)	10 gpd/swimmer
Theater-Arena (add for food)	5 gpd/seat
Theater-Dinner	25 gpd/seat
Theaters Drive-in	5 per/space
Theaters Movie	1 gpd/seat
Travel Trailer Parks w/individual water & sewer hookups	100 gpd/space
Travel Trailer Parks w/o individual water & sewer hookups	50 gpd/space
Veterinarians/ Kennels	0.18 gpd/sq ft

Appendix F

Fire Flow Rates

Use	Fire Flow
Residential (1)	
Single Family (2)	1,000 gpm at 20 psi residual
Townhouses (R-5)	1,500 gpm at 20 psi residual
Garden Type Apts. (R-15)	2,000 gpm at 20 psi residual
High-Rise Apts. (R-22)	2,500 gpm at 20 psi residual
Commercial (1)	
Regional Shopping Centers (C-3)	3,000 gpm at 20 psi residual
Office Buildings	3,000 gpm at 20 psi residual
Institutions (1)	
Hospitals	2,500 gpm at 20 psi residual
Schools	2,500 gpm at 20 psi residual
Industrial (1)	3,000 gpm at 20 psi residual

(1) Above fire flows to be used in the absence of site specific data from fire underwriters or construction plans, which would permit a determination of fire flow requirements using insurance industry standards (Insurance Services Office - ISO). Consideration will be given to reducing the requirement where proposed construction includes sprinkler systems; refer to current ISO recommendations.

(2) Consideration will be given to reducing the requirement to 750 gpm where it can be demonstrated the 1,000 gpm is technically unfeasible.

GUIDELINES FOR SIZING BUILDING SERVICES AND METERS

Having determined the available pressure at the water meter or other source of supply, subtract one half (1/2) pound per square inch pressure for each foot of difference in elevation between such source of supply and the highest water supply outlet in the building or on the premises. Use the "Pressure Range" group shown below within which this pressure will fall and then select the "Length" column which is equal to or longer than the total number of flush tank fixture units required by the Installation. Having located the proper fixture unit value for the required length, the sizes of meter and building supply pipe will be found in the two left-hand columns. In no case shall the building supply pipe be less than three-quarter (3/4) inch in diameter.

Meter & Street Service	Building Supply & Branches	Maximum Allowable Length in Feet					
		40	60	80	100	150	200
		Number of Fixture Units					
Pressure Range - 30 to 45 psi							
3/4"	**1/2"	6	5	4	4	3	2
3/4"	3/4"	18	16	14	12	9	6
3/4"	1"	29	25	23	21	17	15
1"	1"	36	31	27	25	20	17
1"	1-1/4"	54	47	42	38	32	28
1-1/2"	1-1/4"	90	68	57	48	38	32
1-1/2"	1-1/2"	151	124	105	91	70	57
2"	1-1/2"	210	162	132	110	80	64
1-1/2"	2"	220	205	190	176	155	138
2"	2"	372	329	292	265	217	185
2"	2-1/2"	445	418	390	370	330	300
Pressure Range - 46 to 60 psi							
3/4"	**1/2"	9	8	7	6	5	4
3/4"	3/4"	27	23	19	17	14	11
3/4"	1"	44	40	36	33	28	23
1"	1"	60	47	41	36	30	25
1"	1-1/4"	102	87	76	67	52	44
1-1/2"	1-1/4"	168	130	106	89	66	52
1-1/2"	1-1/2"	270	225	193	167	128	105
2"	1-1/2"	360	290	242	204	150	117
1-1/2”	2"	380	360	340	318	272	240
2"	2"	570	510	470	430	368	318
2"	2-1/2"	680	640	610	580	535	500

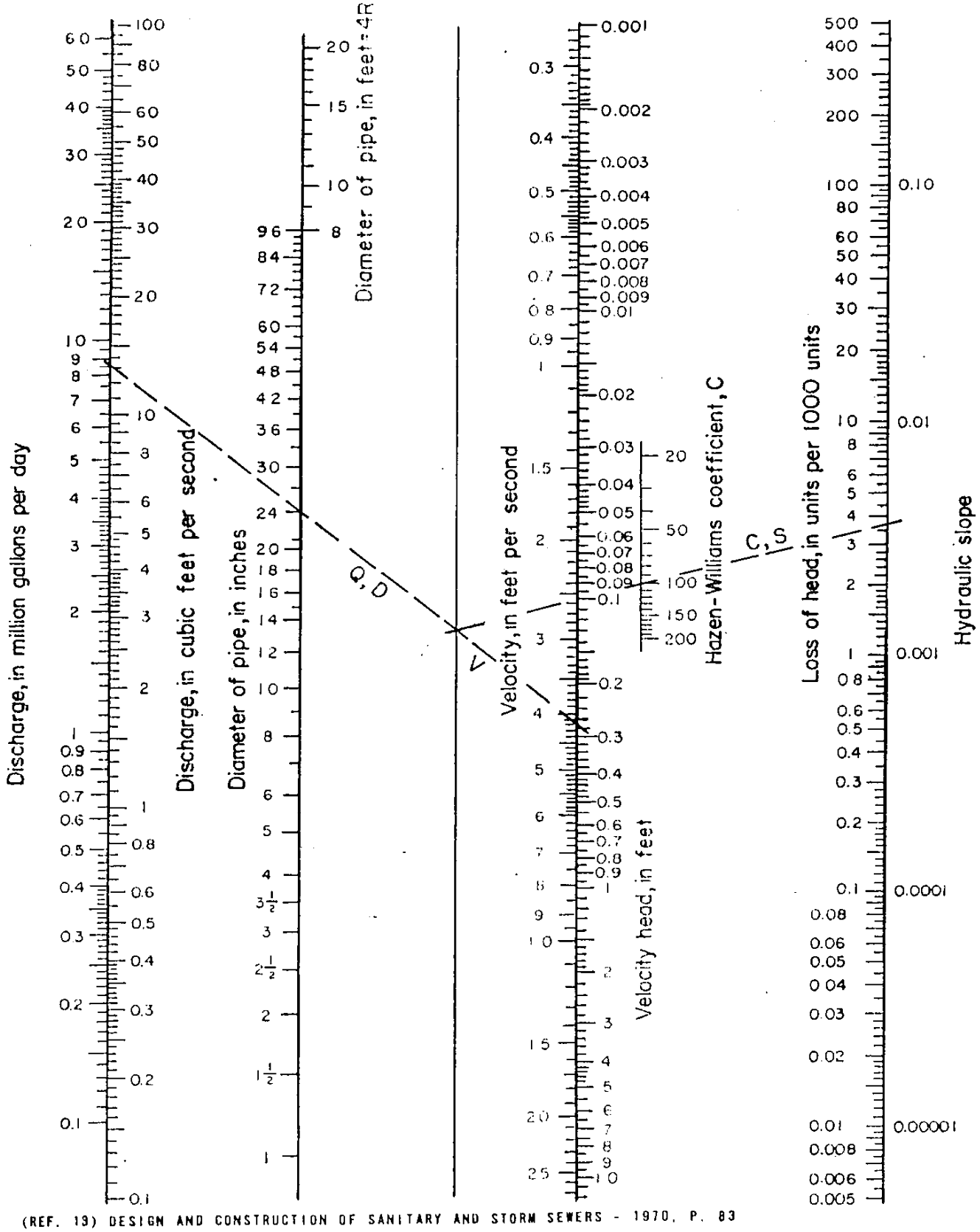
*Maximum Allowable Load on Meter
**Building Supply - 3/4" Minimum

Meter & Street Service	Building Supply & Branches	Maximum Allowable Length in Feet					
		40	60	80	100	150	200
		Number of Fixture Units					
Pressure Range - Over 60 psi							
3/4"	**1/2"	11	9	8	7	6	5
3/4“	3/4"	34	28	24	22	17	13
3/4"	1"	63	53	47	42	35	30
1"	1"	87	66	55	48	38	32
1"	1-1/4"	140	136	108	96	74	62
1-1/2"	1-1/4"	237	183	150	127	93	74
1-1/2"	1-1/2"	366	311	273	240	186	154
2"	1-1/2"	490	395	333	275	220	170
1-1/2"	2"	*380	*380	*380	*380	370	335
2"	2"	*690	670	610	560	478	420
2"	2-1/2"	*690	*690	*690	*690	*690	650

*Maximum Allowable Load on Meter
**Building Supply - 3/4" Minimum

APPENDIX H

HAZEN-WILLIAMS NOMOGRAPH



(REF. 13) DESIGN AND CONSTRUCTION OF SANITARY AND STORM SEWERS - 1970, P. 83

APPENDIX I

MINOR LOSSES OF HEAD IN EQUIVALENT PIPE DIAMETERS

Nature of Resistance	Loss in Pipe Diameters
Angle Valve	
Open	170
Check Valve	
Swing Type, Open	80
Gate Valve	
Wide Open	7
1/4 Closed	40
1/2 Closed	200
3/4 Closed	850
Globe Valve	
Open	340
Standard Elbow	32
Long Swing Elbow	20
45-degree Elbow	15
Tee	
Flow Through Run	20
Flow Side to Run or Run to Side	
No Throat	65
With Throat	45
Lateral	45
Sudden Contraction	
d/D = 1/4	15
d/D = 1/2	12
d/D - 3/4	7
Sudden Enlargement	
d/D = 1/4	32
d/D = 1/2	20
d/D = 3/4	7

Appendix J

Maximum First Flow Elevations
For Each Water Pressure Zone

Revised August 2023

Water Pressure Zone	Elevated Tank Overflow Elevation (feet)	Maximum First Floor Elevation (feet)	Water Pressure Sub-Zone	Sub-Zone Gradient (feet)	Maximum First Floor Elevation (feet)
Airport Square	350	230			
Broad Creek	210	90	Heritage Harbor	270	150
Broadneck / Glen Burnie Low	220	100			
Brooklyn Park North	210	90			
Crofton	290	170			
Gibson Island	160	40			
Glen Burnie High	295	175			
Herald Harbor	240	120			
Jessup	400	280			
Kings Heights / Odenton	330	210	Millersville	360	240
Maryland City	369	250			
Rose Haven	130	10			