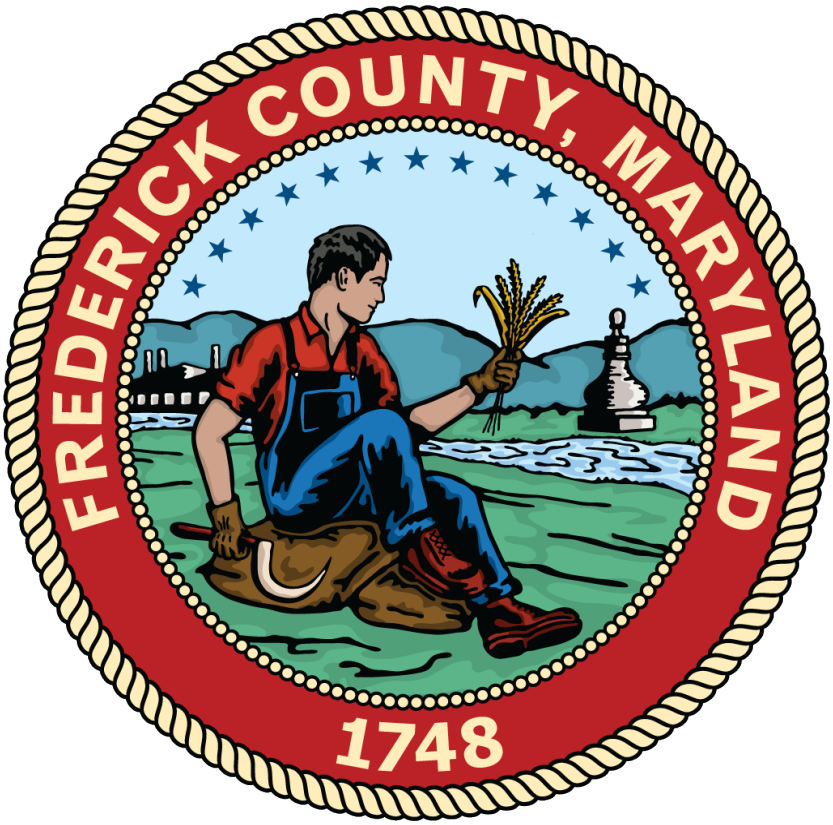
DESIGN MANUAL
FOR
WATER AND SEWER FACILITIES



FREDERICK COUNTY, MARYLAND
DIVISION OF UTILITIES AND SOLID WASTE MANAGEMENT
DEPARTMENT OF ENGINEERING AND PLANNING

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On October 4, 2016, a duly advertised Public Hearing was held in accordance with §2-13-30 of the Code of Public Local Laws for Frederick County to hear comments on the proposed changes to the Design Manual for Water and Sewer Facilties. As stated in the Design Manual, DUSWM has reserved the right to change items only within the Appendices of the Design Manual without a public hearing. These changes would be confined to matters involving regulatory or similar changes.

This Frederick County Design Manual for Water and Sewer Facilities is hereby approved and effective as of the 2nd day of January, 2017.

Jan H. Gardner

Jan H. Gardner, County Executive
Frederick County, Maryland

10/25/2016

Date

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DESIGN MANUAL FOR WATER AND SEWER FACILITIES

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CHAPTER 1. GENERAL

1.1. INTRODUCTION AND PURPOSE OF MANUAL

1.1.1. Administration

1.1.1.1. Severability of Provisions: In the event it is judicially determined that any word, phrase, clause, sentence, paragraph, section or part in or of these regulations, or the application thereof to any person or circumstances is invalid, the remaining provisions and the application of such provision to other persons or circumstances shall not be affected thereby; it being hereby declared that the remaining provisions of these regulations without the word, phrase, clause, sentence, paragraph, section or part in or of these regulations, or the application thereof, so held invalid would have been adopted and approved.

1.1.1.2. Conflict with Other Regulations

1.1.1.2.1. Whenever any provisions of these regulations conflict with any other provisions of law, whether set forth in these regulations, or contained in any restrictions covering any of the same subject matter, that provision imposed by the higher authority shall govern.

1.1.1.2.2. Nothing herein contained shall be taken as restricting any control that the Maryland Department of the Environment (MDE) is empowered to exercise within Frederick County.

1.1.1.3. Appeals

1.1.1.3.1. The Department Head of Engineering and Planning for the Division of Utilities and Solid Waste Management (DUSWM) or their designee is charged with the responsibility of interpreting this Design Manual for Water and Sewer Facilities (hereinafter "Design Manual" or "Manual"). Any deviations from the standards or criteria established in this Design Manual, which the engineer believes to be necessary for the completion of the design, must be submitted in writing to the Department Head. The deviations must be clearly identified and accompanied with justification why they are necessary. The Department Head will respond to the deviation request in writing, either approving or denying the request.

1.1.1.3.2. Written appeals of interpretations made by the Department Head of the Department of Engineering and Planning shall be sent to the Director of DUSWM for a decision. Appeals must be received within ten (10) working days of receipt of the Department Head's decision.

1.1.2. General – Planning

1.1.2.1. Objectives: This Design Manual has been prepared to emphasize good engineering practice in meeting the goals, objectives and policies contained in the *Frederick County Water and Sewer Master Plan*. Any private or public water and sewerage projects shall be required to be consistent with this Plan prior to beginning design and engineering.

Projects shall be required to have the appropriate Water and Sewerage Plan classification on the most recently adopted Plan maps prior to design and engineering.

1.1.2.2. The general requirements, design criteria and engineering practices as found in this document shall be consistent with any procedures or policies instituted in connection with *The Frederick County Adequate Public Facilities Ordinance*, *Zoning Ordinance* or *Subdivision Regulations*.

1.1.3. General Design

1.1.3.1. Objectives: This Design Manual is intended to provide a summary of information, procedures, criteria and practices that are applicable to the undertaking of public water and sewer projects within Frederick County. The design criteria and engineering practices set forth in this Manual with the latest revision of the *General Conditions and Standard Specifications for Water Mains, Sanitary Sewers and Related Structures* (hereinafter referred to as the "Standard Specifications") and the *Standard Details for Water Mains, Sanitary Sewers and Related Structures* (hereinafter referred to as the "Standard Details") outline requirements for the design of projects that are to be integrated into County water and sewer systems.

1.1.3.2. This Design Manual was developed to assist engineers in understanding various requirements associated with designing and building public water and sewage facilities in Frederick County. Capital improvement projects and land development projects, either sponsored by private developers or the County, must conform to the procedures, requirements and criteria set forth in this Manual.

1.1.3.3. This Manual is not intended to restrict the design professional with respect to innovation, practicality, economics or any other fundamental component of engineering. Effort has been focused in this Manual to augment opportunities for value engineering within the framework of design parameters established herein.

1.2. JURISDICTION

1.2.1. County

1.2.1.1. The DUSWM has responsibility for design, construction, operation and maintenance of the public water and sewer systems which it owns.

1.2.2. Private

1.2.2.1. Certain privately owned community and industrial water and sewer systems are not owned by the DUSWM and are not within its jurisdiction. These systems are under jurisdiction of the Maryland Department of the Environment and various other agencies. There are certain State-owned facilities in the County with water and sewer systems that are operated and maintained by State personnel. Also, there are water and sewer facilities in the County that are operated and maintained by Washington County. For the purposes of this Manual, State and Washington County systems are treated as privately owned systems.

1.2.2.2. Typically, the DUSWM's responsibility for water and sewer facilities ends at the property line or within an easement at the meter vault or sanitary sewer cleanout. The portions of water and sewer infrastructure located on a single, privately owned parcel are solely the responsibility of the private property owner.

1.2.3. Municipalities

1.2.3.1. County Standards: Several municipalities within the County own, maintain and operate water and/or sewer systems and have chosen to adopt all or parts of the *Standard Specifications* and the *Standard Details* for use in their systems.

1.2.3.2. Municipal Standards: In those instances where a particular municipality owns, maintains, and operates its own water and/or sewer system and has adopted standards that differ from the County's standards, it is incumbent on the design engineer to contact the respective municipality to obtain and comply with the necessary design and construction standards.

1.2.3.3. See the DUSWM Water and Sewer Services to Municipalities table located in Appendix A.

1.2.4. State and Federal

1.2.4.1. General: All construction, documents, and engineering related to water and sewer infrastructure within the State of Maryland are subject to the requirements of the Maryland Annotated Code and the Maryland Code of Regulations (COMAR).

1.2.4.2. MDE Approval: After review and approval, a construction permit is issued by the Maryland Department of the Environment (MDE) for lines over 15-inches in diameter and for pumping stations and treatment/storage works. This agency also acts as a control and coordinating agency on a statewide basis in establishing priorities for construction grants and loans associated with the Safe Drinking Water Act of 1986, Clean Water Act of 1977 (Public Law 95-217), and various regulations by the U. S. Environmental Protection Agency (EPA). During the construction process, MDE performs certain inspections to assure conformance with design intent. After the infrastructure is placed into operation, MDE performs inspections and requires various laboratory tests to assure water quality regulations are being adhered to. All aspects of the County water and sewer systems that are in operation must be under the responsible charge of persons who are MDE certified operators.

1.2.4.3. Other state and federal agencies exercising control over water and sewer projects with respect to location and siting of facilities include, but are not limited to:

- U. S. Army Corps of Engineers
- Maryland Department of Natural Resources
- Soil Conservation Districts
- Federal and State Highway Administrations

1.2.5. Other Agencies that may Require Coordination

1.2.5.1. CSX

1.2.5.2. Gas Utilities
1.2.5.3. Electric
1.2.5.4. Cable
1.2.5.5. Phone

1.3. PROJECTS DEFINED

1.3.1. Developer Projects: A typical developer project originates when a developer undertakes the subdivision of a parcel of land, as set forth in the County Subdivision Regulations. If the proposed development is in a properly classified area according to the County Water and Sewerage Plan, which designates when and what public water and/or sewage facilities are to be constructed, the development may proceed if other pertinent requirements are met. The developer will be required to underwrite completely the cost of construction of any public water and sewer utilities, as set forth in the Frederick County Water and Sewer Rules and Regulations. Subsequent requirements include the preparation of some or all of the following: hydrogeologic study, feasibility or site location studies, engineering report, construction plans and specifications, easement documents, legal documents, and the stakeout and inspection of the construction work.

1.3.2. Capital Improvement Projects

1.3.2.1. General: Capital Improvement Projects may originate by any of several administrative means, but the common identifying feature distinguishing it from a Developer Project is that funds for the implementation of the project are allocated by budgetary processes within the County. Capital Improvement Projects may involve the installation of major elements of the water or sewer system, such as: water supply and treatment, water transmission and storage, sewer outfalls, collection, interceptors, and treatment facilities.

1.3.2.2. Bids: Construction contracts for capital projects are bid in accordance with the County's procurement rules and regulations.

1.3.2.3. Joint County/Developer Projects: Design and/or construction contracts for joint County and Developer projects will be let or bid in accordance with County procurement rules and regulations. The developer will provide financial guarantees equal to the determined value of the developer's portion of the contracts.

1.4. SYSTEMS DESCRIPTION

1.4.1. General

1.4.1.1. Public water and sewer service is restricted by the County Code to serving those properties located within the County. No new privately owned community water and/or sewer systems are permitted in the County. Privately owned on-site systems that serve individual dwellings are under the jurisdiction of, and require permits from, the County Health Department.

1.4.1.2. The DUSWM and the Planning and Permitting Division (PPD) maintain a series of maps at various scales showing the location and size of both existing and planned elements of the County's water and sewer systems.

1.4.2. Water System

1.4.2.1. General: The County potable water system encompasses all features of a modern public water utility system including water supplies, treatment plants, a network of distribution mains, storage facilities, pumping stations and property service connections. The water utility system is designed to provide a hydraulically balanced system that accommodates fluctuations in consumer demands and furnishes adequate flow rates and pressures to support fire suppression in combination with other system requirements. Drinking water quality (water characteristics that determine its potability) is regulated by the Environmental Protection Agency (EPA) and the Maryland Department of the Environment (MDE). Sources of water supply can be either ground water (wells) or surface water (river, lake or spring). After treating water obtained from the source, the County provides water to the customer's property line at a controlled level of quality and pressure. Fire hydrants are included with the construction of distribution system mains. Water supplied to consumers is metered to each lot or residence at the point of use. The County utilizes a SCADA (Supervisory Control and Data Acquisition) system that "observes" the operational condition of the water system and permits quick response under emergency conditions. The County assumes full responsibility for the operation and maintenance of its water system that typically extends to and includes the customer's water meter (typically located at the property line according to the County's *Standard Details*), unless otherwise arranged via legal documents.

1.4.2.2. Pressure Zones: Because of the topography, the County's water systems are divided into pressure gradient zones in order to provide an acceptable range of operating pressures to consumers.

1.4.2.2.1. General: Pressure gradient elevations have been determined for both the existing distribution network and planned service areas. Zones are identified by the maximum pressure gradient available in terms of elevation above mean sea level. Zone boundaries are defined by the maximum and minimum ground elevations.

1.4.2.2.2. Gravity Pressure Zones:

ZONE #	TANK OVERFLOW	MAXIMUM GROUND ELEV.	MINIMUM GROUND ELEV.
1	473.00	373.00	243.00
2	610.00	510.00	373.00
3*	700.00	600.00	473.00
3**	737.00	637.00	510.00
4	870.00	770.00	637.00
5	1001.00	901.00	770.00
6	FUTURE	FUTURE	FUTURE

* Area served by Monrovia Tanks

**Certain Zone 3 areas of Linganore

1.4.2.2.3. Pumped Pressure Zones: Water pressure zones whose source of pressure is by booster pumping station or by mainline pressure reducing valves shall be designed to match pressure gradients of gravity pressure zones.

1.4.3. Sewer System

1.4.3.1. General: The County sewer system encompasses all features of a modern public sewer utility system including property service connections, collector sewers, trunk or interceptor sewers, pumping stations, treatment plants, and treated effluent outfall sewers. The sewer system is designed to collect wastewater from the customer's property line, convey the wastewater to a treatment plant, perform treatment processes to remove contaminants, and discharge treated effluent to a designated stream or river. The quality of treated effluent and residual sludge is regulated by EPA and MDE. Except in rare instances, wastewater collected from individual customers is not metered. The County assumes full responsibility for the operation and maintenance of its sewer system that typically extends to the customer's property line, unless otherwise arranged via legal documents. The County utilizes a SCADA (Supervisory Control and Data Acquisition) system that "observes" the various components of the sewer system and permits quick response under emergency conditions.

1.4.3.2. Sewer Service Areas: Sewer service areas are typically determined by the topographical boundaries of natural drainage basins. Typically, wastewater is collected by gravity from individual properties and flows by gravity to the lowest point in the collection system pipeline where the wastewater either undergoes treatment at a plant or is pumped to continue its conveyance to a treatment facility. Sewer service areas usually derive their name from the respective treatment plant or the neighboring service area that receives the wastewater.

1.5. PROJECT INCEPTION

1.5.1. Developer Projects

1.5.1.1. Service Area Classification: When a land developer desires to provide public water and sewer services to their proposed development, they must first submit a request to the Planning and Permitting Division (PPD), Department of Planning, for consideration. The Water and Sewer Planner will check the Water and Sewerage Plan and Comprehensive Land Use Plan to evaluate whether the proposed development area is properly classified for such service. If the area is not properly classified, the developer may submit a request for a plan amendment for the area to be reclassified.

1.5.1.2. Adequate Public Facilities: The existing system must have adequate capacity for the proposed project and the project must be in conformance with the Master Plan for Water and Sewer. If any of these requirements cannot be met, the developer will be so advised and will be directed to an alternative course of action. If the project meets the requirements of the *Frederick County Adequate Public Facilities Ordinance* (APFO), the existing system capacity is adequate and the DUSWM will issue an appropriate form of approval in the project review system. The DUSWM will provide the general financial requirements the developer must satisfy in order to continue with the project. If the project

is eligible for public water and sewer services, the developer will need to employ a Maryland Registered Professional Engineer to design the required infrastructure.

1.5.1.3. Engineering Reports: The engineer will begin the project by developing a preliminary report addressing the considerations set forth in the following chapter. The report will be used as the basis for a Public Works Agreement (PWA) or a Public Improvements Agreement (PIA) which dictate financial arrangements for engineering, inspection, and construction costs. Upon the receipt and approval of the preliminary letter report the engineering design of construction drawings is authorized. The requirement for an engineering report may be waived by the DUSWM depending on the size and location of the development.

1.5.1.4. General Procedure: For developer projects, the alignment of the water and sewer mains shall be located so that all existing and proposed lots/parcels shall front public water and sewer mains. These plans are submitted as either preliminary plans or site plans for review and comments through the Planning and Permitting Division, Department of Development Review, to DUSWM. The plans are then brought to completion by addressing all County agency comments. Upon approval of preliminary plans, the developer can proceed with preparation and submittal of improvement plans that provide the finished design for construction of any water and sewer system elements required. Upon receiving County comments, the resubmission shall be as aforementioned for final review and approval. Preparation, submission, and approval of appropriate deed of easements and fee simple property transfers must be completed to satisfy approval for construction. After approval by the DUSWM, the project is ready to advance to the construction phase. The final action by the developer is the financial settlement between the County and developer in accordance with the terms of the PWA or PIA as selected by the developer.

1.5.1.5. Public Works Agreement (PWA): For typical subdivision water and sewer construction, the developer, together with its contractor, arrange an agreement with the County relating to how the construction will proceed and the contractor will be paid. In this context, off-site construction refers to construction of County-owned water and sewer elements on lands not owned by the developer. The developer executes a PWA with the County and the contractor enters into a separate contract with the County for construction of the off-site water and sewer facilities. The developer provides funds for the County's use in paying the contractor and for the cost of related County inspection services.

1.5.1.6. Public Improvements Agreement (PIA): This agreement provides another option for the developer in constructing off-site water and sewer facilities to serve a project. The developer executes a PIA with the County, but the contractor works under a contract with the developer. In addition, the developer provides funds to the County to pay for both County and third-party inspection services.

1.5.1.7. Modified PWA (MPWA): For typical commercial site development, on-site construction refers to construction of non-County owned water and sewer elements on land owned by the developer. Such on-site work is usually accomplished through permits issued by the County Department of Permits and Inspections. However, for on-site projects located within the City of Frederick, and served by County sewer, a Modified PWA is required to be executed with the DUSWM as this document provides for County inspection compensation.

1.5.2. Capital Projects

1.5.2.1. Initiating Capital Projects

1.5.2.1.1. The DUSWM may initiate capital projects through staff planning based on its knowledge of requirements necessary to alleviate existing or projected problems in the overall operation of the systems.

1.5.2.1.2. The County Health Department may propose water and sewer capital projects that come to its attention through its responsibility in maintaining the public health and welfare.

1.5.2.1.3. The County Executive or County Council via the County Executive may request the creation of a capital project to originate the process on a project that has come to their attention.

1.5.2.2. Public Hearings: As required by the County Code, prior to action by the County Executive and County Council, public hearings are held to review the proposed budget items to display publicly all proposals for capital projects and to receive citizen comments relating thereto.

1.5.2.3. Consultant Contracts: Most of the preliminary engineering work associated with identification of capital projects is accomplished by DUSWM staff. After adoption and funding of capital projects is completed, it is typical for the County to hire consultant engineers to provide the detailed engineering for water and sewer projects. Consultant engineer selection is made in accordance with County regulations and policies. Contracts with consulting engineers on water and sewer projects will specify the scope of work, the schedule to be followed, and any other details normally associated with contractual procedures. Any deviations required to the consultant's scope of work will be addressed via change order to the engineering agreement. Unless otherwise specified, the engineer for capital projects will advance a project in the same general manner as described for developer projects.

1.5.2.4. Project Management: The engineer will prepare a concise report of the project describing the purpose and scope of work. A preliminary cost estimate and other items of an engineering nature as specified in subsequent chapters will be prepared. Review and approval routines, unless otherwise specified, will be followed as for developer projects. The design engineer's point of contact for issues relating to water and sewer projects is with the DUSWM. DUSWM will designate a Project Manager from its staff who will assume responsibility for monitoring the project, coordinating details, and reviewing reports, plans, specifications and other data to ensure that the engineer’s work satisfies County requirements.

1.6. CONSTRUCTION PLANS AND SPECIFICATIONS

1.6.1. Purpose: This section presents requirements for construction drawings and specifications.

1.6.1.1. Emergency: In order for the County to plan and provide necessary maintenance activities, including emergency repairs, etc., it is necessary that the plans are clearly drawn, can be accurately scaled, and show all information required for establishment as a permanent record. A bar scale shall be provided on each design drawing so that the sheet can be scaled no matter what paper size is used.

1.6.1.2. Construction Documents: Construction plans must communicate the scope of work for the project and all details necessary for the project to be constructed in the field. Specifications will define contractual relationships and conditions, material quality and workmanship quality. Drawings and specifications must be developed in sufficient detail to depict the elements and their spatial relationship with both existing conditions and planned future improvements. Work and scope definition must be complete to the extent that an inspector has adequate basis for accepting or rejecting the constructed work product.

1.6.1.3. Legibility: It is critical to note that drawings which are not legible or are clearly incomplete per the checklist located in Appendix B, may be returned without being reviewed or processed.

1.6.2. Construction Documents

1.6.2.1. General: The primary documents that form the basis for a construction contract are: the construction plans, the *Standard Specifications, General and Supplementary General Conditions,* and the *Standard Details*. Taken together, these documents represent written instructions to the contractor who, in turn, agrees to provide all means necessary to construct the project as shown on the drawings and as specified.

1.6.2.2. Responsibility: The engineer is expected to describe and display the work in accordance with appropriate standard of care. Sufficient detail must be provided so that both the County and the contractor clearly understand the scope of work and how the work is to be paid for. It is in this context that the County has adopted certain practices for the development of drawings that are coordinated with specifications and the administration of construction contracts for water and sewer projects.

1.6.2.3. Field Work and Data Collection: In preparing plans for construction, the design engineer is responsible to perform updated field surveys and to acquire record information on existing water and sewer elements from the DUSWM. Design engineers are ultimately responsible for verification of existing facilities and their representation on their drawings. Modifications may have occurred that are not reflected in the DUSWM's record drawings. Drawings shall reflect the most recent and accurate information available.

1.6.2.4. Presentation: Construction drawings must present information in both pictorial and text using formats, symbols, and notation as required in these guidelines.

1.6.3. Construction Specifications

1.6.3.1. General: The County has adopted *General Conditions and Standard Specifications for Water Mains, Sanitary Sewers and Related Structures* (Standard Specifications) for construction of water and sewer mains. The design engineer must utilize these standards

except when conditions call for provisions not included in the *Standard Details for Water Mains, Sanitary Sewers and Related Structures*.

1.6.3.2. Supplemental Specifications: In those instances where the County standards do not provide for what is required, the engineer can supplement the standards by providing notes on the drawings, modified pictorial views on the drawings, or separate specifications in a booklet.

1.6.3.3. Standard Format: The format in the *Standard Specifications* will be followed in the preparation of any supplemental booklets. If a section does not exist, it is suggested that the engineer follow the format established by the Engineers Joint Contract Documents (EJCD) Committee. At a minimum, the first page of supplemental specifications shall provide title of project, County Contract Number, date, engineering firm, and seal and signature of a Maryland Registered Professional Engineer.

1.6.3.4. Supplementary General Conditions, Special Conditions and Special Provisions: These sections are extremely important to the construction contract since they contain additions and modifications applicable to each project. The definitions for the aforesaid conditions and provisions are provided in the *Standard Specifications*.

1.6.3.5. Codes and Regulations: The construction design as delineated on the plans and specifications must reflect the most recent versions of all applicable codes and regulations, including but not limited to those associated with EPA, MDE, National Electric Code, OSHA, MOSHA, County Codes, handicap provisions, and the Americans With Disabilities Act. It is incumbent on the design engineer to keep abreast of any and all regulations and codes that affect water and sewer design.

1.6.3.6. Related Standards: In absence of specific design direction from any federal, state, and County requirements, the design standards found in the *Ten States Recommended Standards for Water and Sewer Works* as published by Health Education Services shall be consulted for water and sewer design development.

1.6.3.7. Professional Organizations: Design engineers are encouraged to incorporate standards and practices of recognized professional organizations such as: AWWA, WEF, ASCE, ASME, IEEE, CSI, etc.

1.6.4. Submitting Plans for Approval

1.6.4.1. Checklists: Prior to submitting plans to the County, the design engineer shall fully complete the checklist(s) for each sewer and water project, as applicable. The checklist shall be completed and attached to each set of drawings submitted for review. This shall apply to all capital projects as well as developer projects. A checklist is provided in Appendix B of this Design Manual.

1.6.4.2. Revisions to Approved Plans: If changes are required to the approved plans, initiated by the developer, contractor, or engineer, the original signed copies with the changes marked up, surrounded by clouding with a Delta number assigned and the revision blocks filled out shall be officially submitted to the Department of Development Review with the appropriate review fee. However, phasing revisions to approved plans shall be strictly controlled by the DUSWM. If an applicant wishes to break a plan into

multiple contracts, the original plan should be submitted, as a revision, with the other contracts "grayed back" or removed from the set. Then the contracts for the other phases will need to be submitted as a separate plan or plans. Phasing revisions will not be allowed once the contract is under construction. This criteria is to prevent continuity issues with construction from the standpoint of what must occur both in the field and administratively.

1.6.5. Design and Drafting Standards

1.6.5.1. Plan Media and Lettering

1.6.5.1.1. Drawing Size: All plan submissions shall be on 24"x 36" paper or mylar (depending on the step of the process). Borders shall be 0.5" minimum with a minimum 1" border on the left of the sheet. A standard title block should be located on the lower right corner.

1.6.5.1.2. Font Selection: Font shall be uniform, neat in appearance, and large enough to be read when reduced to half scale.

1.6.5.1.3. Drafting: Refer to the various plan checklists located in Appendix B for detailed requirements and be certain to include a horizontal and vertical datum.

1.6.5.2. Plan Cover Sheet

1.6.5.2.1. Vicinity and Locations Maps: The first sheet of all projects shall include a 1 inch = 600 feet scale vicinity map with three unique sets of grid coordinates arranged to form an "L". If the vicinity map cannot clearly show the location of the project site relative to at least two main roads, then a project location map shall be prepared at a scale of 1 inch = 2000 feet. The location map is required in addition to the vicinity map.

1.6.5.2.2. Position of Vicinity and Locations Maps: If a set of contract drawings contains only one or two drawings, the vicinity map shall be placed at the upper right portion of the first drawing. Whenever there are three (3) or more drawings to the contract, then the first sheet shall be designated as a title drawing with the location map centered on the drawing.

1.6.5.2.3. Other: The vicinity map shall show a north arrow, proposed project boundaries, contract number or proposed work, and boundaries of adjacent existing and future contracts.

1.6.5.2.4. Information: Provide, under or near the vicinity map, an informational block containing the following: water pressure zone, number of lots, number of estimated equivalent dwelling units (EDU), use of buildings/structures, and sewer service areas. In addition to the vicinity and/or location maps, the drawing shall show the contract title, contract number, engineer's name, address and telephone number, and developer's name, address and telephone number.

1.6.5.2.5 General Notes: The first sheet of a set shall show the General Notes pertaining to the contract. See Appendix A for the text of these notes. If the General

Notes cannot be placed on the initial drawing, a note shall be included on that sheet indicating on which sheet the General Notes appear. When applicable, the engineer shall provide additional General Notes indicating pipe materials, special meter requirements, abandoning requirements, etc.

1.6.5.2.6. Filing: For convenience in filing, a note shall be placed immediately above the title block on the right side of each cover sheet indicating the title of the project and its contract number.

1.6.5.2.7. Sheet Index Schedule: On projects with three (3) or more sheets total, a sheet index schedule shall also be shown on the title sheet indicating the purpose of each sheet.

1.6.5.2.8. Index Map: On projects with four (4) or more plan view sheets, an index map showing the plan coverage of each sheet shall be shown together with the corresponding drawing number for ready reference. Scales of index maps are typically 1 inch = 200 feet. At a minimum, sheet index maps should show street names, proposed mains, valves, manholes, and all rights of way and easements.

1.6.5.2.9. As-built Tabulations: If space permits, the first sheet shall also include a tabulation of materials with columns for: bid quantity, as-built quantity, and material/supplier. A standard "quantities box" is supplied in Appendix A.

1.6.5.2.10. Revision Block: Revisions are noted in the appropriate location of the Development Review or DUSWM signature block, as applicable.

1.6.5.3. All Plan Sheets

1.6.5.3.1. PE Seal: Each sheet shall bear the official stamp and the original signature of the professional engineer registered in Maryland who is responsible for the work. Any other COMAR requirements should also be appropriately addressed.

1.6.5.3.2. Signature Blocks: See Appendix A for the required form of the signature block.

1.6.5.3.3. Scales: Each sheet shall indicate the horizontal and vertical scales. Typically, horizontal scales are smaller than 1 inch = 50 feet and vertical scales are 1 inch = 5 feet. Some commercial, industrial and townhouse site plans use 1 inch = 30 feet. Generally, all pictorial views for construction purposes shall be drawn to scale. Views "not-to-scale" are permitted to present schematic or diagrammatic information where spatial relationship is not essential.

1.6.5.3.4. Other: Each sheet in the complete set of drawings shall provide a contract title. Starting with the first sheet, each shall be numbered successively. When drawings cover more than one section, phase or contract, an index sheet shall be provided showing existing, proposed and future sections, phases or contracts. The DUSWM shall ultimately determine the number of phases that may be covered by one set of contract drawings. However, given proper planning, the DUSWM will reasonably accommodate phasing requests so long as the limits are clearly demarcated on the originally approved set and determined by logical breaks at

sewer manholes or by lamphole cleanouts where manhole locations are not feasible. Waterline contract limits must consider valve and hydrant locations as temporary caps and blowoffs are required at terminus points.

1.6.6. Design Considerations and Presentation

1.6.6.1. Existing, Proposed, and Future Conditions

1.6.6.1.1. Proposed: "Proposed" indicates those utilities, easements, buildings, roads, etc. that are intended to be constructed as defined by the plans in hand. Abbreviated as PROP on the drawings.

1.6.6.1.2. Existing: "Existing" indicates those utilities, easements, buildings, roads, etc. that have been constructed and exist (or are considered to exist) at the time the plans are submitted for review. Abbreviated as EX on the drawings.

1.6.6.1.3. Future: "Future" indicates those utilities, easements, buildings, roads, etc. that are either planned for construction subsequent to the proposed work or under concurrent design by others. Abbreviated as FUT on the drawings. Future work shall be "ghosted" on the drawings to more readily delineate these features.

1.6.6.2. Linework: Proposed conditions of work are to be drawn with bold lines. Lightened, dashed lines are used for existing and future conditions.

1.6.6.3. Field Survey: In order to develop the required information to scale, the engineer shall establish accurate horizontal and vertical control points along the route or on the site area. Vertical Datum shall be NAVD 88.

1.6.6.4. Limits of Area to be Shown: The limits of the area to be shown on the drawings may vary to some degree on various types of projects, but in general for capital projects the area covered is usually a continuous strip covering a minimum of 100 feet on each side of the proposed facility, and 200 feet beyond the end of proposed pavement for future roadways. For developer projects, the limits of the area shown shall include as a minimum all features within a 100 foot radius from any proposed construction.

1.6.6.5. Utilities, Structures and Other Features.

1.6.6.5.1. All utilities, structures, topography, landscape and cultural features must be clearly and completely depicted. A tabulation of drafting symbols is given in the *Standard Details*. As a minimum, features to be depicted include, but are not limited to, those in *Standard Detail* §1.1.

1.6.6.5.2. Size, horizontal and vertical location of all existing, proposed, and future surface and sub-surface utilities including, but not limited to: water, sewer, gas, electric, cable TV, together with their respective rights-of-way and easements: Provide typical width dimensions of standard easements and rights-of-way. This information is developed from field surveys, other proposed plans, as-built plans, and information provided by the owner of the respective utility.

1.6.6.5.3. Test Pitting: It is incumbent upon the design engineer to determine (in

advance of construction plan approval) locations of existing utilities or underground structures by means of digging test pits.

1.6.6.5.4. Contract Numbers: Identify and reference County contract numbers of all existing and proposed facilities within and adjacent to the project limits.

1.6.6.5.5. Identify all buildings and other structures within and immediately adjacent to the project limits with all improvements, including wells, septic tanks, drainfields, etc.

1.6.6.5.6. Identify roadway pavements, curb lines, driveway entrances, walkways, fences, walls, etc., including types of materials, widths, heights, and all other descriptive data.

1.6.6.6. Property and Site Information: In new developments where the terrain is being transformed, most of the information shall be obtained directly from approved preliminary or site plans prepared to satisfy planning or subdivision requirements. In this case, the water and sewer plans shall show all proposed improvements including curbs, storm drains, street rights-of-way, and lots as taken from the record plat. Also, construction drawings shall show all existing features that are to remain undisturbed. Property information to be shown is as follows:

Owner name(s) of adjacent properties.

Deed and recording references, including parcel number, lot number, Tax ID#, subdivision name and record plat references(s).

Property survey pipes, monuments or markers, if any.

Street address, if available.

1.6.6.7. Peripheral Easements: To provide for future development, easements to provide water and sewer service to properties adjoining those served by the proposed contract must be established on the development property. This voids inadvertent creation of island parcels that become excluded from water and sewer access.

1.6.6.8. On-Site Water and Sewer: For certain industrial and commercial applications, the water and sewer mains on private property are typically privately owned and maintained. The construction is inspected by the Department of Permits and Inspections staff unless the project is located within the City of Frederick. The interface between the County and the private mains must be clearly indicated on the plans. Also, it is advisable to provide the name, address and telephone number of the private owner.

1.6.6.9. Non-Dedicated Street Water and Sewer: For certain townhouse and apartment developments, the water and sewer system is to be owned and operated by the DUSWM, but the system is to be installed in streets that are to remain privately owned. The DUSWM will have authorized access to maintain the system through appropriate deeded easements that will be clearly indicated in the plans.

1.6.6.10. Other Municipal Water and Sewer: When the water and sewer is to be owned and operated by a municipality or in some way involves another municipality, the nature of the relationship shall be noted on the plans. The municipality should be identified, including a contact person. The applicable design and construction standards shall be identified. See DUSWM Water and Sewer Services to Municipalities table in Appendix A.

1.6.6.11. Trees: The project shall comply with the provisions of the Frederick County *Forest Resource Ordinance* (FRO). Existing trees shall be removed from proposed easements. Proposed trees shall be kept a minimum distance of twelve (12) feet from DUSWM infrastructure to reduce future tree root damage. Construction drawings shall include special trenching and root trimming details when trenching within the drip line of existing trees.

1.6.6.12. Water Courses: Water courses such as streams, swales, and ditch areas, shall be shown and located including width, depth and water depth, and drainage area at the utility crossing, if applicable. Water courses shall be contoured from field data together with the 100-year flood plain and elevation shown on the drawings. Contours shall be shown on both sides of the water course and extended at least 100 feet beyond the parallel alignment of the proposed facility. The impacts of water courses and the expense of construction and maintenance accessibility after the construction is placed into service shall be considered. Construction may be delayed considerably because of the time required to obtain necessary waterway construction and various wetland permits.

1.6.6.13. Encroachments: Encroachments of water and sewer in easements and rights-of-way not under the jurisdiction of the County shall be avoided unless compelling reasons are presented. Encroachments on utilities not under the jurisdiction of the County shall be avoided wherever possible, for example, privately maintained storm drains. Trees, fences, and structures such as footers are considered to be encroachments when situated in water and sewer easements. Requests for permission to encroach in a water and sewer easement should be made to the DUSWM. Routing a water and sewer pipeline through non-County rights-of-way such as State highways and railroads is undesirable from a long-term maintenance perspective. However, when required due to lack of other options, it may require substantial time for negotiating agreements and obtaining permits.

1.6.6.14. Restoration: In developed areas, a restoration table shall be provided. The table shall cover the entire limits of the project. Restoration items shall include, but are not limited to: roadways, grassed areas, driveways, fences, etc. The table shall clearly specify the location and material to be restored.

1.6.6.15. Miscellaneous

1.6.6.15.1. Existing and proposed embankments and other irregularities of terrain, including roadside drainage ditches, shall be shown and spot evaluations of top and bottom of bank shall be provided to prove adequately positive drainage.

1.6.6.15.2. Vehicular access routes for off-road or undeveloped areas shall be identified for use during construction. Consideration must be provided for maintenance access following project completion.

1.6.7. Plan and Profile Views

1.6.7.1. General

1.6.7.1.1. Labeling: Mainline pipe sizes are indicated in plan and profile view as 8" W, 12" W, 8" S, 16" S, etc. Service connection pipe size shall be indicated in the general notes and connection tables. Existing is abbreviated as EX, proposed as PROP, and future as FUT.

1.6.7.1.2. Rights-of-way: Rights-of-way, street pavements, and easements shall be shown in both plan and profile. Width dimensions of each straight run segment shall be shown in plan view. Maryland state roads shall be identified by route number and Maryland State Highway Administration (SHA) plat number, if available.

1.6.7.1.3. Location: Almost always, plan view shall be accompanied by a corresponding profile view. Features labeled in the plan view require corresponding labeling in the profile view. For mainline layout, the profile view shall be located directly below the plan view. For some townhouse developments, the profile view can be shown on a separate sheet if the view is cross-referenced to the plans.

1.6.7.1.4. Profile Axis: Both sides of a profile view must show a vertical axis with major ticks at 5-foot elevation intervals. Each major tick must be labeled with appropriate elevation. Horizontal scale shall not be less than 1-inch = 50 feet.

1.6.7.1.5. Orientation and Titles: All plan and profile views shall be appropriately titled and be oriented the same from right to left. Typically, a title includes street name, and whether the project is water or sewer. Occasionally, profile views require the compass direction indicated.

1.6.7.1.6. North: Every plan sheet or view shall have the true north direction indicated. Good drafting standards dictate that the North Arrow should always point to the top of the sheet

1.6.7.1.7. Water and sewer service connections shall be shown to the property (or easement) line in plan views.

1.6.7.1.8. Combining Profiles: When water and sewer mains are separated by a horizontal distance of ten (10) feet or less, the profile of each main can be combined in one view. If the finished grade elevation between the water and sewer line locations exceeds one foot, separate profiles will be required.

1.6.7.1.9. Limits of Work: Contractor's work limits and access road shall be clearly indicated.

1.6.7.1.10. Benchmarks: Except as described below, the licensed surveyor shall provide a minimum of three (3) temporary benchmarks for any project. The appropriate number of temporary benchmarks will be determined by the DUSWM based upon the size of the project. An exception to the minimum temporary benchmark requirement of three (3) can be granted by the Department Head or

designee when a very small project justifies an exception.

1.6.7.1.11. Grid Ticks: At least three State grid ticks shall be shown on every plan sheet.

1.6.7.1.12. Pipe Material: Type of pipe material and class should be indicated in the profile view and quantities table. Example: DIP CL52 for water mains and PVC (SDR 35 or 26) for gravity sewer mains.

1.6.7.1.13. Detail Numbers: When the *Standard Details* are used, the detail numbers shall be indicated in both plan and profile view or in a general note. This practice is helpful to contractors unfamiliar with the DUSWM standards and reduces the number of problems encountered in the field.

1.6.7.1.14. Match Lines: Where continuity of views is interrupted, indicate the appropriate sheet number or location where the view continues. When there are multiple contracts associated with one development project, each contract shall be drawn to the same orientation from right to left in such a way that no sheets need to be inverted or rotated to match with sheets on adjacent contracts.

1.6.7.1.15. Borings: If special subsurface or boring information is available, it shall be indicated. Also, any structural fill requirements shall be indicated.

1.6.7.1.16. Floodplain: Show 100-year flood delineation.

1.6.7.2. Stationing

1.6.7.2.1. General: Water and sewer mains shall be stationed from a vertical plane through the centerline of the piping.

1.6.7.2.2. Non-Dedicated Street: Where the main is not located in a dedicated street, the horizontal dimension on the profile will reflect the horizontal distances along the centerline of the main as viewed in the plan. The stations on the water profile shall be the actual stations measured horizontally along the water main and the stations on the sewer profile shall be the actual horizontal stations between manholes.

1.6.7.2.3. Dedicated Street: Pipe centerline shall be used to develop the profile view.

1.6.7.3. Ground Line Delineations: The ground line on the profile sheet shall represent the elevations along the centerline of the pipe. Where the proposed street grade differs from the existing grade by one (1) foot or more, the existing grade will be indicated by a dash line and the proposed centerline grade by a solid line. When the water or sewer line is not located within a dedicated street, the ground lines on the profile shall represent existing and proposed elevations along the centerline of the water or sewer main.

1.6.8. Water Mains –MDE Waterline Bacterial Testing

Requirements add the following note to the plans:

"Disinfection and Verification Testing will be performed in accordance with AWWA C651-05, or the latest edition. The contractor shall be required to have bacterial testing performed on all new water mains to demonstrate bacterial levels that meet State MDE requirements prior to the DUSWM granting Conditional Acceptance on the contract. Requirements include, but are not limited to, obtaining two (2) consecutive sets of acceptable samples that have been collected a minimum of 24 hours apart. One sample shall be collected for every 1200 feet, at the end of each branch and the end of the line for residual chlorine, total coliform and *E. coli* analysis. After disinfection the line must be flushed. Chlorine residual samples must yield a result of 1.0 ppm or less before Total Coliform or *E. coli* analysis may be performed. All sample collections shall be performed by individuals certified for drinking water sample collection by the MDE for Total Coliform and *E. coli* analysis. If the contractor has allowed contaminants to enter the pipe during construction (this shall be determined by the inspector) then sampling may be required at reduced distance intervals as determined by the DUSWM. Disinfected water (of chlorine residual 1.0 ppm or less) must stand in the line for at least 16 hours after a final flush. Certified bacterial test results shall be provided to the DUSWM and shall include certification information for both the sample collector and laboratory."

The DUSWM reserves the right to change waterline testing as necessary to meet any governing regulations.

1.6.8.1. Plan View

1.6.8.1.1. Scale: Plans shall be drawn at a scale of 1 inch = 50 feet, or larger, that is, 1 inch = 30 feet.

1.6.8.1.2. Preliminary Plan Compliance: Plan layout of water main should comply with preliminary plan, except for minor changes of alignment. All lots within 200 feet of the main shall have access to the main.

1.6.8.1.3. Location: All County owned water mains, appurtenances, and service piping shall be located in a public right-of-way, in County-owned property, or in an appropriate easement.

1.6.8.1.4. Representation: Pipe lines 24 inches in diameter and smaller shall be shown symbolically at two (2) feet wide at the scale designated. Pipe lines with diameters greater than 24 inches shall be depicted to scale.

1.6.8.1.5. Appurtenance Symbols: Fittings, valves, hydrants, and other appurtenances shall be shown by symbols and identified by size and type, for example, 6" T, 8" V, in both plan and profile view.

1.6.8.1.6. Water Service Connections (WSC): WSC shall be shown as a pipe from the main to a meter at the property line. The WSC size must be labeled, for example 1", in the general notes or as typical, in the plan view.

1.6.8.1.7. Meter Vaults: For large commercial meters, show meter size, vault footprint, and bypass piping, all to scale and within a min. 20'x30' easement. Indicate vault standard detail number.

1.6.8.1.8. Joint Restraint: When joint restraints are required, for example, Megalugs®, indicate where to be used and the related restrained joint length. All "public" valves and fittings are to be MJ restrained joint.

1.6.8.1.9. Crossings: For road, stream, irregular terrain, etc., excavations and crossings, show method of construction in both plan and profile view. Sometimes a larger scale is required. Also, show any special construction needed to protect water main when in close proximity to sewer or other pipes, etc.

1.6.8.1.10. Alignment: Horizontal and vertical alignment must be configured to follow changes in street alignment and to pass obstructions with adequate clearance for maintenance and construction. Alignment changes are accomplished by bends and joint deflection. When pipe is deflected, the equivalent pipe radius shall be shown for each curved segment of pipe.

1.6.8.2. Profile View

1.6.8.2.1. Scale: Profiles shall be at the same horizontal scale as the plan, typically a scale of 1 inch = 50 feet horizontal and 1 inch = 5 feet vertical. Show the main pipe size and pipe material type. Main pipe, air release structures, etc. shall be shown to profile scale, with no exceptions.

1.6.8.2.2. Grades: Show existing, proposed, and future grades.

1.6.8.2.3. Dimensioning: Profile dimensioning shall refer to pipe invert.

1.6.8.2.4. Stationing: Develop stationing from centerline of pipe. Plan view stationing and corresponding inverts shall be provided at 100-foot intervals, fittings and appurtenances. Valves immediately adjacent to tees and WSC locations do not require stationing.

1.6.8.2.5. Labels: Indicate lot number and location for each WSC. Show valves, fittings, etc., by a symbol on the main line.

1.6.8.2.6. Crossings: For any crossings of water mains and sewer or other utilities, indicate a minimum clearance dimension, typically one (1) foot.

1.6.9. Sewer Mains

Work contained in Section 2571 of the *General Conditions and Standard Specifications for Water Mains, Sanitary Sewer and Related Structures* shall be executed to the fullest extent. Place a note on the plans:

"All public gravity sewer lines, including laterals, shall be televised as a condition of inspection in order to obtain substantial completion. Prior to televising, the sewers shall be flushed to clear debris and to readily discover any standing water. All televising shall be referenced to the specific section of the line being inspected (laterals shall be referenced to a lot number) and provided in DVD format to the DUSWM for review. The video results must be viewed and approved by the DUSWM prior to acceptance of the sewer line. Televising firms must be submitted and approved by the DUSWM prior to their use."

1.6.9.1. Plan View

1.6.9.1.1. Scale: Plans should be drawn at a scale of 1 inch = 50 feet, or larger (example: 1 inch = 30).

1.6.9.1.2. Preliminary Plan Compliance: Plan layout of sewer main shall comply with the approved preliminary plan, except for minor changes of alignment. All lots within 200 feet of the main shall have access to the main. Major revisions shall not be permitted without County approval.

1.6.9.1.3. Location: All County owned sewer mains, appurtenance and service piping shall be located in a public right-of-way, in County property, or in an appropriate easement.

1.6.9.1.4. Representation: Pipe lines 24 inches in diameter and smaller shall be shown symbolically as two (2) feet wide at the scale designated. Pipe lines with diameters greater than 24 inches shall be depicted to scale.

1.6.9.1.5. Manhole Numbering: Manholes shall be numbered in consecutive order starting with the lowest invert elevation and proceeding uphill.

1.6.9.1.6. Flow Direction: Indicate flow direction with arrow head above pipe.

1.6.9.1.7. Appurtenance Symbols: Fittings and appurtenances shall be shown by symbols and identified by size and type, for example, 8" STUB, in both plan and profile view.

1.6.9.1.8. Sewer Service Connections (SSC): SSC will be indicated by a single heavy line from the main (preferably in a perpendicular direction from the main) to a cleanout at the property line.

1.6.9.1.9. Cleanout Inverts: The plan shall indicate minimum service elevation and cleanout invert for each lot. This represents the lowest floor elevation that may be serviced by a gravity sewer main.

1.6.9.1.10. Commercial: Commercial or industrial lots may, if desired, have a minimum service elevation specified that allows gravity flow from the most distant part of the lot. If a slope of less than 2% is proposed, the proposed size and slope of the main shall also be provided.

1.6.9.1.11. Crossings: For road, stream, irregular terrain, etc., excavations and crossings show method of construction in both plan and profile view. Sometimes a larger scale is required. Also, show any special construction needed to protect sewer main when in close proximity to storm drains, other pipes, etc.

1.6.9.1.12. Alignment: Horizontal and vertical alignment must be configured to follow changes in street alignment and to pass obstructions with adequate clearance for maintenance and construction. Alignment changes are accomplished by raising or lowering the pipe or providing manholes.

1.6.9.2. Profile View

1.6.9.2.1. Scale: Profiles shall be at the same horizontal scale as the plan, typically a scale of 1 inch = 50 feet horizontal and 1 inch = 5 feet vertical. Main pipe, manholes, structures, etc. shall be shown to profile scale, with no exceptions.

1.6.9.2.2. Grades: Show existing, proposed and future grades.

1.6.9.2.3. Slope: Indicate slope of main in percent.

1.6.9.2.4. Stationing: Develop stationing, preferably from centerline of pipe. Next best is to develop from the centerline of the road or right-of-way. Begin stationing, that is, 0+00, at each manhole axis and proceed upgrade to next manhole axis.

1.6.9.2.5. Labeling: Indicate lot number and show location and station for each SSC.

1.6.9.2.6. Cleanout Invert: Each cleanout invert in plan view shall be labeled with its corresponding station. Such SSC data shall be provided in tabular form for all plans.

1.6.9.2.7. Service Drop Connections: Determine when drop service connections are required and label them as "SSDC".

1.6.9.2.8. Manhole Inverts: Indicate invert elevations and whether in or out at all connections to manholes. When more than two mainline connections, indicate compass directions of each main relative to the vertical axis of the manhole.

1.6.9.2.9. Drop Connections: Determine when drop manhole connections with mainline are required and show same with symbol and label as Type E or F or Inside.

1.6.9.2.10. Manhole Numbers: Indicate manhole number and rim elevation. Also provide a watertight cover, that is, "WT", if manhole rim is below 100-year flood level, a drainage swale or other areas susceptible to flooding manholes.

1.6.9.2.11. Crossings: For any crossings of sewer mains and sewer or other utilities, indicate a minimum clearance dimension, typically one (1) foot outside of pipe to outside of pipe.

1.6.9.2.12. Stream Elevations: Provide the elevation of a stream or swale bottom that parallels within 50 feet of a proposed sewer. Ensure the sewer depth is sufficient to allow another gravity sewer to cross under the stream or swale and connect.

1.6.10. Facilities and Related Structures

1.6.10.1. General: When using water and sewer utility terminology, the term "facility" as used in this Manual refers to non-mainline piping elements such as treatment plants, pumping stations, storage tanks, interceptor flow meters, rechlorination stations, pressure

reducing valves, control buildings, etc. A facility typically has some form of electrical equipment and/or automatically operated mechanical components.

1.6.10.2. Schematics and Sketches: Drawings and specifications for facilities typically involve unique and non-recurring design features that require considerably more individualized drafting effort and specification research than the typical pipeline design. Also, facility design involves coordination of a variety of technical disciplines. In most instances, the design engineer can economize on drafting effort by first preparing sketch plans and schematic diagrams for planning and preliminary design submittals. Preparation of formal construction drawings can begin after conceptual decisions associated with the sketch plans are approved.

1.6.10.3. Scale: Except for schematic diagrams and reproductions of package components, drawings shall be made to true scale. It is incumbent on the design engineer to verify the size, dimensions, and interface requirements of all components or features employed in the design.

1.6.10.4. Requirements: Although detailed design, drawing and specification requirements may be presented in the individual chapters dealing with facilities, all requirements found in Chapter 1 herein are applicable as a minimum.

1.6.10.5. Standardizations: The designer shall consult the DUSWM to determine, which components, process schemes, etc. have proven performance and support histories.

1.6.10.6. Site Ownership: In most cases, the facility site, including any driveway access, will be owned by the County. For developer projects, the property boundaries are delineated and labeled "Fee Simple Dedication to Frederick County."

1.6.10.7. Design Considerations

1.6.10.7.1. Safety: Avoidance of hazardous conditions, provide railings, ingress and egress, and required safety equipment. Meet OSHA, MOSHA, and County safety requirements.

1.6.10.7.2. Miscellaneous: Includes acceptance procedures for equipment and processes; Painting and Coating Plan; Water for Testing; Laboratory Facilities; Office Area; Chemical Storage and Handling; Operation and Maintenance Manuals; Start-Up and Equipment Checkout; Training County Operators; and Site Restoration.

1.6.10.8. Types of Drawings and Specifications Required

1.6.10.8.1. General: Design of facilities requires the following information and types of drawings to meet minimum design requirements.

1.6.10.8.2. Site Plan: On second drawing sheet, show location of major facility units, components, and utilities such as electrical service, buildings, vaults, lighting, tanks, water and sewer pipes, yard piping, conduit runs, valves, generators, paving, fencing, etc. Provide grading plan, landscaping plan, and benchmark. Show fee simple property outline and any pertinent easements. Scale

for site plans can be no smaller than 1 inch = 20 feet.

1.6.10.8.3. Mechanical: Plan, profile and sectional views of piping and equipment installation. Layout, that is, physical location of equipment. Installation of equipment, means of support. HVAC, sleeves and seals wall and floor penetrations. Show dimensional relationships. Considerations to minimize vibrations and noise from rotating machinery and air movement. Space for maintenance access. Potable water and drain piping runs. Space heating. Floor drains. Backflow preventers.

1.6.10.8.4. Electrical: Schematic diagrams include one line power schematics, control schematics and instrumentation schematics. Control logic diagrams. When manufactured package components are required, show interconnection with other components. Wire types and sizes, electrical power service installation and meter, type of voltage and phasing. Conduit materials, sizes and routing of runs. Circuit breaker directories. On-site generator location and installation. Type, size and mounting details of panel boxes. On-site alarms and controls. SCADA of data and alarms to the Operations Center requires equipment installation. Running time meter, ammeters, etc.

1.6.10.8.5. Architectural

1.6.10.8.5.1. Scale: Floor plans, details, etc. shall be drawn at a scale of 3/8 inch = 1 foot, unless otherwise approved by the County.

1.6.10.8.5.2. Details: Details shall be carefully coordinated with other work efforts to show all information required for fabrication, construction, and installation of the items detailed.

1.6.10.8.5.3. Handicap Requirements: Handicap accessibility shall be addressed on a case-by-case basis. In general, all permanent facilities with administrative areas must have full handicap accessibility and be barrier free. The Americans With Disabilities Act requirements must be met.

1.6.10.8.6. Structural: Details of cast-in-place concrete pads, floors and walls. Implementation of results of soils tests and reports. Special excavation and backfilling requirements.

1.6.10.8.7. Sediment and Erosion Control Plan: A separate sediment and erosion control plan is not required if the work proposed is within the area of disturbance for the development. Otherwise, separate plans are required for SCD approval.

1.6.10.8.8. Hydraulic: Show number of EDUs, flow rate capacities, peaking factors, critical pressure parameters, etc.

1.6.10.8.9. Process: Schematic diagram of biological and chemical processes. Provide plan view and profile view of process. Odor control provision as necessary. Chemical handling and disposal provisions.

1.6.10.8.10. Access: Design shall consider and provide for vehicular access, parking, and turn-around space during all weather and seasonal conditions. Types of vehicles to be considered include: pickup trucks, passenger cars, sewer vacuum cleaning trucks, mobile cranes, backhoes, etc. Also consider type of driveway entrance and associated hazards.

1.7. PERMITS AND APPROVALS

1.7.1. State and Federal

1.7.1.1. MDE Permit: The MDE must approve certain plans and issue water and sewer construction permits. Moreover, design review fees must be paid, if developer funded, before MDE will begin their review.

1.7.1.2. Miscellaneous: Plans must be submitted and approvals obtained from other state and federal agencies. Permits from the following agencies are typical for most water and sewer designs:

- Maryland Department of the Environment (waterways)
- Army Corps of Engineers
- Maryland Historic Trust
- State Highway Administration (right-of-way and driveway entrance)
- Other agencies

1.7.2. Soil Conservation: Approval and signatures must be obtained by the design engineer from the Frederick or Catoctin Soil Conservation Districts.

1.7.3. County: For all above ground structures, the owner or their agent shall make all applications to obtain the required building and grading permits prior to bid of the project. Any footer construction, plumbing work or electrical work requires permits from the County. Make application to County Department of Permits and Inspections. Other County agencies requiring various approvals include Office of Life Safety and Development Review.

1.7.4. Other:

1.7.4.1. Utility companies: telephone, electric, television, cable, natural gas, etc., must issue all permits when their jurisdictions are encountered.

1.7.4.2. Railroads: Any railroad crossing or parallelism is subject to a permit and/or licensing agreement from the affected railroad. Many times "riders" are attached to railroad permits, typically telecommunication companies that jointly occupy railroad rights-of-way. In those cases, separate side permits are required in addition to the railroad permit. Permitting can be tedious, requiring considerable time for approval. Licensing Agreements for County lines must be executed by the County.

CHAPTER 2. WATER MAIN DESIGN

2.1. GENERAL

2.1.1. Availability of Water: Design engineers shall check with the DUSWM to determine the availability of water service to the site of proposed subdivision or connection.

2.1.2. Definitions

2.1.2.1. Raw Water Mains: Water mains that convey raw or untreated water from a supply source such as a well to a water treatment plant. For purposes of designing the location of raw water mains, they are considered to be contaminated and thus must be located sufficiently distant from mains containing potable or finished water, that is, raw mains are considered to be sewer force mains or storm drains as related to the proximity to potable water mains. DUSWM has authority over the design and construction of raw water mains.

2.1.2.2. Transmission Mains: Major supply mains conveying water from treatment plant to distribution mains. DUSWM has authority over the design and construction of transmission mains.

2.1.2.3. Distribution Mains: Water Mains constructed to provide distribution of water from major transmission mains to service mains. DUSWM has authority over the design and construction of distribution mains.

2.1.2.4. Water Service Connection (WSC): Represents the piping that originates at the distribution main and terminates at the outlet of the customer's meter. Almost always the meter is located on the customer's side of property line about one (1) foot from the property or easement line.

2.1.2.5. Ownership: The WSC is owned and maintained by the County. Each WSC will correspond to a particular water service customer account. On drawings, the water service connection is labeled by the abbreviation “WSC”, and typically inserted in the general notes.

2.1.2.6. Water Distribution Pipe: Represents the piping configuration that connects from the terminus of the County's WSC (that is, meter vault) and is terminated five (5) feet from the customer's building. The water distribution pipe is owned and maintained by the property owner.

2.1.3. Responsibility

2.1.3.1. County Water System: After acceptable completion of construction, the water system is maintained by the County. Elements of the water system owned and maintained by the County include well supplies, raw water mains, treatment plants, storage tanks, pumping stations, transmission mains, distribution mains, mainline valves, fire hydrants, WSCs, water meters, water meter yokes, and water meter vaults. The water system elements owned by the County are always located on County owned property, in public rights-of-way, or in public water easements on privately owned property. Water related

elements which are situated within private property (and not in a public water easement) are constructed and maintained by the property owner.

2.1.3.2. Private Water Systems: Some large commercial sites operate water distribution systems to serve their sites that include water mains, valves, hydrants, etc. that are owned by the site owner. It is important to show clearly the limits of the private system and note this on the plans. In all cases, the private water systems are designed and constructed according to the Maryland Department of the Environment (MDE) requirements.

2.1.4. Tributary Population: Water systems which provide for a complete watershed shall be designed and sized, taking the following into consideration:

2.1.4.1. The estimated future tributary population that follows the County Water and Sewerage Plan and the applicable regional comprehensive plan.

2.1.4.2. The entire water service area shall be assumed to be completely developed according to the County comprehensive plan.

2.1.4.3. Water systems that initially provide service for only part of a water service area shall be sized and built to provide for the entire water service area. Otherwise, provisions shall be made for future increased capacity.

2.1.4.4. Supporting data shall be shown in the pre-design report or on the plans.

2.1.5. Flow Projection

2.1.5.1 Quantity of Flow

2.1.5.1.1. Population Equivalent: In sanitary engineering practice, it is generally accepted that each person will consume 100 gallons of water per day. From a hydraulic loading standpoint, 100 gpd represents one person, called "one population equivalent." This equivalent population flow, 100 gpd, has been regarded as the upper limit for domestic flow projection as a daily average.

2.1.5.1.2. Equivalent Dwelling Unit (EDU): For design planning, the County uses the population equivalent for residential areas of 2.5 persons per dwelling, or 250 gpd per dwelling. In doing flow projection calculations the term EDU is used and is equal to 250 gpd per dwelling.

2.1.5.1.3. Seasonal Peaking Factor: Because of increased water demand during the summer months, the County has determined that the average daily water flow is 1.4 times the average daily sewer flow. This factor is important when projecting flow rates for water treatment plants and storage tanks.

2.1.5.1.4. Flow Projections: Shall be based upon the guidelines shown in the Appendix C.

2.1.5.2. Average Daily Flow (ADF): Average daily flow is the arithmetic sum of the average daily domestic flow plus the average daily commercial flow plus the average daily industrial flow plus any other average daily flows from the service area. The average daily

commercial, industrial, and other flows shall be based on the period in which these flows are generated. The arithmetic sum of the average daily flow components (gallons per day) should then be divided by 250 to obtain the total EDU basis for the design. Note: For purposes of calculating flows here, the term flow is equivalent to flowrate, that is, volume of water per unit time.

2.1.5.3. Peaking of Flows

2.1.5.3.1. Peak flow is average daily flow (ADF) peaked in accordance with the peak hourly flow (PHF) that has been determined to be 1.4 times the ADF.

2.1.5.4. Fire Flows: Fire flow is the flow for fighting fires as required by the Rules and Regulations or Life Safety. Minimum fire hydrant design flows are set forth in the Appendix C.

2.1.5.5. Design Hydraulic Flows: Design Domestic Flow = Peak Domestic Flow + Peak Commercial Flow + Peak Industrial Flow. This provides the maximum flowrate when fire flows are not included.

2.1.5.6. Design Peak Flow: Design Peak Flow = Design Domestic Flow + Fire Flow. Whenever pumped flow enters a water main or storage tank, the domestic pumping rate shall be equal to or exceed the design domestic flow and the fire pumping rate shall be equal to or exceed the design peak flow.

2.1.5.7. Hydraulic Calculations: When water main diameter must be determined by hydraulic calculations, the pressures in the main must remain within required ranges for design peak flows.

2.1.6. Storage

2.1.6.1. Minimum fire flow and total storage requirements are set forth in the Appendix C.

2.2. DESIGN

2.2.1 Location

2.2.1.1. General: Water mains should be routed in a public right-of-way whenever possible. Water mains are generally located at least ten (10) feet from a private property line or easement when line is parallel to the property line.

2.2.1.2. Rights-of-Way

2.2.1.2.1. New Subdivisions with Pavement, Curb and Gutter: Water mains shall, where practical, generally be placed seven (7) feet from the center line of the street right-of-way (on opposite side of street from sanitary sewer).

2.2.1.2.2. New Subdivisions with Pavement and No Curb: Water mains shall, where practical, generally be placed five (5) feet from the center line of the street right-of-way (on opposite side of street from sanitary sewer).

2.2.1.2.3. Existing Developments with Pavement and Curbs: In existing developments with curbs, water mains shall be located, after full consideration is given to all existing and proposed facilities, within the dedicated right-of-way.

2.2.1.2.4. Existing Development with Pavement and No Curbs: In existing developments without curbs, water mains shall, where practical, generally be located outside of the edge of pavement on the opposite side of the street from the sewer, except that the main shall not be laid under a future curb or within a ditch line. The location of other existing and proposed facilities within the right-of-way shall be fully considered.

2.2.1.2.5. Along Existing State and County Roads: Water main locations shall be such that the edge of trench is no closer than 2.5 feet from the edge of the roadway, where practical.

2.2.1.3. Easements

2.2.1.3.1. General: When it is necessary to route or locate water mains in a non-public right-of-way or non-DUSWM-owned land area, then the engineer shall proceed to establish water and sewer easements to be deeded to the County. The statutory 6-foot easement at the periphery of building lots is generally considered to be reserved for non-water and sewer utilities.

2.2.1.3.2. Through Public and Private Properties: Where the routing of a water main intrudes into or through public and/or private properties, the design engineer shall give a thorough analysis of its impact upon all existing and/or proposed physical features of the site. In all cases, the design engineer must initiate and have the owner initiate the necessary Deed of Easement(s) to the County.

2.2.1.3.3. Size: Standard width for water easements is 30 feet. Even if there is only one pipeline, such as a 4-inch raw water, 30-foot width is required. If one water pipe is involved, position the pipe with a 10/20-foot offset; do not place at the 15/15-foot centerline of the easement. The offset permits a second vehicle to pass around a backhoe that is centered over the pipeline. When two pipelines are in the easement, they shall be positioned at offsets of 10/10/10. On terminal water mains, easement shall extend at least 15 feet beyond the cap or blow off. Certain construction and maintenance scenarios may require additional easements or easement area. This is dependent on the constructability issues that are present. If the maintenance of the line will require more space than the proposed permanent easement, then the current design will need to be reevaluated and additional easement may be required.

2.2.1.3.4. Configuration: Easements for water mains shall be configured from straight line segments with a uniform width of 30 feet. Avoid routing easements through the central interior area of building lots. Whenever possible, keep easement centered over lot boundaries. Also try to keep easement lines parallel to property boundary lines. No building footers or underground structures are permitted to be built in an easement. In most cases, trees must be cleared from and kept out of the easements. In the event of a minor leak or a major break in the main, the main must be readily accessible to repair crews and vehicles.

2.2.1.3.5. Labeling: On plan views, label easements as "W/S" and include the width dimension, for example, "30' W/S EASEMENT". In an effort to reduce drawing clutter, the label may refer to the general notes. The W/S identification is to discourage use by electrical, telephone, storm drain, cable TV and other utilities.

2.2.1.3.6. Townhouses and Multifamily Areas: Some private developments prefer to establish privately maintained (that is, non-dedicated) road right-of-ways in which County owned and maintained water mains are situated. During the planning stages of the project, the engineer shall consult with the DUSWM to develop an acceptable plan for delineating the water easement configuration on the plans.

2.2.1.3.7. Notice of Encroachment: When a water main is to be routed through lands owned by agencies of the County, for example, the Division of Parks and Recreation, the design engineer must initiate a Declaration of Right to Retain Easement. This establishes a valid water main easement on record in the event the County agency transfers ownership of the land in the future.

2.2.2. Diameter

2.2.2.1. Minimum Public and Private: The minimum size water main for serving two or more fire hydrants shall be 8-inch diameter. Otherwise, the minimum size for accommodating one hydrant shall be 6-inch. Larger size mains will be required as necessary to accommodate the required fire flow and peak domestic flow while maintaining the minimum residual pressure specified elsewhere in this Chapter.

2.2.2.2. Transmission Mains: For water transmission mains originating from treatment plants or storage reservoirs, the size of the main will be based on a projected peak flowrate that is based upon simultaneous occurrence of required fire flowrates and peak hourly domestic flowrate.

2.2.2.2.1. Maximum Velocity: The diameter shall be sized for a maximum velocity of five (5) feet per second (fps) at non-fire flow conditions. The engineer shall furnish confirming calculations for approval.

2.2.2.2.2. Maximum EDU: When no fire flow is required, a maximum of ten (10) EDUs may be connected to a 4-inch diameter line. The engineer shall furnish calculations supporting hydraulics to obtain approval.

2.2.3. Depth

2.2.3.1. Cover: Normal cover over water mains shall be a minimum of 3.5 feet to the crown of the pipe from finished grade.

2.2.3.2. Maximum Depth: Depth of water mains shall not exceed 7.5 feet to the crown of the pipe without DUSWM approval. Engineer should make every effort to maintain the minimum cover while designing the water main.

2.2.3.3 Options: The design engineer should exhaust alternate options before lowering the depth of the waterline to avoid conflicts.

2.2.4. Pressure

2.2.4.1. Maximum and Minimum: All water mains, including those not designed to provide fire protection, shall be sized after a hydraulic analysis based on flow demands and pressure requirements. The system shall be designed to maintain a minimum pressure of 20 psi at ground level at all points in the distribution system under conditions of fire flow. The normal working pressure in the distribution system shall be no greater than 100 psi and not less than 35 psi at the first floor elevation (at the meter outlet.)

2.2.4.2. Pressure Boosting: If in certain areas, the County system cannot provide 35 psi, the developer will be required to furnish storage or on-site booster pumping systems so as to obtain necessary service pressures.

2.2.4.3. Pressure Reduction: In certain instances, where the County system provides pressures greater than 100 psi, the developer will be required to furnish main-line or meter vault pressure reduction devices so as to obtain necessary service pressures.

2.2.5. Hydraulics

2.2.5.1. Sewer to Water Flowrate Relationship: Flowrate calculations for ultimate sizing of water mains, pumps, etc. may need to take into account that the total average daily flowrate for domestic EDUs must be multiplied by a factor of 1.4. This factor is based upon actual County data obtained during summer seasonal lawn sprinkling.

2.2.6. Materials

2.2.6.1. Pipe: Almost always, ductile iron pipe and fittings manufactured to AWWA standards is used for potable water mains. No PVC or other plastic pipe is permitted.

2.2.6.2. Joints: For joint design, see the *Standard Specifications*.

2.2.7. Fire Protection

2.2.7.1. General: When fire protection is to be provided, water main design shall be such that fire flows and facilities are in accordance with requirements of the State Fire Marshall and of the State Insurance Services Office.

2.2.7.2. Sizing Booster Pumps, Water Mains, Etc.: The design hydraulic flowrate for fire hydrants shall be as provided in this Design Manual under Fire Hydrant Flow Rates. After construction, public hydrants will be color coded according to their flowrate capacity by the DUSWM.

2.2.7.3. Sprinkler Systems: For single and multiple family dwellings, townhouses, and commercial projects that require sprinkler systems, the engineer should consult with the Division of Utilities and Solid Waste Management, Department of Engineering and Planning.

2.2.7.3.1. Adequate water at the meter outlet during sprinkler demand and major water appliance demand combined flowrates. Larger service connection piping and meter may be required, especially when water pressure is less than 45 psi.

2.2.7.3.2. Adequate backflow prevention to keep stagnant sprinkler water (also ethylene glycol) from flowing back into the County's system.

2.2.7.3.3. Enlarged private property piping to maintain pressure to sprinklers under high flowrate conditions. Complete information and meter details, i.e., meter size, pipe size, vault size, etc., shall be shown on the plans.

2.2.8. Dead Ends

2.2.8.1. Requirements: In order to provide increased reliability of service, reduce head loss, and avoid taste complaints, occurrences of dead ends shall be minimized by looping mains or providing tie-ins where appropriate.

2.2.8.2. Fire Hydrants: No more than one fire hydrant is permitted on an unlooped 6-inch main.

2.2.8.3. Maximum Number of Dwellings: No more than 25 single family or townhomes may be serviced on a dead end or cul-de-sac regardless of the street configuration.

2.2.8.4. Private: Commercial and industrial developments that have privately owned and maintained water mains shall provide on-site looping for fire protection and overall system reliability, where necessary.

2.2.8.5. Hydraulic modeling: May be required by the DUSWM to ensure there will be no hydraulic or regulatory issues created by the dead end.

2.2.8.6. Flushing Devices: Where dead-end mains occur, auto flushing devices other than the DUSWM standard shall produce flows that will provide a velocity of at least 2.5 feet per second in the water main being flushed. No flushing device shall be directly connected to any sewer.

2.2.9. Alignment

2.2.9.1. General: The horizontal and vertical alignment of water mains must be made to follow changes in street alignment to pass safely over or around obstructions. These changes in alignment may be made by either use of bend fittings (with restraint design) or by pipe joint deflections.

2.2.9.2. Curved Alignments: When the alignment of a water main is to be curved without using bend type fittings, the permissible deflection radii for pipe and offset for joints shall not exceed that specified per *AWWA C600*. Indicate the appropriate radius of curvature in the plan view.

2.2.9.3. With Other Utilities: Generally, other utilities shall parallel water mains and conform to design standards for horizontal and vertical clearance requirements set forth elsewhere in this Manual.

2.2.10. Main Appurtenances

2.2.10.1. Valves

2.2.10.1.1. Sizes: Mains 4 inches to 24 inches require valves of the same size as the main. Butterfly valves shall be provided for sizes larger than 16-inches in diameter unless a deviation is approved by the Department Head. Position indicators shall be furnished for all butterfly valves. Valves smaller than 18-inch shall be resilient-seat (R-S) gate valves. Mains larger than 24 inches may require valves smaller than the main, if approved by the DUSWM.

2.2.10.1.2. Division Valves: All division valves (that is, valves interconnecting two pressure zones) shall be resilient seat gate valves for all sizes.

2.2.10.1.3. Locations: All mains are to be valved at connections to larger mains. Valves shall be installed on the system at such places to isolate sections as may be necessary. This is typically achieved by placing four (4) at each cross and three (3) at each tee, with the exception of fire hydrant tees. Valves shall be installed on all fire hydrant leads as close to the water main as possible. Spacing of valves shall generally be as follows:

Main Size	Maximum Valve Spacing (feet)
4″	400**
6″	800*
8″ thru 12″ (Residential Land Use)	1,000*
8″ thru 12″ (Other Land Use)	1,200*
16″ (with service connections)	1,200
16″ (no connections)	2,000
Over 16″	3,000
* In townhouse or single family areas, no more than 25 units shall be serviced between two valves.	
** No more than 10 units may be serviced with this size main unless hydraulic calculations are provided proving adequacy.	

2.2.10.1.4. Tapping Sleeves and Valves: Tapping sleeves and valves shall be used when more than 20 domestic services would be shut off during an installation of a standard tee. The main being tapped may be the same size as the proposed main or tapping valve. Tapping sleeves and valves to be ductile iron and mechanical joint.

2.2.10.2. Valve Vaults

2.2.10.2.1. Valve Boxes in Lieu of Vaults: For gate valves 16 inches and smaller, refer to Valve Boxes for Water Mains as shown in the *Standard Details*.

2.2.10.2.2. Tapping Valves: For tapping sleeves and valves refer to the *Standard Details 117.1* for guidance. A vault may be required given the size of the line being tapped.

2.2.10.3. Fittings: Fittings shall be of a material as stated in the *Standard Specifications.* All fittings shall be precisely shown with a symbol and identified as to size and type, on plan and profile views. Plans shall clearly indicate whether the water system design is based upon use of concrete buttresses or restrained joints or both.

2.2.10.4. Fire Hydrants

2.2.10.4.1. General: Water mains not designed to carry fire flows shall not have fire hydrants connected to them. Minimum fire hydrant design flow rate requirements are set forth in the Appendix C.

2.2.10.4.2. Single Family Residential: Hydrants must be provided at each street intersection and at intermediate points between intersections measured 500 feet along an improved road, in single family residential areas. The distant most corner of any proposed dwelling shall have hydrant coverage.

2.2.10.4.3. Multifamily Residential: Hydrants must be provided at each street intersection and at intermediate points between intersections measured 300 feet along an improved road, in multifamily residential areas. The most distant corner of any proposed dwelling shall have hydrant coverage.

2.2.10.4.4. Arterial Roads: Fire hydrants shall be located along major highways. Fire hydrants shall be located along interstates, where feasible and accessible. If the highway is divided (monumented), hydrants shall be located alternately on either side.

2.2.10.4.5. Other: All other uses of property, including commercial shopping centers, malls, industrial high-rise, or elevator-type condominiums and apartments shall meet the requirements aforesaid and provide hydrants within both the front and the rear of the aforementioned buildings. A hydrant shall be provided within 100 feet of sprinkler or standpipe fire department connections. All private fire hydrants shall be painted a different color than public fire hydrants.

2.2.10.4.6. Yard Hydrants: Yard hydrants and hose bibs that are privately maintained shall utilize metered water.

2.2.10.4.7. Reference: See the *Standard Details* and Section 2550 of the *Standard Specifications* for approved types of hydrants and installation requirements.

2.2.10.4.8. Configuration: If a hydrant is located at the end of a line and not

connected to a tee, then joint restraint shall be used to enable the removal of the hydrant for either repair or the possible extension of the line.

2.2.10.5. Air Release Valves

2.2.10.5.1. Location: Air release valves (ARV) or combination vacuum release valves shall be installed at prominent peaks on long supply mains eight (8) inches and larger, when no customer connections are within 25 feet of the crest.

2.2.10.5.2. Interdictions: Automatic ARVs shall not be used in areas subject to flooding from streams, inlet spreads, or other surface runoff.

2.2.10.5.3. Manual: Manual ARV's are not to be used without written permission of the County.

2.2.10.6 Blow-offs

2.2.10.6.1. Permanent: Shall be designated at the end of each dead end main for smaller line sizes that do not support fire flows. On all other dead end mains, a fire hydrant shall be designated and serve as the blow-off.

2.2.10.6.2. Temporary: Shall be designated for areas that are being constructed in phases and will be extended in the future.

2.2.10.6.3. Valleys: Dewatering fire hydrants shall be placed at the extreme and other prominent low points in all size mains for the purpose of sediment removal and draining the line for repairs.

2.2.11. Service Connections

2.2.11.1. Location

2.2.11.1.1. WSCs shall be shown on all relevant contract drawings from the main to the property line or as directed by the DUSWM. WSC piping is always located in a right-of-way or easement, except for the end portion connecting to the meter that portion is located about one (1) foot inside the private property line.

2.2.11.1.2. WSC piping passing in close proximity to sewers can be protected by installing the piping in a suitable sleeve. Sleeved piping is also required for certain routings beneath State Highways. Piping shall be PVC coated or otherwise protected, as approved by DUSWM, when placed inside a sleeve.

2.2.11.1.3. WSCs shall be located five (5) feet upstream from the center line of property to be served and SSCs shall be ten (10) feet downstream from the water. It is important to locate the WSC (meter) in a predictable location to facilitate locating the WSC in the event it becomes buried by subsequent construction or site grading. If driveway locations are known, avoid placing meter vaults and piping in or under paved driveways.

2.2.11.1.4. Double WSCs (DWSC) (that is when two meters are supplied to one

connection pipe) may be permissible in certain existing single family residential developments as approved by DUSWM, Department of Engineering and Planning. In locating meters at property corners, make every effort to avoid conflicts between the meter vault, electric transformer, and driveway areas. Double service connections are only permitted with the 3/4-inch meter and standard vault. Double service connections cannot be used when a pressure reduction valve or sprinkler service is involved. Refer to *Standard Detail* 110.1 or 110.4.

2.2.11.1.5. Connection Crossing Property Boundary: When a particular private property site has no access to a County water main except by routing water piping through a second private property site, it is incumbent upon the owner requesting the water service to obtain a perpetual 10-foot wide easement on said second site. The easement must abut the existing right-of-way or easement containing the water main and extend to the property receiving the water service. The WSC can be established with the meter located about one (1) foot inside the said second site. Such installations are to be avoided unless compelling reasons are presented to the Division of Utilities and Solid Waste Management for approval. Approval of all interested County agencies is also required, especially Planning and Zoning.

2.2.11.2. Sizing

2.2.11.2.1. In most cases, the size of the connection piping is determined by the size of the meter selected. When the situation involves combinations of long runs of connection piping, sprinkler demands, commercial demands or low pressure gradient in the main, the piping should be oversized.

2.2.11.2.2. Large Connections: Service connections three (3) inches and larger must be designed showing detail of service connection piping, vault, and vault bypass piping in both plan and profile.

2.2.11.3. Meters

2.1.11.3.1. General: See Section 2550 of the *Standard Specifications* and pertinent sections of the *Standard Details* for residential services. Commercial and industrial services must be individually sized on a case-by-case basis by the design engineer. The designer is urged to reference the AWWA Manual M6, *Water Meters -- Selection, Installation, Testing, and Maintenance*.

2.2.11.3.2. Meters: Meters are required for fire service. See the *Standard Details*.

2.2.11.3.3. Meter Vaults: Vaults for meter installations must be as indicated in the *Standard Details*. Custom meter vaults may be necessary in certain instances and will require review and approval by the County.

2.2.11.3.4. Pressure Reduction Valves: At site locations where the water pressure gradient exceeds 100 psi for a few number of service connections, a combination pressure reduction valve and meter are situated in the meter vault. See the S*tandard Details*.

2.2.11.3.5. Unimproved Lots: (Intentionally left blank)

2.2.11.3.6. Abandonment: If the design calls for an existing WSC to be disconnected, the plans must show special instructions for capping off the piping.

2.2.11.3.7. Road Excavations: WSCs that must cross an existing County or State road requires a permit. The methods must be specified for construction. See Road Excavations this Chapter.

2.2.12. Clearances

2.2.12.1 Water Main Crossing Sanitary Sewer, Force Main, Storm Drain, Other Utilities: Water main shall have a minimum vertical clearance of one (1) foot outside diameter to outside diameter (OD to OD) above the sewer or other utility. Horizontal crossing angles shall not be less than 45 degrees.

2.2.12.2. Water Main Parallel to Sanitary Sewer or Force Main: Where sewer and water mains are more than 10 feet apart, water mains shall be one (1) foot above the sewer or other utilities. Where sewer and water mains are less than ten (10) feet apart, water mains shall be vertically above sewers a minimum of six (6) feet. Allowance of separation less than ten (10) feet shall be at the discretion of the DUSWM.

2.2.12.3. Exceptions: When the aforementioned clearances are not practical, the sewer shall be encased and indicated on the plan and profile. Special joints may be required on the water or sewer main, as specified by the County. See the *Standard Details*.

2.2.13. Structural

2.2.13.1. General: Main pipe and fitting wall thickness shall be sufficient to accommodate internal operating and surge pressures, vacuums, and active and passive earth loads. The structural design of water main piping shall conform to AWWA standards except as modified herein.

2.2.13.2. Design: Typically, for ductile iron pipe, the design procedure is as follows:

2.2.13.2.1. Design for internal pressures (static pressure plus water hammer allowance)

2.2.13.2.2. Design for external loads (earth load plus H-20 truck loads).

2.2.13.2.3. Use the larger resulting wall thickness.

2.2.13.2.4. Add a 0.08-inch service allowance.

2.2.13.2.5. Add a standard casting tolerance (3 to 8-inch, 0.05 inches); (10 to 12-inch, 0.06 inches).

2.2.13.2.6. Calculate total wall thickness and determine standard thickness class of pipe (that is, 52 or 54). Note that thickness class shall allow direct tapping of the corporation stop with a minimum of three (3) thread embedment.

2.2.13.3. Buttresses and Anchorages: Bends, tees, fire hydrants and dead ends shall be anchored or buttressed, as shown in the *Standard Details*. Clearly indicate location of buttresses and anchorages on the plans.

2.2.13.4. Joint restraint: Restraints such as Megalug® or mechanical joint retainer glands are required for unstable soil conditions, areas of congested utilities, stream crossings, uncontrolled fill, dead ends for future extensions, possible soil failure during emergency excavation and repair, etc. The number of joints to be restrained shall be delineated and noted on the plans and profiles in accordance with approved restrained length computations. See the *Standard Details*. DUSWM reserves the right to require restrained joints where they deem it necessary due to potential safety issues associated with future maintenance.

2.2.13.5. Areas of Structural Fill: Wherever water mains are to be constructed in areas of structural fill, the design engineer shall indicate the requirement for joint restraint. Note the special requirements on the plans and profiles. Specifics of joint restraint to be shown on plan (distance, method, etc.).

2.2.13.6. Steep Slopes: Wherever water mains are constructed at slopes greater than 5:1, special anchoring is required. See the *Standard Details*.

2.2.14. Road Excavations

2.2.14.1. General: Water mains that penetrate the rights-of-way of Maryland State Highway Administration, County, railroad, or other utility upon which there exists pavement or other features that may not be disturbed and, therefore, require the employment of tunneling or boring techniques, shall be designed to accommodate these methods of construction. The design engineer shall, after a preliminary review by the DUSWM, be responsible for securing written approval of the technique(s) and permits as required from the utility, railroad, or agency whose right-of-way is being penetrated. The County will assist in securing approval where it is deemed necessary.

2.2.14.2. Bore and Jack Pipe: Water pipe under State and/or County roads shall be installed in a tunneled or jacked sleeve, as required by the State Highway Administration or County Division of Public Works in their respective rights-of-way. Water pipe and sleeves under railroads shall be designed according to specifications of the railroad being crossed. The beginning and end stations for the sleeves shall be shown in profile. See the *Standard Details*.

2.2.14.3. Open Cut: In instances where open cut methods of installation are proposed, the conditions of the permit must be clearly shown on the plans. A copy of the permit must be secured and on file with the DUSWM before the County will approve the plans.

2.2.15. Tapping Main

2.2.15.1. General: When the water main must be tapped to provide service to a property site, the design engineer must perform necessary research and investigation to achieve a sound design. If construction of the main was somewhat recent, the County has as-built records of the size, type of material, wall thickness, and location of the water main. If

records are not available, test pitting is required to determine requirements for tapping the main.

2.2.15.2. Wet Tapping: Tapping the main while it remains pressurized, is generally preferred. Wet tapping can be achieved either with a corporation stop threaded into the main or with a tapping sleeve and valve. Typically, mains can be directly tapped and threaded when the diameter and wall thickness are sufficiently large in comparison to the size of the threaded opening. Tapping sleeves are typically used when the existing main would be structurally weakened if tapped without the sleeve. Tapping sleeves and valves shall be ductile iron and mechanical joint. Use of tapping saddles for service connections shall not be permitted unless a request is approved by the DUSWM.

2.2.15.3. Cut-in Tapping: Another method of tapping a main is to take the main out of service, dewater it, cut it, and install necessary fittings, valves, etc. When no valves are available to isolate a portion of a main to allow dewatering, a "line stop" can be utilized to insert fittings, valves or other appurtenances while the main is under pressure. This method in conjunction with a detailed sequence of construction must be prepared, approved and coordinated with the DUSWM.

2.2.15.4. Authority: The method of tapping and conditions for any interruptions to other customer's water service pressure must be indicated on the plans. The design engineer shall consult the DUSWM to develop the method of tapping.

2.2.16. Cross Connection Control

2.2.16.1. Backflow Prevention Devices: In situations where the customer's private piping is deemed by the County to have reasonable potential to cause contaminated back flow into the County's water main, suitable back flow prevention devices are required.

2.2.16.2. Interconnection with Wells: Interconnection of piping that supplies County public water with piping with privately owned well supplies is NOT permitted. When County water is connected to a property with wells, all wells on the property must be permanently sealed and abandoned pursuant to State law and Health Department requirements.

2.2.16.3. Liability: The US EPA and MDE holds the purveyor of water service accountable for any injuries caused by water contamination originating from a customer's connection.

2.2.16.4. Siamese Connections: When building exteriors provide siamese fittings for connection of fire trucks or standpipe connections of any kind, a backflow preventer is required. Sprinkler systems require back flow prevention.

2.2.16.5. Commercial and Industrial: Where industrial or commercial operations expose the building water system to biological or chemical contamination, back flow prevention is required.

2.2.17 Stream Crossings

2.2.17.1. Above-water Crossings: Not permitted.

2.2.17.2. Underwater Crossings: A minimum cover of 3.5 feet shall be provided over the pipe with appropriate stream bank protection. When crossing water courses which are greater than ten (10) feet in width, the following shall be provided:

2.2.17.2.1. Restrained Joints or Concrete Encasement: Shall be required the full length of the crossing.

2.2.17.2.2. Valve Locations: Shall be provided at both ends of water crossings so that the section can be isolated for testing or repair. The valves shall be easily accessible, and not subject to flooding.

2.2.17.2.3. Pipe Thickness: Shall be a minimum of two (2) classes above the minimum specified in the *Standard Specifications*.

2.2.17.3. Water Mains Crossing Under Streams or Drainage Ditches: The minimum cover shall be 3.5 feet, or as directed by the DUSWM or the agency regulating the crossing of the waterway, usually the MDE-Water Resources Administration. Pipe shall be mechanical joint utilizing Megalug® joint restraint, or equal, at each joint through the said crossing.

2.2.17.4. Streambank Restoration: Design must be in accordance with the latest MDE-Water Resources Administration regulations and waterway construction permit. Plans must clearly delineate the actual limits of disturbance, restoration, dewatering basins, etc.

2.2.17.5. Dewatering: Stream crossings of pipes exceeding eight (8) inches may require design and installation of a dewatering device.

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CHAPTER 3. SEWER MAIN DESIGN

3.1. DESIGN REQUIREMENTS

3.1.1. Availability of Sewer: Designers shall check with the DUSWM to determine the availability of sewer service to the site of proposed subdivision or connection.

3.1.2. Definitions

3.1.2.1. Building Drain: Represents the piping that conveys wastewater down through a building and terminates at the connection to the building sewer. Usually the building drain pipe terminates at the building exterior wall. The building drain is owned, constructed, and maintained by the property owner. Design and construction of building drain pipes are regulated by agencies other than DUSWM.

3.1.2.2. Building Sewer: Represents the piping that connects to the building drain and conveys wastewater to the SSC at the property line. The building sewer is owned, constructed, and maintained by the property owner. Design of building sewer piping is regulated and inspected by agencies other than DUSWM.

3.1.2.3. SSC: Represents the piping that originates at the cleanout at customer's property or easement line and terminates at the County's sewer main. The SSC is owned and maintained by the County and is typically located just inside the property line that it serves. In most cases, each SSC will correspond to a particular water service customer account. On drawings, the SSC is called out by the abbreviation, SSC. SSCs are often referred to as sewer laterals. The maximum number of properties served by one service connection pipe is two (i.e., townhouses).

In rare instances, a grinder pump owned and maintained by the County will be situated on private residential property. The grinder pump receives the flow of wastewater through the building sewer from the house and pumps it through a force main pipe to a gravity sewer main or a pressure main. It is incumbent on the property owner to grant an easement to the County for maintenance of the grinder pump and associated force main. Cost of electric power for the grinder pump is at the expense of the property owner. Project design should avoid the use of grinder pumps whenever possible. The use of private interior ejector pumps to serve basements shall take precedence over use of a County-owned grinder pump.

3.1.2.4. Collector Sewer: Main line sewer typically serving three or more properties. It is usually located in the street or a sewer easement and receives wastewater from various SSCs and conveys the wastewater by gravity to another collector or interceptor. Typical diameters are 8-inch, 10-inch, and 12-inch. Design and construction of collector sewers are regulated by the DUSWM.

3.1.2.5. Interceptor Sewer: Main line sewer that receives wastewater from a number of collector sewers and conveys it by gravity to a treatment plant. Interceptor sewers are owned and maintained by the County. Typical diameters are 14-inch and larger. Interceptor sewers are located in a public right-of-way or a sewer easement. Design and construction of interceptor sewers are regulated by the DUSWM.

3.1.2.6. Outfall Sewer: Main line sewer that either conveys wastewater from an isolated subdivision to another collector or conveys treated wastewater effluent from a treatment plant to a receiving stream. Design and construction of outfall sewers are regulated by the DUSWM.

3.1.2.7. Force Main: Force main (sewer) conveys wastewater under pressure from a sewage pumping station to a point, usually at a higher elevation, where the wastewater changes to gravity induced flow. Design guidelines for force mains are given in Chapter 4. Design and construction of force mains are regulated by the DUSWM.

3.1.3. Responsibility

3.1.3.1. County Sewer System: After the sewer infrastructure is completely constructed and accepted, the sewer system is maintained by the County. The parts of the system that are owned and maintained by the County include SSC cleanouts and piping, grinder pumps and associated force mains, sewer mains, manholes, sewage pumping stations, force mains, wastewater treatment plants, and treated effluent outfall pipes. The sewer system elements owned by the County are always located in or on County owned property, in public rights-of-way or in sewer easements on privately owned property. Sewer related elements that are situated within private property (and not in a sewer easement) are maintained by the property owner.

3.1.3.2. Private Systems: Some large commercial sites operate sewer collection systems to serve their sites that include sewer mains, manholes, etc. that are owned by the site owner. It is important to show clearly the limits of the private system and note this on the plans.

3.1.4. Tributary Population: Sewer systems that provide for a complete sewershed shall be designed and sized, taking the following into consideration:

3.1.4.1. Estimated Future Tributary Population: Follows the Water and Sewerage Plan and the applicable regional comprehensive plan.

3.1.4.2. Assumptions: The entire sewershed shall be assumed to be completely developed according to present zoning or to the comprehensive plan's proposed zoning.

3.1.4.3. Future Sizing: Sewer systems that initially provide service for only a part of a complete watershed shall be sized and built to provide for the entire sewershed. Otherwise, provision shall be made for future increased capacity. Proper consideration to allow for the characteristics, that is, domestic, commercial, and industrial wastes and groundwater infiltration of the area under consideration shall be made. When a sewage plant is to be built in modules, the DUSWM shall decide the initial capacity to be constructed and the size of future modules.

3.1.4.4. Data: Supporting data shall be shown in the pre-design report or on the plans. Major collector and interceptor sewers require a design analysis that utilizes the form provided in Appendix C.

3.1.5. Flow Projection

3.1.5.1 Quantity of Flow

3.1.5.1.1. Population Equivalent: In sanitary engineering practice, it is generally accepted that a person will generate 100 gallons of sewage per day. From a hydraulic loading standpoint, 100 gallons of sewage per day represents one person called "one population equivalent." This equivalent population flow, 100 gpd, has been regarded as the upper limit for domestic flow projection as a daily average.

3.1.5.1.2. Equivalent Dwelling Unit (EDU): For design planning, the County uses the population equivalent for residential areas of 2.5 persons per dwelling, or 250 gpd per dwelling. In doing flow projection calculations the term EDU is used and is equal to 250 gpd per dwelling.

3.1.5.1.3. Commercial: For commercial lots the flow projection shall be based upon the guidelines shown in Appendix C. Sewer flows are based on sewer connections unless the use creates a flow type not specified in Appendix C, then the flow will be established by the DUSWM on a case-by-case basis.

3.1.5.2. Average Daily Flow: Average daily flow is the arithmetic sum of the average daily domestic flow plus the average daily commercial flow plus the average daily industrial flow plus any other average daily flows from the service area. The average daily commercial, industrial, and other flows shall be based on the period in which these flows are generated. For purposes of calculating flows here, the term flow is equivalent to flowrate, that is, volume of water per unit of time.

3.1.5.3. Peaking of Flows:

3.1.5.3.1. Peak Flow: Peak flow is the average daily domestic flow peaked in accordance with the MDE curve in Appendix C or as otherwise specified by MDE requirements.

3.1.5.3.2. Peak Commercial and Industrial: Peak commercial or industrial flow is the average daily commercial or industrial flow peaked in accordance with the MDE curve in Appendix C. When pertinent data is available, the commercial or industrial flow can utilize a peaking factor higher than the MDE curve.

3.1.5.3.3. Summation of Flows: The average daily domestic flow, average daily commercial flow, and average daily industrial flow shall be combined and then peaked using the MDE curve in Appendix C. When pertinent data is available, the commercial and industrial flows can utilize a peaking factor higher than the MDE curve. In all instances, the peaking is applied before the Infiltration and Inflow (I/I) flows are added in.

3.1.5.3.4. Pumped Flow: Whenever pumped flow enters a gravity sewer, the peak flow shall be equivalent to the pumping rate.

3.1.5.4. Infiltration and Inflow (I/I)

3.1.5.4.1. Design: For design purposes, the upper limit of allowable infiltration and inflow within the areas of the project is 400 gallons per inch diameter per mile per

day.

3.1.5.4.2. Planning: For planning purposes, the upper limit of allowable I/I within the area of the project can be assumed to be 200 gallons per acre per day.

3.1.5.5. Design Hydraulic Flow

3.1.5.5.1. Design Hydraulic Flow: Design Hydraulic Flow = Peak Domestic Flow + Peak Commercial Flow + Peak Industrial Flow + Infiltration and Inflow Allowance. This provides the maximum flowrate value which is to be used as the basis for preparing designs.

3.2. DESIGN

3.2.1. Location

3.2.1.1. General: Sewer mains shall be routed in a public right-of-way whenever possible. Where feasible, sewer mains are generally located at least ten (10) feet from a private property line or easement when line is parallel to the property line. However, a deeper sewer may require additional distance be provided.

3.2.1.2. Rights-of-way

3.2.1.2.1. New Subdivisions with Pavement, Curb and Gutter: Collecting sewers or force mains shall, where practical, generally be placed no less than five (5) feet from the face of the curb or proposed curb (on the opposite side of the street from the water main). Where it is not feasible for manholes to be located within the pavements, they shall be located wholly within a grass plot or wholly within the sidewalk. Sewers shall not bisect a curb longitudinally at an angle of less than 45-degrees.

3.2.1.2.2. New Subdivisions with Pavement and No Curb: Collecting sewers or force mains shall, where practical, be located five (5) feet from the center line of the street right-of-way (on the opposite side of the street from the water main). Where it is not feasible for manholes to be located within the pavements, they shall be located wholly within a grass plot or wholly within the sidewalk.

3.2.1.2.3. Existing Developments with Pavement and Curbs: Collecting sewers or force mains shall be located after full consideration is given to all existing and proposed facilities within the dedicated right-of-way.

3.2.1.2.4. Existing Development with Pavement and No Curbs: Collector sewers and force mains shall, where practical, generally be located outside of the edge of pavement on the opposite side of the street from the water main, except that the sewer shall not be situated under a future curb or within a ditch line. The location of other existing and proposed facilities within the right-of-way shall be fully considered.

3.2.1.2.5. Along Existing State and County Roads: Sewer main locations shall be such that the edge of the trench is no closer than 2.5 feet from the edge of the

roadway, where practical.

3.2.1.3. Easements

3.2.1.3.1. General: When it is necessary to route or locate sewer mains in a non-public right of way or non-County-owned land area, then the engineer shall proceed to establish water and sewer easements to be deeded to the County. The statutory six (6) foot easement at the periphery of building lots is generally considered to be reserved for non-water and sewer utilities.

3.2.1.3.2. Through Public and Private Properties: Where the routing of a sewer main intrudes into or through public and/or private properties, the design engineer shall give a thorough analysis of its impact upon all existing and/or proposed physical features of the site. In all cases, the design engineer must initiate the necessary deed of easement to the County.

3.2.1.3.3. Size: Standard width for sewer easements is 30 feet. Even if there is only one pipeline, such as an 8-inch sewer, 30-foot width is required. If one sewer pipe is involved, position the pipe with a 10/20-foot offset rather than at the 15/15-foot centerline of the easement. The offset permits a second vehicle to pass around a backhoe which is centered over the pipeline. When two pipelines are in the easement, they shall be positioned at 10/10/10. On terminal sewer mains, easements shall extend at least 15 feet beyond the axis of the manhole. Easements may need to be supplemented with temporary construction easements based on the depth of the trench and the OSHA required slope of the trench wall.

3.2.1.3.4. Configuration: Easements for sewer mains shall be configured from straight line segments and be of uniform width, that is, 30 feet. Avoid routing easements through the central interior area of building lots. Whenever possible, keep easements centered over lot boundaries. Also try to keep easement lines parallel to property boundary lines. No building footers or underground structures are permitted to be built in an easement. In most cases, trees must be cleared from and kept out of the easements. In the event of a leak or break in the main, the main must be readily accessible to repair crews and vehicles.

3.2.1.3.5. Labeling: On plan views, label easements as "W/S" and include the width dimension, for example, "30' W/S EASEMENT". In an effort to reduce drawing clutter, the label may refer to the general notes. The W/S identification is to discourage use by electrical, telephone, storm drain, cable TV, and other utilities.

3.2.1.3.6. Townhouses and Multifamily Areas: Some private developments prefer to establish privately maintained (that is, non-dedicated) road right-of-ways in which County owned and maintained sewer mains are situated. During the planning stages of the project, the engineer shall consult with the DUSWM to develop an acceptable plan for delineating the sewer easement configuration on the plans.

3.2.1.3.7. Notice of Encroachment: When a sewer main is to be routed through lands owned by the County - for example, County parks - the design engineer must initiate a Deed of Notice of Encroachment and Right to Retain Easement. This

establishes a valid sewer main easement on record in the event the County agency transfers ownership of the land in the future.

3.2.2. Diameter

3.2.2.1. Minimum Diameter: No main line gravity sewer conveying raw sewage shall be less than eight (8) inches in diameter.

3.2.2.2. Minimum Service Connection: No service connection piping shall be less than six (6) inches in diameter. See the *Standard Details*.

3.2.3. Depth

3.2.3.1. Main

3.2.3.1.1. General: Sewers shall be designed sufficiently deep to receive sewage from basements. The use of grinder pumps is discouraged in new construction; use of grinder pumps in new construction is permitted only in extraordinary circumstances as determined by the DUSWM.

3.2.3.1.2. Minimum: The minimum depth of a main line gravity sewer shall be 3.5 feet to prevent freezing and pipe deformation. Sewers with less than 3.5 feet of cover are permitted only in instances where the horizontal distances do not exceed 100 feet and when utilizing epoxy lined DIP or C-900.

3.2.3.1.3. New Subdivisions: New residential subdivisions shall be designed to serve a finished basement. If desired, the minimum basement elevation may be shown on the plans. If townhouses are to be constructed on slabs, they must be noted and a finished slab elevation may be provided on the plans.

3.2.3.1.4. Commercial and Industrial Parks: Commercial and industrial lots shall provide the most remote corner of the proposed building with gravity sewer service.

3.2.3.1.5. Improved Lots: Sewer main inverts shall be a minimum of 2'+ h below cellar elevations where h = feet of distance between the building setback line and the sewer multiplied by the required house connection slope of 0.02. (Use actual building location, if known, instead of building line.) For buildings or houses without cellars, sewers shall be a minimum of 2' + h below first floor elevations. In all cases, sewer main depth shall be sufficient to meet criteria established for house connection, depth, grade, and clearance.

3.2.3.1.6. Unimproved Lots: For unimproved lots, maximum sewer depth as controlled by adjacent lots shall not exceed ten (10) feet. Where lots can be expected to be filled to the level of the established grade, depth, as regulated by adjacent house connections, shall normally not exceed eight (8) feet. Greater depth may be required to clear future storm drains. In all cases, depth shall be sufficient to meet criteria established for house connection depth, grade, and clearance.

3.2.3.2. Other: See Service Connections in this Chapter.

3.2.4. Hydraulics

3.2.4.1. Manning's Formula: Computations for velocity of flow shall be based on the Manning formula using values of "n" contained in Appendix C.

3.2.4.2. Maximum Velocity: The ideal maximum permissible flow velocity under peak conditions shall be ten (10) feet per second for all pipe materials. Under extreme conditions the maximum pipe velocity shall not be greater than 15 feet per second. Suitable drop manholes shall be provided to break the steep slopes to limit the velocities in the connecting sewer pipes between manholes. Where drop manholes are impractical for reduction of velocity, the sewer shall be of ductile iron or other abrasion resistant material.

3.2.4.3. Slope

3.2.4.3.1. Requirements: The following are minimum slopes for main line sewers in feet per hundred feet. When a pipe is flowing full, the minimum slope provides a velocity of two feet per second.

Sewer Size	Minimum Slope in Feet Per 100 Feet
8-inch	0.50
10-inch	0.30
12-inch	0.25
15-inch	0.18
18-inch	0.15
21-inch	0.12
24-inch	0.10
27-inch	0.07
30-inch	0.06
36-inch	0.05
42-inch	0.045

3.2.4.3.2. Terminal Sewers: Terminal sewers require a minimum slope double those indicated above.

3.2.4.3.3. Minimum for Service Connections: Piping in service connections has a minimum slope of 2%, based on the *Standard Specifications*.

3.2.4.4. Head Losses at Manholes: Miscellaneous head losses at manholes and junctions shall be allowed for as follows:

3.2.4.4.1. At manholes on straight runs, allow head loss of 0.05 feet.

3.2.4.4.2. The radius of turn shall not be less than two pipe diameters, therefore for calculations allow 0.25 times the velocity head. Velocity head = velocity (in feet per second) squared, divided by 64.4. In no case shall total allowance be less than 0.05 feet.

3.2.5. Materials

3.2.5.1. Pipe: Material for gravity sewer mains and connection piping is typically PVC. Large diameter sewers may utilize DIP and RCP as approved by the DUSWM.

3.2.5.2. Manholes: Manholes are typically pre-cast concrete.

3.2.5.3. Other: See the *Standard Specifications* for currently approved materials.

3.2.6. Alignment

3.2.6.1. Mains: Gravity sewer main lines are always aligned by a laser beam straight from manhole to manhole. No designs using deflection at the joints is permitted. Manholes must be used at all changes in horizontal or vertical alignment. Flow in manholes is not permitted to turn at an acute angle.

3.2.6.2. Service Connections: Gravity SSC piping is shown preferably as being perpendicular to the main line in plan view. Angled connections to the main, as viewed in plan, are acceptable as shown on the approved improvement plans submitted to DUSWM. Service connection piping must always show as a straight run of pipe from the main to the cleanout at the property or easement line, in plan. Vertical alignment shall meet requirements according to the *Standard Details*.

3.2.7. Manholes

3.2.7.1. General

3.2.7.1.1. *Standard Details:* Manhole details are shown in the *Standard Details*. The designer shall use these standards as required by the design situation and shall designate the detail number on the contract drawings. Invert of outgoing pipe must drop a minimum of 0.1 feet from any incoming pipes.

3.2.7.1.2. Numbering: Manholes shall be numbered sequentially beginning with the number 1 at the lowest manhole invert elevation and progressing accordingly upstream. When the design calls for connection of a proposed sewer to an existing manhole, the existing manhole retains its existing number.

3.2.7.2. Location

3.2.7.2.1. Manholes shall be installed at the end of each line; at all changes in grade, size, or alignment; at all intersections of flow.

3.2.7.2.2. Location in Unimproved Areas: All manholes located in unimproved areas shall be constructed with the rim one (1) foot above existing or finished grade, whichever is greater. Rim elevations shall be provided for all manholes.

3.2.7.2.3. Except for terminal manholes, which are allowed to accommodate as many as three service connections, any non-terminal manhole is allowed no more than two service connections. Service connections are permitted only within 180

degree envelope that is perpendicular to the outlet pipe as seen in plan view.

3.2.7.2.4. A minimum of 12 inches clearance from outside diameter to outside diameter must be provided on the manhole wall between connecting pipes. Use a larger diameter manhole if necessary to increase clearance. As a rule of thumb, for two 8-inch pipes connecting to a typical 48-inch diameter manhole, 12 inches of clearance is provided if the pipelines are at greater than 50 degrees included angle as seen in plan view.

3.2.7.2.5. A lamphole cleanout may be used in lieu of a terminal manhole only for special conditions and in no case be installed at the end of a main segment greater than 150 feet in length. When used, call out the *Main Line Cleanout (Lamphole)* Detail number on the plans and label as a lamphole, that is, "LH-1".

3.2.7.2.6. Manholes shall be spaced at distances not greater than 400 feet for sewers 15 inches in diameter or less, and 500 feet for sewers 18 inches in diameter or greater. Distances up to 600 feet may be approved by the DUSWM in cases where adequate modern cleaning equipment for such spacing is readily available.

3.2.7.2.7. Spacing greater than 600 feet may be permitted in sewers larger than 18 inches with prior written approval from the DUSWM.

3.2.7.2.8. Sewers greater than 24-inches in diameter shall not be permitted to make 90-degree turns in one manhole. Two manholes with 45-degree turns must be furnished at a minimum.

3.2.7.2.9. No manholes shall be located within the flood area of storm water management ponds or ponds with a permanent pool.

3.2.7.3. Drop Type

3.2.7.3.1. Drop manhole must be used, for certain pipe diameters, when the invert of an incoming main is more than 0.5 feet above the invert of the flow channel of the manhole. Drop manholes cause a reduction in flow velocity and splashing, thereby avoiding odors and erosion.

3.2.7.3.2. Reference the *Standard Details* for specific dimensions.

3.2.7.3.3. Drop manholes shall not be utilized for main diameters greater than 15 inches.

3.2.7.3.4. The construction drawings shall show the drop with a symbol and indicate the type of drop in the plan and profile views.

3.2.7.4. Diameter

3.2.7.4.1. Manholes shall have a diameter of 48 inches for use with pipes 24 inches or less in diameter.

3.2.7.4.2. For pipes greater than 24 inches, a 72-inch diameter manhole shall be

used.

3.2.7.5. Flow Channel

3.2.7.5.1. The flow channel through manholes must be made to conform to shape and slope to that of the sewers. See *Standard Details*.

3.2.7.6. Joints: Use of grout to seal PVC pipe connections to a manhole is not permitted. Grout does not adhere well to PVC material. See standard detail for flexible seal. When tapping into an existing manhole to provide connection for another main or house connection pipe, the flexible joint must be specified. Existing manholes not originally constructed to County standards may require replacement of the entire manhole. The design engineer shall be responsible for scheduling a mutual field meeting with the DUSWM for an official determination of replacement.

3.2.7.7. Watertight Requirements

3.2.7.7.1. Watertight manhole covers are to be used wherever the manhole lids may be flooded by street or overland runoff.

3.2.7.7.2. Watertight manhole covers shall be used where the manhole is located within the 100-year floodplain, or in areas that are historically flooded more frequently than the 100-year probability.

3.2.7.7.3. Watertight manhole covers shall be utilized when the rim is within eight (8) feet of a curb.

3.2.7.7.4. Watertight lids shall be furnished on all manholes that are in close proximity to storm water management ponds.

3.2.7.8. Changes in Pipe Diameter: Under no circumstances will a larger diameter main discharging into a smaller diameter main be allowed, including when the smaller diameter main has an increased capacity due to a greater slope. All downstream lines shall be included in the upgrade to maintain at least the same size as the proposed main.

3.2.7.9. Vents

3.2.7.9.1. Vents shall be provided a maximum of every 1500 feet and a minimum of 200 feet from streams when watertight manholes are utilized consecutively along the said distance.

3.2.7.9.2. The top of the vent shall be a minimum of one (1) foot above the 100-year flood elevation. The vent shall be protected from flooding debris and vandalism. The vent protection design shall be approved on a case-by-case basis by the DUSWM. See the *Standard Details*.

3.2.7.10. Monitoring Manholes

3.2.7.10.1. Requirements: Monitoring manholes (see the *Standard Details*) are required at all commercial and industrial sites and at any location that has the

potential, as deemed by the DUSWM, to discharge toxic or otherwise harmful waste into the County's sewer system. Monitoring manholes serve at least three purposes. First, they enable verification of compliance with the County's pretreatment requirements and permits. Second, they enable detection of point sources of waste that require pretreatment and are not permitted by the County. Third, they enable quick verification that a sewer user is not contributing to a problem in the sewers.

3.2.7.10.2. Pipe Angles: The angle between the inflow and outflow pipes must be 180 degrees, with no exceptions. Slope of the incoming pipe cannot be greater than 2%.

3.2.7.10.3. Inverts: Manhole inverts shall be high enough to prevent backups from the mainline from affecting flow measurements. Invert elevation drop through a monitoring manhole is zero feet.

3.2.7.10.4. Stabilization of Flow: Flows into the monitoring manholes must be laminar and stabilized. Generally this is accomplished by providing a minimum of 25 pipe diameters of straight pipe before entering the manhole.

3.2.7.10.5. Flume Requirements: When required because of the Standard Industrial Classification Code (SIC Code) for a particular sewer user, a flow measuring device shall be included with the Monitoring manhole. The device shall be a Palmer-Bolus flume or equivalent.

3.2.7.11. Electrical: Electrical equipment installed in or used in manholes shall be UL listed, explosion proof, and resistant to corrosion from either sewer gases or immersion in sewage.

3.2.8. Service Connections

3.2.8.1. Location

3.2.8.1.1. SSCs shall be shown with symbol for the pipe and cleanout on plan view of the drawings. The connection is between the main and the property line or as directed by the DUSWM. SSC piping is always located in a right-of-way or easement, except for the end portion (cleanout) which is located about one (1) foot inside the private property line. Minimum slope of connection piping is 2% as required by the *Standard Specifications*.

3.2.8.1.2. Connection Crossing Property Boundary: When a particular private property site has no access to a County sewer main except by routing sewer piping through a second private property site, it is incumbent upon the owner requesting the sewer service to obtain a perpetual 10-foot wide easement on said second site. The easement must abut the existing right-of-way or easement containing the sewer main and extend to the property receiving the sewer service. The SSC can then be established with the cleanout located about one (1) foot inside the second site. Such installations are to be avoided unless compelling reasons are presented to the DUSWM for approval. Approval of all interested County agencies is also required, especially planning and zoning.

3.2.8.1.3. SSCs shall be located five (5) feet downstream from the center line of property to be served and SSCs shall be ten (10) feet downstream from the water. It is important to locate the SSC (cleanout) in a predictable location to facilitate locating the SSC in the event it becomes buried by subsequent construction or site grading.

3.2.8.1.4. Invert depth of the cleanout at the property or easement line is a critical factor when designing sewer service to a property site. Minimum depth (cover) is 3.5 feet to prevent freezing (see minimum depth requirements elsewhere in this Chapter). Minimum cleanout elevation (relative to the mainline) is determined by computing: main invert elevation at the connection + main pipe diameter in feet + (0.02 * horizontal distance from main to cleanout.). Cleanouts shall have a maximum depth of ten (10) feet unless justification is provided to the Department Head to allow for a deviation. The absolute deepest cleanout that may be allowed is 13 feet if the Department Head concludes the request is justified. Ejector pumps shall be used to provide basement service if the use of gravity sewer (for the basement) is the primary factor in placing a cleanout deeper than ten (10) feet. Distance between cleanouts shall not exceed 100 feet along the SSC. Cleanouts shall also be installed when the lateral changes direction. Show cleanout invert with a symbol in plan view and the station of the SSC in the profile view. Provide elevation of the cleanout in either plan or profile.

3.2.8.1.5. Sewer Service Drop Connections (SSDC) are required either to raise the elevation of the cleanout when the cleanout location is in such a way that the connecting pipe would be sloped greater than 5%. The design engineer shall evaluate each SSC to determine if it is standard or drop. If the drop connection is used, the appropriate Detail number and label must be called out in profile view, that is, SSDC in order for the contractor to price the installation correctly.

3.2.8.1.6. Manhole Connections: Extending SSCs from proposed manholes is acceptable. Invert of the connection is always 0.1 feet higher in elevation than the outlet invert of the manhole. Extending SSCs from existing manholes is acceptable under certain conditions. If the manhole was not constructed to acceptable standards, wall penetrations may severely weaken the structural integrity so replacement of the manhole may be required. Invert of the connection to the existing manhole should be about six (6) inches above the top of the bench. If an internal drop can be used with a 90 degree elbow at the top of the bench, then the bench can remain intact.

3.2.8.1.7. Double SSCs (DSSC) (that is when two properties drain to one connection pipe) are permissible under special circumstances; typically service to townhouses.

3.2.8.1.8. Crossings: SSCs that must cross an existing County or State road requires a permit. The methods must be specified for construction and also be coordinated with the appropriate road agency. See Road Excavations in this Chapter.

3.2.8.2. Sizing

3.2.8.2.1. In most cases of single family residential connections, the size of the

connection piping is determined by the 6-inch minimum in the standard detail. For commercial developments with high flows, the piping shall be sized to accommodate any peak flows with substantial safety factor.

3.2.8.2.2. Service connections eight (8) inches and larger must be designed with complete pictorial detail of service connection piping in plan and profile.

3.2.8.3. Abandoning Connections: If the design calls for an existing SSC to be disconnected, the plans must show special instructions for capping off the piping.

3.2.9. Clearances

3.2.9.1. Sewer Main Crossing Water, Force Main, Storm Drain, Other Utilities: Sewer main shall have a minimum vertical clearance of one (1) foot outside diameter to outside diameter (OD to OD) below the other utility. Horizontal crossing angles shall not be less than 45 degrees.

3.2.9.2. Sewer Main Parallel to Water, Force Main, Storm Drain, Other Utilities: Where sewer and water mains or other utilities are less than ten (10) feet apart, water mains or other utilities shall be vertically above sewers a minimum of six (6) feet. Where more than ten (10) feet apart, sewer mains shall be one (1) foot below the water or other utility. Restrained joint pipe or concrete encasement shall be used where minimum separation cannot be maintained.

3.2.10. Structural Design

3.2.10.1. General: This Design Manual together with the *Standard Specifications* and the *Standard Details*, provide standardized practices that have demonstrated good performance. However, it is incumbent on the design engineer to question the structural adequacy of the design under preparation to verify that structural failures will not occur. Unusual soil conditions, deep installations, and heavy vehicular traffic may require supplementary specification to the County's standard practices. The structural design of sewers shall conform with the methods given in the *ASCE Manual No. 37 for the Design and Construction of Sanitary and Storm Sewers*, except as modified herein.

3.2.10.2. Mainline: Typically, PVC, SDR 35 pipe is used for construction of the County's collector sewers. When bedding and backfilling is according to the S*tandard Specifications* and the *Standard Details*, no additional specification has been required unless there are unusual soil conditions. PVC pipe installed deeper than 14 feet of cover shall be SDR 26 and shall be called out on the profile view. For situations such as lack of enough cover or construction of stream crossings that require additional strength, ductile iron pipe or C-900 PVC shall be used in place of SDR 35 or 26 PVC. If there is a possibility that the pipeline may be exposed from stream erosion, then concrete encasement of pipe is required. For sewers installed on slopes of 20% or greater, concrete anchors are used. See the *Standard Details*.

3.2.11. Road Excavations

3.2.11.1. General: Sewer mains which penetrate the rights-of-way of the Maryland State Highway Administration (MSHA), County, railroad, or other utility upon which there

exists pavement or other features which may not be disturbed and, therefore, require the employment of tunneling or boring techniques, shall be designed to accommodate these methods of construction. The design engineer shall, after a preliminary review by the DUSWM, be responsible for securing written approval of the technique(s) and permits as required from the utility, railroad, or agency whose right-of-way is being penetrated. The County will assist in securing approval where it deems necessary.

3.2.11.2. Jacking Pipe: Water pipe under State and/or County roads shall be installed in a tunneled or jacked sleeve, as required by the State Highway Administration or County Division of Public Works in their respective rights-of-way. Sewer pipe and sleeves under railroads shall be designed according to specifications of the railroad being crossed. The entire crossing with all pertinent details shall be shown in profile. See the *Standard Details*.

3.2.11.3. Open Cut: In instances where open cut methods of installation are proposed, the conditions of the permit must be clearly shown on the plans. A copy of the permit must be secured and on file with the DUSWM before the County will approve the construction document package (PWA, PIA).

3.2.12. Tapping Mains

3.2.12.1. General: When designing sewer piping that requires tapping into an existing sewer system, the design engineer shall consult with the DUSWM to make plans for diverting the sewer flow while construction take place. Special instructions for diverting the flow must be shown on the plans.

3.2.12.2. Dog-house Manholes: Tapping main lines to accommodate another main requires a new manhole be constructed over the existing main. Use of a dog-house type manhole may facilitate the construction. See the *Standard Details*.

3.2.12.3. Service Connections: Tapping main lines for an SSC typically requires a tapping saddle. Tapping saddles are not usually obtainable when the diameters of the existing main and the proposed connection pipe are equal.

3.2.13. Pretreatment

3.2.13.1. General: Sewer service customers who are involved in activities which have the potential to discharge non-conforming waste, for example, toxic substances, solids, chemicals, oil, grease, etc. must provide pretreatment control to continue to discharge into the County sewer. Additionally, wastewater from customers cannot be too hot or discharged in slugs or surges to the extent that the discharge interferes with normal operation of the sewers. When required, the property must complete a SIC questionnaire with the DUSWM's Department of Regulatory Compliance.

3.2.13.2. Monitoring Manholes: During design phases of all industrial and commercial projects, the engineer shall consult with the aforementioned County agency to assure that no improper waste discharges occur. Monitoring manholes may be required as mentioned elsewhere in this Chapter. Customarily, vehicular repair and restaurant operations require a grease trap. Complete specifications for the installation of the grease trap (or other pretreatment device) must be shown on the plans.

3.2.14. Stream Crossings

3.2.14.1. Above-water Crossings shall not be allowed.

3.2.14.2. Underwater Crossings: A minimum cover of three (3) feet shall be provided over the pipe with appropriate stream protection. When crossing water courses that are greater than ten (10) feet in width, the following shall be provided:

3.2.14.2.1. Concrete encasement shall be required the full length of the crossing [this item determined where necessary by the DUSWM].

3.2.14.2.2. Force mains shall have valves provided at both ends of stream crossings so that the section can be isolated for testing or repair. The valves shall be easily accessible, and not subject to flooding.

3.2.14.2.3. For small stream crossings, a full length of pipe shall be centered in the center of the stream.

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CHAPTER 4. PUMPING STATIONS

4.1. GENERAL

4.1.1. Design Standards

4.1.1.1. General: The complete design discussed in the following sections represent standardized practice by the County and conformance thereto will be obligatory for all pumping stations except when directed to the contrary by the DUSWM. Unless otherwise directed in Chapter 4, all provisions of Chapter 1 apply as minimum requirements. The complete design, as approved by the DUSWM, shall be bid and constructed as ONE contract by the developer. Specialties such as paving and landscaping shall NOT be performed by the County or "others."

4.1.1.2. State Review: All water and sewer pumping stations that serve more than two (2) homes require a design review by the Maryland Department of the Environment (MDE). Construction permits for these stations are also issued by MDE. MDE has issued design requirements in the latest edition of MDE "Design Guidelines for Wastewater Facilities" which acts as a supplement to the Ten States Standards. For reference purposes, users of this Manual shall consult *The Recommended Standards for Sewage and/or Water Works*. Ultimately the design must meet or exceed MDE and Frederick County design conditions.

4.1.1.3. Operation Experience: These County standard design guidelines are based not only on recognized textbook and regulatory provisions, but also experience and standard operating/maintenance (O & M) procedures. Operations and maintenance functions are presupposed, but not limited to the following goals: ease of access for maintenance, standardized tools and equipment, reduced parts inventory, predictability of maintenance needs, and reliability of interfacing equipment. With these goals in mind, the County may specify manufacturers and associated equipment for use in all pumping stations.

4.1.1.4. Noise Control: All water and sewer pumping stations shall be designed to minimize noise in accordance with COMAR 26.02.03 or the latest version thereof.

4.1.2. Preliminary Design

4.1.2.1. General: Pumping station designs have the potential for a wide variety of configurations. It is difficult for these design guidelines to provide a simple sequence of steps that will lead to the final design without the need for numerous reviews and revisions. Nevertheless, if the designer learns and follows these guidelines, it will expedite the County design review process and greatly reduce the number and complexity of reviews.

4.1.2.2. Analysis: An analysis of any existing collection system and the impact of the estimated contributed flow must be performed by the engineer and submitted to the County prior to the commencement of any design. Prior to making detailed drawings and specifications, the designer shall perform a hydraulic analysis together with a graphic sketch plan and submit the same to the County for review and comment.

4.1.2.3. Other Considerations: In terms of preliminary planning for detailed drafting, major design considerations include but are not limited to: need for emergency power, number of and type of under/above ground structures, complexity of controls, water hammer, odor control, prescreening, grit removal, and to what degree a package design could be used as opposed to a custom design.

4.1.2.4 Designers are encouraged to use *Pumping Station Design*, Third ed., G. M. Jones, R. L. Sanks, G. Tchobanoglous and B. E. Bosserman II, Eds., Burlington, MA: Elsevier, 2006 for Pumping Station Design.

4.1.3. Design Drawings

4.1.3.1. General Requirements: Drawings for pumping stations shall provide adequate graphic treatment to various design aspects including: site plan, electrical, structural, landscaping, sediment/erosion control, details, hydraulic criteria, pump/system curves, architectural, and plumbing schematic.

4.1.3.2. Site Plan

4.1.3.2.1. General: One site plan shall indicate all major features of design and provide adequate detail to describe properly the pump station and its appurtenances.

4.1.3.2.2. Scale: All plans applicable to the site (site and grading, landscaping, sediment control, etc.) shall be prepared at a scale no smaller than 1-inch = 20 feet.

4.1.3.2.3. Locations: Location and size of structures, mechanical and electrical components must be dimensioned and drawn to scale. Provide profile views as necessary to show critical vertical locations.

4.1.3.2.4. Topography: Existing and proposed contours shall be provided at one-foot intervals.

4.1.3.2.5. Other Features: All existing and proposed physical features within 100 feet of the pump station's property line shall be shown.

4.1.3.2.6. Dimensioning: Provide adequate dimensioning to locate structures, specify pavement widths, utility spacing, etc. All dimensions shall be tied to a non-destructible or an easily recovered point, such as: property corners, existing buildings, or other permanent landmark.

4.1.3.2.7. Indicate contract limits if the station is to be constructed in another phase, by others, etc.

4.1.3.3. Electrical

4.1.3.3.1. Provide complete plan layout indicating all conduit sizes, wire sizes, and equipment locations, including lighting and other appurtenances. Show all conduit (buried and non-buried) locations inside and outside of all buildings that are existing or proposed.

4.1.3.3.2. Installation details of equipment that is wall mounted, or suspended from the ceiling, or otherwise required for clarity.

4.1.3.3.3. Single line schematic diagrams incorporating all electrical components required for operation of the facility.

4.1.3.3.4. Complete lighting schedule stating the model, size, location, and installation data as well as appurtenances. Vandal-proof exterior lighting shall be provided, when required.

4.1.3.3.5. Complete control and alarm diagrams.

4.1.3.3.6. The placement of controls below ground level is not permitted, as this will further aggravate confined space regulations.

4.1.3.3.7. Elevation of control panels with dimension, and properly identifying each component.

4.1.3.3.8. Complete circuit breaker schedule indicating size, and identifying each circuit.

4.1.3.3.9. Ventilation equipment schedule giving fan size, operating conditions, location, model, installation data, etc., and outlining louver data, such as fixed, motorized, size, material, etc.

4.1.3.3.10. Provide a legend for all symbols used for the above.

4.1.3.3.11. Secondary power facilities and alarm equipment shall be designed so that they may be manually activated for periodic maintenance checks to ensure proper operation.

4.1.3.4. Landscaping

4.1.3.4.1. Conifers are the preferred decorative landscaping treatment for newly designed pumping stations. All other shrubbery and planting shall be low-maintenance and hardy for this region of the country. Consideration shall be given to maintenance equipment in the selection of landscaping treatments. Under no circumstances shall large trees, shrubs, etc. obstruct maintenance vehicles, i.e. "vactor" truck booms, during routine work.

4.1.3.4.2. A landscaping plan shall be prepared showing planting arrangement of shrubs and trees, etc.

4.1.3.4.3. Identify each by genetic names as well as common names, and specify size and planting information in a schedule format with a legend.

4.1.3.4.4. Provide special planting details and specifications as applicable to each species.

4.1.3.5. Sediment and Erosion Control

4.1.3.5.1. A sediment control plan and site development plan shall be provided in accordance with the Soil Conservation District (SCD) requirements and the *Standard Specifications*.

4.1.3.5.2. All SCD signature blocks, details, notes, etc. shall be provided and approved by SCD.

4.1.3.6. Design Details

4.1.3.6.1. Plan views, profiles, sections, etc. shall be provided for valve vaults and other above or below ground structures.

4.1.3.6.2. Any other structure or appurtenance that cannot be adequately described in general notes or is not standard, shall be detailed appropriately.

4.1.3.6.3. Fencing, with appropriately sized vehicle and personnel gates, shall be provided to secure the site. See the *Standard Specifications*.

4.1.3.6.4. Pavement details indicating various course thicknesses shall be furnished on the design drawings.

4.1.3.6.5. Mechanical supports for equipment such as fans, controls, piping, etc. shall be detailed.

4.1.3.7. Hydraulic Criteria

4.1.3.7.1. List the following minimum information, in table format, directly on the construction drawings adjacent to the pump curve plot:

- Number of users, EDUs, etc.
- Peaking factors
- Total flow
- C-factors (pipe material)
- Length of force main
- Diameter of force main
- Static head

4.1.3.7.2. Special hydraulic criteria not specifically mentioned above must be furnished when requested by the DUSWM.

4.1.3.7.3. The design engineer shall fully investigate water hammer and provide additional necessary surge protection of the pumping stations as required, including surge tanks, as applicable. The use of solid state soft-start, soft-stop pump controls, or approved alternates, are typically required.

4.1.3.8. Pump Curves

4.1.3.8.1. Pump performance curves represent a plot of the performance characteristics of a pump in terms of its ability to add energy to the system across a range of flow rates.

4.1.3.8.2. Pump curves are developed by operating the pump at a constant speed with the fluid hydraulics in any connecting piping stabilized. Flowrate data versus pressure data is then recorded. Flowrates are varied using a valve for throttling. Manufacturers' tests of pumps are usually performed with water.

4.1.3.8.3. Prior to proposing a particular pump for a design application, the designer should be thoroughly familiar with the pump curve in terms of the manufacturer's recommended operating ranges, the best efficiency, suction head requirements, and the brake horse power required to drive the pump.

4.1.3.8.4. Closed vein impellers shall be avoided when pumping wastewater. Wastewater pumps shall be capable of passing manufactured so-called flushable wipes.

4.1.3.9. System Curves

4.1.3.9.1. System curves represent a plot of the performance characteristics of a piping system to which a pump is to be connected. System curves are developed by the designer using basic principles of hydraulics. Similar to pump curves, the system curve is a curve plot of a range of flowrates through the piping system versus the total dynamic pressure heads required by the system.

4.1.3.9.2. The system curve is an aggregate of three curves: static head, dynamic head, and minor head losses. Static head represents the net pressure head seen by a pump connected to the system when no fluid is moving. Static head is normally computed by taking the difference in elevation between the highest point in the piping system and the lowest point. Dynamic head, on the other hand, represents the total head required to move the fluid through the system when accounting for fluid friction losses. Minor losses represent head losses due to fluid friction in fittings such as: elbows, reducers, check valves, gate valves, flow meters, etc.

4.1.3.9.3. To plot the friction head versus flowrate, either the Hazen-Williams or the Darcy-Weisbach equations are acceptable. Common friction coefficients for various pipe materials can be found in Appendix C.

4.1.3.10. Pump and System Curves

4.1.3.10.1. The system curve shall be plotted and superimposed on the manufacturer's pump curve. The intersection of the pump and system curve determines the operating point of the pump that is directly associated with the pipe distribution system. Curves that are submitted to the County shall be accompanied by hydraulic calculations and pipe distribution system diagrams so that the development of the curve plots can be verified. All system curves shall be superimposed or reillustrated on the design drawings.

4.1.3.10.2. Curve plots shall be furnished on the contract drawing. All data that is not relevant to the development of these curve plots shall be omitted. Pump operating points shall be labeled with all coordinates identified.

4.1.3.10.3. Adjacent to the curve plot, the design engineer shall provide the computation of the total static head. The length, diameter, and friction coefficients shall be provided in a tabular form.

4.1.3.10.4. In many cases, particularly with potable water pumping stations, more than one system curve must be developed because the distribution system changes during various pump operating conditions. Suction and discharge pressures may vary widely because of changes in storage tank levels or large draft conditions. A minimum of two curves are required. One curve shall represent the most favorable conditions sustained by the pump and the other curve shall represent the most unfavorable conditions the pump could sustain.

4.1.3.10.5. The specifications for the pump shall include the following information:

- # of pumps
- Discharge nozzle size (in.)
- Suction nozzle size (in.)
- Maximum design speed (rpm)
- Design capacity (gpm)
- Design TDH (feet)
- Efficiency at design point
- Brake horsepower required at the maximum design point
- Minimum solid size (in.)
- Net positive suction head required at the maximum flow design point (ft.)
- Secondary design capacity (gpm)
- Secondary TDH (ft.)
- Efficiency at second point, minimum
- Impeller diameter (in.)
- Motor horsepower

4.1.3.11. Architectural

4.1.3.11.1. Elevation views shall be furnished for all four sides of buildings. Indicate compass directions.

4.1.3.11.2. Floor plans shall be at a scale no smaller than 1/2" = 1'-0".

4.1.3.11.3. See County Department of Permits and Inspections for applicable building codes and regulations.

4.1.3.12. Plumbing Schematic

4.1.3.12.1. For piping smaller than four (4) inches in diameter, an isometric diagram shall be furnished that indicates fittings, valves, sizes, etc.

4.1.4. Specifications

4.1.4.1. Specifications, if they are not too lengthy, may be directly incorporated into the design drawings. Otherwise, the specifications shall be on 8½-inch x 11-inch paper, GBC bound, and submitted concurrently with the design drawings for review.

4.1.4.2. Specifications shall be in a format that is similar to the CSI specification designations.

4.1.5. Cost Estimates

4.1.5.1. At the conclusion of the design process, the engineer shall prepare a detailed cost estimate for the pumping station for review and approval by County. This estimate shall be developed for each major category of work including civil, mechanical, electrical, structural, architectural work, and contingencies.

4.2. SITE SELECTION AND DESIGN

4.2.1. Locations

4.2.1.1. The locations must be specifically determined for each project based on various criteria applied to potential sites. In addition to satisfying the functional needs of the system it serves, the site location must be evaluated as to its visual, odor, and noise impact on the surrounding neighborhoods.

4.2.1.2. The design engineer shall take into account the surrounding environment of the site and provide a site design that is aesthetically appealing to existing as well as any future development of surrounding areas.

4.2.1.3. Pump station sites and their associated entrance roads shall be located a minimum of two (2) feet above the 100-year floodplain elevation. Under no circumstances shall stations and entrance roads be located within a floodway, even if the elevation is two (2) feet above the 100-year floodplain using current information. Also, avoid locations vulnerable to overland drainage and erosion.

4.2.1.4. In locating the pumping station and supplemental above ground facilities, the design engineer shall ensure compliance with existing County ordinances regarding land use, set back requirements, etc. and if required, prepare all data, and obtain any variance(s) to existing zoning regulations to be in conformance as necessary.

4.2.1.5. Land required for pumping stations is obtained for ownership by the County (fee simple) including a 20-foot wide fee simple panhandle right-of-way for vehicular access routes to an existing or proposed public roadway. If two utilities are to be present within the 20-foot panhandle, a minimum of five (5) additional feet of easement is required on either side of the panhandle for maintenance purposes. As part of this process, a survey of the property is required, together with a record plat and a metes and bounds description of the parcel.

4.2.1.6. Existing drainage problems must be investigated and corrected.

4.2.2. Site Size

4.2.2.1. In determining the space requirements of the facility, particular attention shall be given to width provided for the access road to ensure adequate space for grading and drainage within the purchased land. Future expansions of the facility shall be fully considered.

4.2.2.2. The design engineer's goal shall be to meet all applicable zoning requirements for public utilities, when possible.

4.2.3. Land Acquisition and Dedication

4.2.3.1. Pumping station sites and any necessary land space for access routes to the nearest public thoroughfare shall be acquired by the developer in fee simple. The site will then be deeded to the County.

4.2.3.2. The pumping station site shall be deeded to County prior to construction unless otherwise specified in the executed construction agreement.

4.2.4. Layout

4.2.4.1. Location of all proposed facilities required for the pumping station site shall be clear and concise to permit a complete field stakeout from the site plan.

4.2.4.2. Parking and Turnarounds: A minimum of two (2) parking spaces shall be provided. Adequate paved area shall be provided for a tandem three-axle sludge truck for vehicle access and turnarounds. All paving sections shall be in accordance with County Standards for Local Roads.

4.2.4.3. Access Road: The pumping station shall be readily accessible to maintenance vehicles by an access road, minimum 12 feet wide, paved in accordance with County Standards for Local Roads. The road shall be centered in a minimum 20-foot wide fee simple right-of-way. Excessively long access roads may require additional paved width and/or right-of-way. A 3% grade for a landing area shall be provided a minimum of 30 feet from the public street. The station shall be located outside the public street right-of-way, or where deemed necessary by the County. Minimum pavement specification is 2-inches of surface course on 4-inches of base course on 6-inches of compacted graded aggregate (CR-6, GAB) base unless otherwise approved by the DUSWM.

4.2.4.4. Traverse Information: All locations of proposed facilities shall be projected from a traverse, and/or base line established from the traverse, in which case the base line shall be located so that it will not be interrupted by the proposed construction. Location of proposed facilities shall not be referenced from other proposed facilities for stakeout purposes.

4.2.4.5. Grading: Grading around the pumping station site shall have a maximum side slope of 3:1 unless otherwise approved by the County. On flat sites, adequate spot shots shall be provided to ensure positive drainage away from the site.

4.2.4.6. Topography Limits: Existing contours and other topography shall be shown for the entire site including 100 feet minimum outside of proposed property boundary. Contour interval shall be one (1) foot.

4.2.4.7. Utilities: Water and sewer lines shall be located at the edge of the pavement of the access road when possible. Supply dimensions of their respective locations.

4.2.5. Soil Investigations

4.2.5.1. At least two soil borings will be taken at the building, wet well, dry well locations, etc. to determine soil types, rock, water table elevations, soil bearing values, etc. These boring logs will be included on the contract drawings or specifications. A soils report outlining the recommendation of the design must be submitted at 60% design completion.

4.2.6. Fences

4.2.6.1. The pump station site shall be enclosed with a minimum 8-foot high chain link fence (fabric height), having a minimum 14-foot wide double leaf vehicle gate across the driveway. Site layout may require a single 6-foot wide personnel gate be provided for site maintenance access.

4.2.6.2. Fences shall be bonded green or black vinyl/PVC to be topped with three strings of barbed wire. See the *Standard Specifications* for more details.

4.2.6.3. Pumping stations that have long driveways (up to the fenced portion of the site) shall be provided with a locking drop bar type gate (at the driveway entrance) to prevent loitering. Provide a gate detail on the plans.

4.3. STRUCTURAL/ARCHITECTURAL

4.3.1. Above Ground Structures

4.3.1.1. The building designed to house pumping equipment and/or electrical controls systems must conform to the County Building Code and latest revisions thereto.

4.3.1.2. Buildings (generators, controls, etc.) with exposed superstructures shall be architecturally compatible with surrounding structures. Buildings shall utilize maintenance free and structurally significant materials (such as brick masonry units) on the exterior. Vinyl siding shall not be used.

4.3.1.3. Buildings shall be designed to be vandal-proof. Under no circumstances shall windows be provided. The use of wood doors is also not permitted.

4.3.1.4. Small facilities may utilize precast buildings when deemed appropriate according to good engineering practice.

4.3.1.5. Provisions shall be made in the structure for traversing monorails with cranes of adequate capacity to facilitate the removal of pumps, motors, valves, and all other related heavy equipment.

4.3.2. Below Ground Structures

4.3.2.1. Confined Spaces: The engineer shall emphasize eliminating the need for maintenance personnel to enter the OSHA definition of a confined space.

4.3.2.2. Buoyancy calculations must be furnished on all underground structures such as: wet wells, dry wells, large vaults, etc.

4.3.2.3. No steel underground structures are permitted for either temporary or permanent installations.

4.3.2.4. Fiberglass stations or structures that are double wall thickness may be considered for very small installations only. See the definition on pump station classifications elsewhere in this Chapter. Fiberglass structures must withstand backfill and earth pressure without deformation or puncture.

4.3.2.5. Precast concrete shall typically be used for wet wells, dry wells, valve vaults, etc. Excessive depth and high ground water may require cast-in-place structures be used.

4.3.2.6. Underground walls shall be provided with external waterproofing (e.g. bitumastic).

4.3.3. Roofing

4.3.3.1. Roofing shingles shall be at a minimum of 30-year fiberglass. Shingles, standing seam metal roof or other roofing materials shall be consistent with similar residential architecture in the area.

4.3.3.2. Flat roofs are not permitted on small buildings and shall be avoided whenever possible.

4.3.4. Flooring

4.3.4.1. Floors shall be reinforced concrete and sloped to a central floor drain. Floor shall be sealed with a clear rubber-based smooth finish. Finished floor shall be a minimum of six (6) inches above finished grade to minimize flooding of the building.

4.3.4.2. Grating shall be aluminum or fiberglass meeting Federal and State safety requirements.

4.3.5. Door Locks, Padlocks and Keying

4.3.5.1. Doors are to be UL listed, heavy duty, insulated, metal, and fire-resistant. Internal panic hardware shall be furnished on all open-out doors.

4.3.5.2. All locksets and padlocks shall be keyed to the Frederick County Division of Utilities and Solid Waste Management's (DUSWM) Best Access System/Stanley Security Solutions (Best Lock) key system. No substitutions allowed.

4.3.5.3. All locksets shall be compatible with Best Lock 7 pin interchangeable core cylinders. All padlocks shall be Best Lock Series 11B (order number 11B772L). All permanent cores shall be Best Lock "C" Series Standard (order number 1C7…). Permanent core face finish shall be the same as the lockset finish.

4.3.5.4. Provide construction cores and keys for all locksets and padlocks during the construction period. The construction cores shall be replaceable by the permanent cores. Construction control and operating keys and cores are not part of the permanent keying system or furnished on the same keying system. Construction cores and keys will be returned to the contractor after the permanent cores are installed by the Owner.

4.3.5.5. The permanent keys and cores will be provided in accordance with the Owner's approved keying schedule. Best Lock shall provide a keying schedule to the Owner for keying (mark) information and approval. All keys shall be stamped with the applicable key mark for identification on one side and "Do Not Duplicate" on the other side. Provide one (1) key per key mark used and one (1) blank key per core provided. The permanent cores and keys shall be shipped from Best Lock directly to the DUSWM Facility Maintenance Supervisor for installation.

4.3.6. Handicap Accessibility

4.3.6.1. Control buildings shall be constructed to be barrier-free. Floor plans, when applicable, must be submitted for approval.

4.3.7. Lighting Requirements

4.3.7.1. Outside area lighting shall be dusk-to-dawn lamps with shatter-proof bulbs and no outside switches.

4.3.7.2. An outdoor ground fault interrupter (GFI) receptacle shall be furnished with a switch or breaker in the equipment control panel.

4.3.8. HVAC

4.3.8.1. Because control panels are to be enclosed in a building (to eliminate the hazard maintenance personnel experience repairing control panels in a driving rain), regardless of the size of the station, electric space heating shall be considered for all stations. Provisions also shall be made, if applicable, to ensure against condensation forming on controls and other major items of equipment.

4.3.8.2. Dehumidifiers and sump pumps are to be furnished for all underground structures, except wet wells.

4.3.8.3. Provide calculations showing that excess heat from pumps and other equipment will be adequately removed from the building. Otherwise, air conditioning is required to keep electrical equipment from failing.

4.3.8.4. Full HVAC design shall be incorporated into the pump station design.

4.3.9. Fixtures

4.3.9.1. If potable water is available to the site, sinks shall be furnished for personal sanitation. Reduced pressure backflow preventers are required on all potable water supplies to pump stations.

4.3.9.2. If chemical treatment is utilized at a pumping station, eye washes, sinks, etc. will be necessary.

4.3.10. Penetrations

4.3.10.1. Walls: All penetrations (such as conduits, pipes, etc) to wet wells, valve vaults, walls, etc. shall be gas and liquid tight.

4.3.10.2. Floors: Floor penetrations shall utilize steel or PVC sleeves.

4.4. POWER REQUIREMENTS

4.4.1. General: All electrical designs and components shall be in strict accordance with all applicable National Codes, County Codes NEMA and power company requirements. It is incumbent on the design engineer to contact the power company to determine the type of electrical power available.

4.4.2. Normal Power

4.4.2.1. Voltage Phase Selection:

4.4.2.1.1. Three-phase service available from Potomac Edison is 4-wire wye at either 277/480 or 120/208 volts. Compared to the 120/208 service, the 277/480 service requires less costly wire and switchgear, but a dry transformer is required for 120-volt appliances. For installations with pumps five (5) horsepower and smaller, either three-phase power or 120/240 volt single-phase power can be used. However, the decision as to which voltage to use is based upon considering cost trade-offs among: the initial cost to bring electric service to the site; the costs for electrical equipment at the station; and the monthly user charges.

4.4.2.1.2. All installations with pumps over five (5) horsepower require three-phase power. Pumping stations employing equipment that requires a non-standard voltage configuration that requires a step-up/down transformer will not be allowed.

4.4.2.2. Across the Line Starting: This is the preferred method of designing controls for motors 50 HP or less, even though a larger on-site generator is required. Permission shall be obtained from the power company prior to starting the electrical design.

4.4.2.3. Reduced Voltage Starting: Conventional reduced voltage and solid state starting systems shall be used for motors above 50 HP. Solid state controls shall have bypass

contactors to reduce the generation of heat in the Thyristors. The power company will need the horsepower sizes of the electrical equipment to determine the degree of voltage reduction. Reduced voltage starters will need bypass contact points to allow the starter to be manually actuated. Consideration will be given to the size of the pumps and inrush current necessary to determine if this is a feasible expectation.

4.4.2.4. Typically the power company expects the contractor to install the meter socket (pedestal or wall mount) and the conduit from the meter socket to power source. This scope of work must be clearly delineated on the plans.

4.4.3. Emergency

4.4.3.1. Dual Power Sources: Dual power sources for emergency operations of pumping stations shall be considered and thoroughly investigated and coordinated with the power company in all cases. The provision of dual power sources shall involve the connection to the station of two substantially independent power sources (separate substations). It shall be capable of automatic and manual start-up and cut-in with sufficient capacity to provide power for full station capacity, lighting, and ventilation as well as other systems necessary for the adequate operation of the pumping station during an outage of one of the sources.

4.4.3.2. Emergency Power Generator: The emergency power generator shall be capable of automatic and manual start-up and cut-in with sufficient capacity to provide power for full station capacity, lighting, and ventilation as well as other systems necessary for the adequate operation of the pumping station during a 24-hour power outage of the primary source.

4.4.3.3. The design engineer shall perform a complete cost analysis in determining the lowest cost alternative (between dual power source and emergency power generator) and provide the County with complete recommendations. The County prefers dual commercial power supply.

4.4.3.4. Provision of connection for a portable generator may be required by the DUSWM.

4.4.4. Power Circuits

4.4.4.1. Electric meters and main disconnect switches shall be placed on the exterior wall of buildings.

4.4.5. Control Circuits

4.4.5.1. All pump controls shall be automatic and have manual controls in addition to the automatic controls, so that testing and maintenance of critical components can be performed.

4.4.6. Motors

4.4.6.1. Where possible, all electric motors and equipment shall utilize energy saving characteristics and be highly efficient.

4.4.6.2. Each pump motor control circuit shall be equipped with phase loss protection so that individual motor starting circuits are prevented from operating during conditions of phase loss or reversal.

4.4.6.3. The pump motor horsepower, not including the motor service factor, shall be equal to or exceed the pump's maximum horsepower requirement. Motor service factors shall be reserved for electrical voltage variations only.

4.4.7. Wiring and Cabling

4.4.7.1. Requirements for wiring and cabling shall be supplied either on the construction plans or the specifications.

4.4.8. Grounding

4.4.8.1. Under no circumstances shall electrical grounding systems be connected directly to piping systems that carry water or wastewater. This contradicts the requirements of local code enforcement, however the NEC does not require such a connection and the prevention of potential stray currents causing electrolytic corrosion must be prevented.

4.5. WATER PUMPING STATIONS

4.5.1. General: The engineer shall make special reference to the National Fire Protection Association manual as applicable in the design of pumping station electrical control and ventilation systems.

4.5.1.1. Design features of the structure and mechanical equipment shall take into account the functional requirements of pumping, automation, maintenance, personnel safety, and noise controls. Pumping units, design features, and mechanical appurtenances must be carefully selected by the design engineer for performance, reliability, and efficiency.

4.5.1.2. Backup power is required for all stations that provide fire flow or serve more than 25 homes where storage cannot supply average daily flow for at least four (4) hours.

4.5.2. Hydraulic Criteria

4.5.2.1. General: The pumping units shall be selected to satisfy both the initial and ultimate design hydraulic peak flows as described in Chapter 2, if feasible. If not feasible, then the pump capacity may be scaled down to accommodate the initial flow rate and an intermediate flow rate based on an approved interim state of development. Pumping units can be upgraded by means of impeller changes, speed changes, or both. At least one standby pump shall be provided and shall be designed and equipped to be operational at all times. Pumps shall be of such capacity that with the largest unit out of service, the remaining pumps will deliver the peak flow.

4.5.2.2. A complete analysis of the hydraulic conditions of the system shall be made to determine average, maximum and minimum operating gradients, water hammer conditions, etc.

4.5.2.3. A sufficient number of system curves shall be developed to show design points, including the average daily flow (ADF) and fire flow conditions, to be satisfied by an individual pump as well as a number of pumps operating in unison.

4.5.2.4. The system curves shall be shown on the contract drawings and shall indicate a minimum of three (3) design points to be met by each of the design procedures for demonstrating the effects of pumping on the pipe system.

4.5.2.5. When required by the DUSWM, hydraulic gradient diagrams shall be provided in addition to the system curves and shall be at a scale of 1 inch = 50 feet horizontal; 1 inch = 5 feet vertical, and shown on the Contract Drawings, indicating: hydraulic gradients, flows, velocities, friction coefficients, existing ground elevation, proposed pipe grades, and any other pertinent data.

4.5.3. Pumps

4.5.3.1. Pumps for use in potable water pumping stations are generally to be centrifugal closed impeller type, horizontal split-case, electric motor driven, and are selected on the basis of maximum efficiency at the operating points of the system curve. In some instances, turbine pumps may be used in lieu of the type mentioned above, but will require the approval of County before substantial design is initiated.

4.5.3.2. A minimum of one standby pump shall be provided and available for service at all times. Additional pumps may be provided, depending on the flow rates to be accommodated as determined by the system curve. Typically, two jockey pumps and two fire flow pumps will be required as a minimum, but the design engineer is responsible for verifying this general requirement.

4.5.3.3. The number of pumps may be reduced by providing two (2) speed operation or variable speed drive controls.

4.5.3.4. Pump discharge velocities shall typically be operated between five (5) and ten (10) feet per second. Tank supplied systems shall have suction pressures maintained at a sufficient point to prevent cavitation.

4.5.3.5. In-line booster stations shall be located such that a minimum of 25 psig is maintained on the suction side of the distribution system when the pump station is operating at maximum flow.

4.5.3.6. When pressure in zone is controlled solely by a booster pumping station, a pressure relief valve is required to prevent excessive build-up of pressure.

4.5.4. Control Equipment

4.5.4.1. Controls shall provide automatic shutoff at 15 psig suction pressure.

4.5.4.2. Pumping units and necessary appurtenances for operational control must be carefully selected by the design engineer for performance, reliability, and efficiency.

4.5.4.3. Pumping stations are to be designed for automatic operation, requiring only periodic visits by maintenance personnel, usually once per week.

4.5.4.4. Controls are required for automatic start and stop of pumps, based on hydraulic pressures or flow rates as determined by the design of the station. Some stations may require "cushion tanks" to minimize pump cycling under low flow conditions. County typically uses hydropneumatic tanks as a control device.

4.5.4.5. Controls are necessary for the protection of equipment in the instances of pressure surges due to normal starting and stopping of pumps, or in the event of a power outage.

4.5.4.6. Pressure gauges for direct reading of line conditions shall be placed on both suction and discharge piping of each pump, and on the main discharge header piping after the last pump.

4.5.4.7. An electrical control center shall be provided in a convenient location within the building for switch gear, motor control units, and for flow recording equipment. Alarms shall be provided and sent via telemetry to the DUSWM operations center as the system operation warrants. Under no circumstances shall these types of pumping stations be below ground or in a confined space. See the telemetry paragraph for further information.

4.5.5. Mechanical Piping and Appurtenances

4.5.5.1. Arrangement of piping and equipment within the station shall be made with adequate space for maintenance, repair, and removal or replacement of equipment as well as to safeguard personnel working in the station.

4.5.5.2. Removable grating made of aluminum or fiberglass shall be used for access around and over piping, etc. Valve stems shall be extended up to grating level or above as applicable.

4.5.5.3. Clearances and other design features shall conform to MOSHA standards.

4.5.5.4. The layout of main system piping within all pump stations shall be based on Class 150 standard flanged ductile iron pipe and fittings. Manifolds shall include flexible couplings for make-up and for expansion and contraction of the piping system.

4.5.5.5. Control and instrumentation piping shall be copper or stainless steel.

4.5.5.6. Butterfly valves shall be provided on the suction and discharge side of each pump to permit removal. Check valves shall be placed on the discharge side of each pump. Evaluate potential water hammer problems and incorporate resolution in the design. Provide isolation valves to allow for repair of check valves.

4.5.5.7. Forced air ventilation is to be provided, designed with sufficient capacity to remove heat generated by pump motors and controls.

4.5.5.8. Floor slabs shall be sloped to provide for positive drainage to a sump pump for removal.

4.5.6. Telemetry

4.5.6.1. Telemetry of critical status and conditions from the water pumping station to the New Design Water Treatment Plant is via 800 megahertz radio transmission.

4.5.6.2. Station control room or panel should provide for housing of radio related components, including an antenna. Additionally, an interface panel for connections between individual sensor circuits and the radio components is required.

4.5.6.3. Typical conditions monitored include but are not limited to:

- High Tank Level
- Zone Low Pressure
- Normal Power
- Auxiliary Power
- Building Intrusion
- Zone Flow Rate (analog)
- Tank Level (analog)
- Low Tank Level
- Pump Failure
- Zone High Pressure

4.5.7. Metering

4.5.7.1. Turbine, differential pressure, or magnetic flow meters are required with a 30-day circular chart recorder.

4.5.7.2. Meter accuracy must be 95 percent of the anticipated flow requirements.

4.5.7.3. The maximum pressure drop through a meter must not exceed four (4) psi during fire flow conditions.

4.5.7.4. Sufficient straight runs of pipe will be needed prior to the water entering the meter in order to stabilize the flow. Each manufacturer of a particular meter has specific requirements and dimensions that are suggested to stabilize the flow. The design engineer must fully investigate these requirements and incorporate them into the design.

4.5.7.5. Meters shall be required to provide a 4-20 ma signal to the SCADA interface panel so that real time data can be seen and placed in a historian.

4.6. SEWAGE PUMPING STATIONS

4.6.1. General: The engineer shall make special reference to the National Fire Protection Association manual NFPA 820 in the design of pumping station electrical control and ventilation systems.

4.6.1.1. Design features of the structure and mechanical equipment shall take into account the functional requirements of pumping, automation, maintenance, personnel safety, and noise and odor controls. Pumping units, design features, and mechanical appurtenances must be carefully selected by the design engineer for performance, reliability, and efficiency. Pumping stations may be the built-in-place or the prefabricated package types.

4.6.1.2. Backup power is required for all stations, except as otherwise provided herein.

4.6.1.3. Suitable masonry buildings are to be considered for enclosures for pump station controls and backup power supply systems. This shall be true of all size pump stations.

4.6.1.4. The maximum speed for synchronous motors driving small pumps is 75 HP and less is 1,800 rpm. The maximum speed for synchronous motors driving larger pumps shall not exceed 1,200rpm. A design that incorporates the lowest speed pump possible is optimal for reducing wear on the pump.

4.6.2. Classifications of Pump Stations

4.6.2.1. Very Small Stations (Grinder) are less than 25 EDUs and less than 20 gpm. Duplex pumps are grinder pumps with a discharge of 1.5 or 2-inch diameters. They can be package, prefabricated, or built-in-place. Twenty-four (24) hour wet well storage is to be supplied in lieu of back-up power. Control panels can be an outdoor pedestal-mount type. Fiberglass wet wells are permissible if buoyancy and structural concerns are addressed.

4.6.2.1.1 The DUSWM prefers to avoid low pressure sewer systems, but will review applications for a low pressure sewer system on a case-by-case basis.

4.6.2.2. Small Stations (Grinder) are stations that pump between 20 and 80 gpm, inclusive. In duplex pump stations, only one pump is to be used to handle peak flows. Discharge piping is between two (2) and three (3) inches. These stations can provide for future growth if the pump case is available with a range of impeller and horsepower sizes. Prefabricated or built-in-place stations can be utilized. Controls can be located outside, as was the case with small stations, or in an appropriately sized building depending on reliability requirements. Flow meters are required.

4.6.2.3. Medium Stations (Trash) are stations that pump between 80 and 500 gpm. Typically these stations are duplex, but can be triplex. These stations are expandable for future growth by replacing existing impellers or making provisions for a third pump. However, the motor size must be carefully evaluated before impellers are replaced, otherwise a motor overload could occur. Pumps shall handle 3-inch solids with a 4-inch discharge. The discharge size is critical for future expansions. Prefabricated stations can be used if the flow is less than 300 gpm, otherwise built-in-place stations must be used. Controls are to be located in an appropriately sized building. Splash baffles may be required on interior walls. A flow meter is required.

4.6.2.4. Large Stations (Trash) are stations that pump over 500 gpm. These stations must be of the wet well/dry well type. All underground structures must be type II concrete.

4.6.2.5. MDE guidelines shall be followed for determining if an auxiliary power source or overflow detention structure is required.

4.6.3. Hydraulic Criteria

4.6.3.1. General: The pumping units shall be selected to satisfy both the initial and ultimate design hydraulic peak flows as described in Chapter 3, if feasible. If not feasible, then the pump capacity may be scaled down to accommodate the initial flow rate and an intermediate flow rate based on an approved interim state of development. Pumping units can be upgraded by means of impeller changes (and considering the existing motor

size), speed changes, or both. At least one standby pump shall be provided and shall be designed and equipped to be operational at all times. Pumps shall be of such capacity that with the largest unit out of service, the remaining pumps will deliver the peak flow.

4.6.4. Force Mains

4.6.4.1. Force main sizes shall be determined by consideration of total friction head, size of the solids, maximum and minimum desirable velocities, and by power requirements. For diameters of 3-inch and smaller, SDR-21, ASTM-2241 PVC is typically used with gasket joints. For diameters 4-inch and larger, DIP is used. Friction factors for PVC pipe are typically C = 140 and for DIP, C = 120.

4.6.4.2. The minimum and maximum velocities are 2.25 feet per second (fps) and 7 fps, respectively. When pumping rates will not satisfy velocity requirements, pump capacities must be adjusted accordingly.

4.6.4.3. Force mains shall discharge into a manhole from a rising grade, where possible, at or near the invert of the effluent pipe. See the *Standard Details*.

4.6.4.4. Crown elevations that are higher than force main outlets shall be avoided. This keeps force main full at all times.

4.6.4.5. Blowoffs shall be provided at all line sumps and air release/vacuum valves provided at the peaks and on long runs as required.

4.6.4.6. At certain critical stations, a tee and two resilient seat gate valves shall be placed on the force main in close proximity to the pump station to facilitate bypassing the pumping station with portable emergency pumps. This valved connection shall terminate near the ground surface in a vault with special couplings or threaded pipe as determined by the DUSWM. The point of connection shall be conveniently located with respect to the outside wet well opening.

4.6.4.7. Manifold force mains require special hydraulic calculations with appropriate system curves, pump curves, etc. Manifold force mains should be avoided in areas that are subject to future expansions and growth.

4.6.4.8. An insulated #6 AWG trace wire shall be furnished for all nonmetallic force mains.

4.6.4.9. Force main piping and fittings must be designed to withstand maximum surge pressures and water hammer.

4.6.4.10. For clearances and stream crossings see Chapters 2 and 3.

4.6.5. Pumps

4.6.5.1. Wet Well/Dry Well Type

4.6.5.1.1. Water seals shall be provided on all pumps where possible; otherwise, grease seals shall be used. Ceramic shaft sleeves of 400 Brinell hardness or greater, shall be provided in all cases.

4.6.5.1.2. Each pumping unit shall be fitted with stainless steel wear rings and bearings capable of a minimum 10,000 hours AFBMA-10 bearing life.

4.6.5.1.3. Each pump shall have an individual separate suction line from the wet well and shall have sufficient positive suction head measured from the low water level in the wet well. Pumps shall be capable of passing 3-inch (minimum) diameter spheres, and pump suction and discharge opening shall be at least four (4) inches in diameter. Each pump discharge volute casing and suction elbow shall be provided with an inspection and cleanout opening.

4.6.5.1.4. The minimum head for individual pumps must be identified to determine the maximum brake horsepower (motor size) required and the maximum flow at which the pump may operate satisfactorily.

4.6.5.1.5. A vibration performance specification for each pumping unit shall be achieved by means of proper balancing and structural supporting. At operating RPM, at no point on the pump drive motor, steady bearing support beam for intermediate shafting and the pump, shall the vibration velocity exceed 0.30 inches per second.

4.6.5.2. Submersible

4.6.5.2.1. In the extension of the County sewerage system, occasionally there is a need for small sewage pumping stations to serve limited areas or small volumes of flow. Usually, this type of station is temporary and necessary only to provide an interim service until a gravity system can be extended or completed.

4.6.5.2.2. When the need is established for pumping stations to be installed with peak capacities less than 300 gallons per minute, the County may then consider the employment of prefabricated submersible duplex pumping units set in a below-ground, wet well structure. However, in the design of this type of pump station, the engineer shall eliminate problems associated with confined space entry problems by maintenance personnel.

4.6.5.2.3. The use of grinder pumps or ejector stations shall only be permitted when directed by the County. Ejector pumps (private) located inside the home may be used as needed to sewer basements.

4.6.5.2.4. The minimum head for individual pumps must be identified to determine the maximum brake horsepower required and the maximum flow at which the pump may operate satisfactorily.

4.6.5.2.5. Submersible pumping stations shall incorporate, but not be limited to: no valves in wet well but enclosed in a separate vault with emergency pump around connection, hoist provisions for removing pumps, all alarms and mechanical requirements.

4.6.6. Wet Well Design

4.6.6.1. The determination of the volume of the wet well is critical to the pump station design as its capacity affects the time the sewage will remain in the station and the frequency of operation of the pumps. The wet well receiving the incoming sewage shall be sized to provide a minimum pumping cycle of 10 minutes, alternating with the total time on and the total time off, using the following formula:

$$V = T * Q/4$$

where: V = Volume in gallons of wet well between lead pump on and lead pump off levels

T = Pumping cycle in minutes

Q = Pumping rate of lead pump in gallons per minute

4.6.6.2. To reduce the occurrence of odor, the detention period for sewage in the wet well is not to exceed 30 minutes at the average flow rate for the initial, intermediate, and ultimate design years. This can be achieved by the operator making adjustments to the level controls.

4.6.6.3. If initial average flows are insufficient to actuate the pump within a 30-minute period, temporary removable appurtenances shall be placed in the wet well or the liquid level control points shall be lowered.

4.6.6.4. The differential between pump start and off levels shall not be less than two (2) feet. The wet well floor shall be sloped at 45 degrees to form a hopper. To establish net positive suction head (NPSH), the net volume of the wet well shall be measured from a level approximately one (1) foot above the top of the pump volute.

4.6.6.5. Wet wells utilizing submersible pumps shall not provide ladders or manhole steps for access by maintenance personnel.

4.6.6.6. Underground structures shall be made of reinforced concrete. Wet well interior surfaces in particular, shall be coated with 40 mils of coal-tar epoxy or equivalent. Access doors must be of aluminum and sized for safe removal of equipment.

4.6.6.7. The wet well shall be protected from debris that could clog or foul the pumps depending upon the type and size of station. Design engineer shall propose a method for DUSWM approval.

4.6.7. Dry Wells

4.6.7.1. A separate sump pump shall be placed in the dry well to remove both seepage and leakage which shall be pumped to the wet well.

4.6.7.2. The floor of the dry well shall be sloped to the sump pump for positive drainage.

4.6.7.3. The sump pump discharge piping, as well as any mechanical or electrical conduits, shall pass through the separation wall of the wet well, well above the high water level of the wet well and shall be gas tight.

4.6.7.4. To enable the control of flooding in the dry well, plug valves will be placed on the suction piping and the valve stems will have extensions to allow access from the control room floor.

4.6.7.5. Pressure gauge taps, with pet cock fittings and pressure gauge, shall be placed on the suction and discharge lines of each pump as well as on the main discharge header after the last pump.

4.6.8. Control Equipment

4.6.8.1. When a two (2) pump system is designed, controls shall allow the lead pump to automatically alternate and operate at the discretion of the operator.

4.6.8.2. To be compatible with telemetry, pump operation is to be controlled by an analog controller capable of a 4-20 ma electrical output. Output must be in proportion to the height of the liquid in the wet well. The level of sewage in the wet well is to be activated by a pressure transducer. The liquid level sensor shall be designed and located as not to be influenced by turbulence from flows entering or leaving the wet well. A back-up high level alarm shall be furnished that utilizes a float switch.

4.6.8.3. A separate manual control shall be provided so that the pumps may be manually activated or shut down at the low level alarm.

4.6.8.4. Automatic alarms shall have individual circuit breakers.

4.6.8.5. Controls shall be placed above grade in a suitable building. Refer to previous discussions in this Chapter.

4.6.8.6. Alarms shall be provided and shall be sent via telemetry to the DUSWM Operations Center control panel as the system operation warrants. A schematic of the telemetry system shall be shown on the plans.

4.6.8.7. All main pumps shall be provided with pilot lighting indicating "on" and "off" operating status, and lights shall be green and red, respectively, and be located at a central control panel. Indicator lights for the pumps shall be located on the outside of each starter cabinet.

4.6.8.8. An electrical control center shall be provided in a convenient location to house the switch gear, motor control units, telemetry, and flow recording equipment.

4.6.9. Mechanical Piping and Appurtenances

4.6.9.1. Pump suction and discharge piping shall be ductile iron pipe with standard flanged joints. All flexible couplings or joints shall be suitably restrained.

4.6.9.2. Air or oil cushioned check valves shall be placed on each individual pump discharge line. Vertical ball check valves can be used in submersible stations.

4.6.9.3. Shutoff valves shall be placed on both the suction and discharge lines to facilitate the removal of each of the pumping units. For pipes up to 20 inches in diameter, plug valves are to be used for shutoff valves within the station.

4.6.9.4. Flexible couplings shall be selected to allow for proper expansion and contraction of the piping system.

4.6.9.5. Grating (cat walks) shall be provided in the pump room to facilitate access to all piping without climbing over pipes, equipment, etc.

4.6.9.6. Adequate lighting shall be provided both inside and outside all stations. Lighting in the wet well shall be explosion proof.

4.6.9.7. Heavy-duty, corrosion resistant, and maintenance-free screens shall be placed outside over all louvers and vents.

4.6.10. HVAC

4.6.10.1. Forced air ventilation shall be provided to both the wet well and dry well independent of each other. The wet well ventilation shall be of the forced air, positive pressure type with spark proof fan wheel and motor control units. The wet well vents shall not penetrate into the motor room or pump room. The system shall be sized to provide a minimum of 30 complete air changes per hour under manual control and with a time clock control, a minimum of two (2) complete air changes per hour. Dry well ventilation rates shall be ten (10) and four (4) respectively.

4.6.11. Telemetry: For each class remote telemetry unit (RTU), see Appendix C.

4.6.11.1. Telemetry of critical status and conditions from the water pumping station to the New Design Water Treatment Plant is via 800 megahertz radio transmission.

4.6.11.2. Station control room or panel shall provide for housing of radio related components, including an antenna. Additionally, an interface panel where connections between individual sensor circuits and the radio components is required.

4.6.11.3. Typical conditions monitored include, but are not limited to:

- High Wet Well Level Alarm
- Wet Well Level (analog)
- Low Wet Well Level Alarm
- Normal Power
- Auxiliary Power (run & malfunction)
- Building Intrusion
- Flow metering data

4.6.12. Metering

4.6.12.1. A magnetic flow meter with totalizer is to be provided.

4.6.12.2. Meter accuracy is to be 95% of true flow.

4.6.12.3. Provide sufficient straight piping runs as required by meter manufacturer.

4.6.12.4. Meters shall be required to provide 4-20 MA signal to the telemetry interface panel.

4.6.13. Headworks

4.6.13.1 All wastewater pumping stations shall be protected by suitable headworks. Design engineer shall evaluate the extent of headworks required, for example, grit removal, barscreen, comminutor, odor control, etc., for DUSWM approval.

CHAPTER 5. MISCELLANEOUS FACILITIES

5.1. GENERAL

5.1.1. Definition: The term "facility" refers to a water or sewer installation that involves electrical/mechanical equipment usually operated by automatic controls. Examples of facilities are pumping stations, treatment plants, water storage tanks, rechlorination stations, etc.

5.1.2. Design Process and Format: Design of facilities shall be as previously specified in Chapters 1, 2, 3 and 4. Complete design criteria, sectional views to scale, and schematic diagrams must be included on the plans.

5.1.3. Water System Flow Calculations

5.1.3.1. Well Supply

5.1.3.1.1. Minimum requirement is that when the well with the highest drought rated flowrate is out of service, combined pumping capacity of remaining wells must equal or exceed Average Daily Flowrate (ADF) based on the number of EDUs times a peaking factor of 1.4.

5.1.3.1.2. Combined total drought pumping capacity of all wells must be greater than or equal to a factor of two (2) times the ADF.

5.1.3.1.1. Wells shall be pumped for a minimum of 90 days during a typically dry period of the year in order to determine the capacity of the wells when stressed.

5.1.3.2. Water Storage Tanks: Usable tank's storage capacity, that is, gallons, must be the larger size as calculated in three different ways:

5.1.3.2.1. Provide 30 minutes of chlorine contact time at the maximum flowrate into the tank.

5.1.3.2.2. Minimum storage must exceed total of one (1) day's average domestic flow + fire storage + minimum of four (4) hours of smallest pump run time + 1 foot of elevation difference between pump off level to HWL + 1 foot of elevation difference between HWL and tank overflow invert + dead storage.

5.1.3.2.3. Based on supply pumping capacities (gpm), storage must provide for four days of simulated summer heat wave demand when largest well is out of service, assuming no fire flows are required. That is: total usable storage must be equal to or exceed the difference between 4 x 1.5 times the average daily domestic flow in gallons and 4 x the total gallons provided by the well supply when the largest well is out or service.

5.1.3.3. Water Flow Calculations: Treatment capacity of the water plant must be equal to 1.4 times the ADF based on EDUs. This provides for lawn sprinkling and other peak usage during summer conditions. Peak hourly flow is four (4) times the ADF based on EDUs.

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CHAPTER 6. SEWAGE TREATMENT PLANTS

6.1. GENERAL

6.1.1. Definitions:

6.1.1.1. Design Process and Format: Design of facilities shall be as previously specified in Chapters 1, 2, 3, and 4. Complete design criteria, sectional views to scale, and schematic diagrams must be included on the plans. Additionally, process schematic and hydraulic profile must be included on the plans.

6.1.2. Sewer Flow Calculations:

6.1.2.1. Sewage flows shall utilize an EDU count to determine the plant capacity. When the treatment plant replaces an existing facility, then historical data shall be used if it is greater than the EDU count capacity calculated. Plant shall be sized to properly treat average daily flow, maximum day flow, and wet weather peak flows.

6.1.3. Auxiliary Electrical Power:

6.1.3.1. Engineer shall ensure that proper electrical service is provided to the site. Typically, this will require 480 volt / 3 phase service.

6.1.3.2. Phase converters (digital or rotophase) shall not be utilized.

6.1.4. Disinfection

6.1.4.1. Chlorine disinfection is no longer used due to issues associated with byproducts. Design shall include disinfection by use of ultra-violet light.

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APPENDIX A
(Drawing Tables and General Notes)

DUSWM Water and Sewer Services to Municipalities

General Notes for Drawings

Contract Quantities Table

Water and Sewer Service Connection Quantities Table

Water Service Location Table

Sewer Service Location Table

Signature Block

*DUSWM reserves the right to update all Appendix items as needed or as required by applicable law.

DUSWM WATER AND SEWER SERVICES TO MUNICIPALITIES

Town/City	W/S Design Review	W/S Inspection	W/S Service Connections	County System
Brunswick	No	No	No	No[1]
Burkittsville	No	No	No	No
Emmitsburg	No	No	No	No
Frederick	Sewer[2]	Sewer[2]	Sewer[2]	Sewer[2]
Middletown	No	No	No	No
Mt. Airy	No	No	No	No
Myersville	No	No	No	No
New Market	Yes	Yes	Yes	Sewer/Water
Rosemont	Yes	Yes	Yes	Water
Thurmont	No	No	No	No
Walkersville	Yes	Yes	Yes	Sewer
Woodsboro	No	No	No	No

Notes:

1 The County owns and maintains a low pressure sewer system (LPSS) in Knoxville/New Addition that utilizes the City of Brunswick's sewer treatment plant.

2 The County owns and maintains certain sewer lines to the north of the City that flow to the Tuscarora Interceptor and into the Ceresville Pumping Station. A flow Diversion Box at Frederick County's Monocacy Wastewater Pumping Station delineates the limit of collection system ownership.

GENERAL NOTES FOR DRAWINGS

The cover sheet for all plans involving the construction of water and sewer facilities shall have as a minimum the following general notes:

GENERAL NOTES

1. All water and sewer construction shall be in accordance with the *Frederick County General Conditions and Standard Specifications for Water Mains, Sanitary Sewer and Related Structures* and the *Standard Details for Water Mains, Sanitary Sewer and Related Structures*.

2. The contractor shall not tap or penetrate existing water and/or sewer mains without approval from Frederick County DUSWM.

3. The contractor shall not operate valves on existing County-owned water mains.

4. The contractor is responsible to avoid the spillage of raw sewage. The contractor shall furnish the necessary equipment (sewer plugging, pumping, containment, etc.) to prevent said spillage.

5. Excavation within a State road right-of-way shall be performed in accordance with the provisions in the permit issued by the Maryland State Highway Administration (MSHA).

6. Excavation within a County road right-of-way for the purpose of the installation of utilities, storm drains, etc. shall be performed in accordance with the provisions in the permit issued by the Frederick County Division of Public Works.

7. Existing utilities are shown from best available records. The contractor shall test pit in the area of known utilities to verify size, elevation, location and type prior to performing any work. Any utility, whether shown or not, that is damaged by the contractor shall be repaired immediately at no expense to the owner. SHOULD THE CONTRACTOR DISCOVER DISCREPANCIES BETWEEN THE PLANS AND FIELD CONDITIONS, THE UTILITY OWNER IS TO BE NOTIFIED IMMEDIATELY. SHOULD THE CONTRACTOR MAKE FIELD CORRECTIONS OR ADJUSTMENTS WITHOUT THE AUTHORIZATION OF THE OWNER, THEN THE CONTRACTOR ASSUMES THE RESPONSIBILITY FOR SAID CORRECTIONS OR ADJUSTMENTS.

8. Any necessary adjustments to existing manholes, valve boxes, etc., are to be done by the contractor. The contractor is responsible for removing and replacing any existing fences, driveways, signs, drainage pipes, mailboxes, shrubs, trees, etc. damaged or removed during construction. All disturbed areas shall be returned to their original condition or better.

9. The contractor shall notify Miss Utility (1-800-257-7777) 5 days prior to start of construction.

10. The contractor shall be responsible for keeping silt and debris out of the sewer and storm drainage systems for the duration of the contract.

11. The contractor shall maintain access to all property owners at all times. The contractor will coordinate with property owners and acquire their approval if access must be interrupted

for short time periods.

12. Disinfection and verification testing will be performed in accordance with AWWA C651-05 or latest edition. The contractor shall be required to have bacterial testing performed on all new public water mains to demonstrate bacterial levels meet state MDE requirements prior to the County granting conditional acceptance of the contract. Requirements include, but are not limited to obtaining two consecutive sets of acceptable samples that are collected a minimum 24 hours apart. One sample shall be collected for residual chlorine, total coliform, total and E. Coli analysis for: every 1200 feet of pipeline [?]; at the end of each branch; and at the end of the line. After disinfection the line must be flushed. Chlorine residual samples must yield a result of 1.0 PPM or less before total coliform or E. Coli analysis may be performed. All sample collections shall be performed by individuals certified for drinking water sample collection by the Maryland Department of Environment. Laboratories utilized for the analysis shall be certified by the Maryland Department of Environment for total coliform and E. Coli analysis. If the contractor has allowed contaminants to enter the pipe during construction (this shall be determined by the inspector) then sampling may be required at reduced distance intervals as determined by the DUSWM. Disinfected water (of chlorine residual 1.0 PPM or less) will stand in the line for at least 16 hours after a final flush. Certified bacterial tests shall be provided to the DUSWM and shall include certification information for both the sample collector and the laboratory.

13. Requirements for Televising Sanitary Sewer Lines

    All public gravity sewer lines and laterals shall be televised as a condition of inspection in order to obtain conditional/operational acceptance. Televising shall be done in accordance with Section 2571. II.A.2. of *Standard Specifications*. Televising firms must be submitted and approved by the DUSWM prior to their use. The DVD must be viewed and approved by the DUSWM prior to acceptance of the sewer mains and laterals and placing any portion of the system into service.

    The following procedures must be followed:

    1) All sewer mains and laterals for the project must be installed, backfilled and compaction tests reviewed and approved by the DUSWM prior to televising.
    2) Complete all pressure tests, deflection tests and MH vacuum tests prior to televising.
    3) All mains and laterals shall be flushed with water, dyed red, in a manner sufficient to remove all dirt and debris and provide enough water to discern any standing water. Flushing will take place no earlier than 48 hr prior to televising and will be witnessed by the DUSWM inspector. Contractor shall ensure that no construction debris is flushed into the receiving sewer.
    4) Stand pipes to laterals will be labeled with lot #, etc. with a bold, black, permanent marker by the contractor and verified by the inspector as correct. Pan the lot # with the camera prior to inserting camera into the cleanout stack.
    5) Project name, number, date, time, type and size of pipe and MH #-MH # or lot # will be displayed on the screen at all times and must not obscure the view of the sewer pipe. There must be a running count of the linear footage shown on the screen.
    6) After televising and prior to Conditional Acceptance, if the DUSWM determines that any infiltration, debris or damage may have occurred to any main or lateral, these must be flushed and televised again.
    7) Video of all lines and laterals must be placed on one DVD if space permits (if not, place mains on one DVD and laterals on another) in a format that can be viewed on Windows Media Player or Real Player. A written report must be provided from the televising

company containing a log noting the information in item 5 above, the general condition of the line/lateral and any specific features. The main lines and laterals log must be kept in the same sequence as shown on the DVD.

8) Tolerances:
-No dirt, stone or other debris permitted in mains or laterals.
-No standing water in laterals.
-The decision to allow any standing water in mains will be determined by the DUSWM based on pipe diameter, % slope and/or other factors as determined by the DUSWM.

CONTRACT QUANTITIES TABLE

The cover sheet shall have a quantities table for all projects that involve the construction of water and/or sewer lines. The table provides information that is useful to various County engineering, construction management, operations, and administration personnel. The table is not intended for use by contractors preparing estimates, bids, etc. and shall be duly noted by the engineer.

The following table shall furnish the minimum information in the format similar to that provided below. Engineer shall add/delete items as required by project scope.

QUANTITIES

ITEM	ESTIMATED	UNITS	AS-BUILT (To be completed by the County)	SUPPLIER/MATERIAL
8″ SEWER		LF		
6″ SEWER		LF		
MANHOLES:				
• STD 48″		EA		
• WATERRIGHT 48″		EA		
DOGHOUSE MH'S 48″		EA		
VENTS		EA		
DROP MANHOLES:				
• TYPE E		EA		
• TYPE F		EA		
SHC TYPE A,B				
• SINGLE		EA		
• DOUBLE		EA		
SHC TYPE C,D				
• SINGLE		EA		
• DOUBLE		EA		
LAMPHOLE		EA		
CASING PIPE				
_____″		LF		
8″ WATER		LF		
6″ WATER		LF		
8″ VALVE		EA		
6″ VALVE		EA		
STD HYDRANT		EA		
DEWATERING HYDRANT		EA		
CAP & BLOWOFF		EA		
AUTO AIR-RELEASE VALVE		EA		
WHC				
• 3/4″		EA		
• 1″		EA		
• 1-1/2″		EA		
TAPPING SLEEVE & VALVE		EA		
CASING PIPE		LF		

WATER AND SEWER SERVICE CONNECTION QUANTITIES TABLE

The cover sheet shall have a quantities table for all projects that involve the construction of water and/or sewer service connection. The following table shall furnish the minimum information in the format provided below.

Service Connections			[County Use Only]	
Type	Standard Detail Number	Estimated	As-Built	Remarks
WSC New				
WSC Abandon				
WSC Replace				
DWSC New				
DWSC Abandon				
DWSC Replace				
SSC New				
SSC Abandon				
SSC Replace				
DSSC New				
DSSC Abandon				
DSSC Replace				

WATER SERVICE LOCATION TABLE

An example of the table that shall appear in the design drawings follows:

Water Service Connections

Lot #	Street Name	Single/Double	Meter Dist. fr. Prop. corners (l/r)	Meter Dist. from Main	Dia	Station of Corporation Stop
1	Elm Street	S	25′L/30′R	18′	1″	1+50
2-3	Elm Street	D	Corner	16′	1″	2+73

Water Service Connections

Lot #	Street Name	Single/Double	Meter Dist. fr. Prop. corners (1/r)	Meter Dist. From Main	Dia	Station of Corporate Valve

SEWER SERVICE LOCATION TABLE

An example of the table that shall appear in the design drawings is as follows:

Sewer Service Connections

Lot #	Street Name	C/O Grade Elevation	Lowest Floor Elevation	Cleanout Invert.	As-Built Information					
					Station	U/S	D/S	Length	Depth	Remarks
1 *	Willow Way *		4.14.12 *	412.50 *	2+50 *					

Note: The design engineer shall fill out all requested information indicated with an asterisk (*). The remaining as-built information is to be completed by the Inspector with the exception of the column labeled "Station".

Sewer Service Connections

Lot #	Street Name	Lowest Floor Elevation	Cleanout Elev.	As-Built Information					
				Station	U/S MH	D/S MH	Length	Depth	Remarks
*	*	*	*	*					

SIGNATURE BLOCK

Standard approval signature block for projects containing County DUSWM owned and maintained sewer systems that do not require approval by the Division of Planning and Permitting. "County Sewer Only" projects typically apply to projects within Walkersville, Knoxville/New Addition and portions of the City of Frederick.

FREDERICK COUNTY DUSWM SIGNATURE BLOCK

APPROVED: _____
DEPARTMENT HEAD, DoEP DATE

APPROVED: _____
ENGINEERING MANAGER, DoEP DATE

Approval is valid for two (2) years after the last date shown above. The project must be under construction before the approval expiration to be considered active. Otherwise, a resubmittal of plans, including applicable fees, must be made to DUSWM Engineering and Planning for re-approval. Fees for resubmittal cannot be waived.

REV. #	DATE	REVISION DESCRIPTION *For Revisions to Previously Approved Plans	CONSULTANT: DATE AND INITIAL		DUSWM: DATE AND INITIAL	

* DUSWM -- Division of Utilities and Solid Waste Management (County Water and/or Sewer Only).
* DoEP -- DUSWM, Department of Engineering and Planning.
NOTE: Signature block to be placed at bottom right of the cover sheet.

APPENDIX B
(Checklists)

Preliminary Plans

Site Improvement Plans

Improvement Plans

FREDERICK COUNTY
DUSWM

PROJECT NAME: _____
FREDERICK COUNTY CONTRACT NO.: _____
CONSULTING FIRM: _____
PROJECT MANAGER/DESIGN ENGINEER: _____
CHECKED BY:_____ DATE: _____
STATUS: (Initials = completed, N/A = not applicable, * = see attached explanation)

==========

PRELIMINARY PLANS

SUBMITTER		COUNTY REVIEW
	1. General	
____	1.1 Title	_____
____	1.2 Vicinity Map	_____
____	1.3 Show the current water and sewer classification of the property	___
____	1.4 Engineer's Name, etc.	_____
____	1.5 Developer's Name, etc.	_____
____	1.6 Smallest scale: 1"=100'.	_____
____	1.7 Project Scope, Number of Lots, townhouses, rentals, Equivalent Dwelling Units, etc., if known.	_____
____	1.8 Existing and future utilities and easements shown	_____
____	1.9 Proposed W/S utilities and easements shown	_____
____	1.10 Existing, proposed, future street and pavement layouts shown	_____
____	1.11 Indicate W/S easement encroachments by storm drains, etc.	_____
____	1.12 Indicate W/S encroachment in others' easements, e.g., MSHA right-of-way	_____

____ 1.13 When other than FrCo owned or maintained by W/S, identify as private or identify municipality, etc. ____

____ 1.14 Indicate when FrCo owned W/S in private (non-dedicated) streets ____

____ 1.15 Indicate proposed facilities such as swimming pools, clubhouses, etc. ____

2. Water

____ 2.1 Pipe sizes indicated ____

____ 2.2 Adjoining properties have access to the water main, either by an easement or by the water main being extended to the property line ____

____ 2.3 Easements shown (Minimum Size = 30 feet) with water offset 10 feet to one side ____

____ 2.4 Existing homes within 200 feet of a new distribution line must have access to the water main ____

____ 2.5 Fire hydrants spaced and shown ____

____ 2.6 Water mains are looped ____

____ 2.7 Pressure zones delineated and labeled, if known ____

____ 2.8 Indicate possible booster stations, if known ____

____ 2.9 Indicate special metering, fire services, if known ____

____ 2.10 Indicate Cross Connection Control provisions ____

3. Sewer

____ 3.1 Pipe sizes indicated ____

____ 3.2 Adjoining properties have access to the sewer main, either by an easement or by a stub extended to the property line ____

____ 3.3 Easements shown (Minimum Size = 30 feet) ____

with sewer offset 10 feet to one side

____ 3.4 Existing homes within 200 feet of a new sewer main must have access to the sewer main ____

____ 3.5 Hydraulic capacity of existing mains and pump stations should be checked ____

____ 3.6 Show flow direction arrows between each manhole ____

____ 3.7 SSCs shown, approximate locations ____

____ 3.8 Note any service restrictions, e.g., first floor only ____

____ 3.9 Note any low service connections subject to overflow if sewer main surcharges slightly ____

____ 3.10 Number manholes from lowest invert to highest invert ____

____ 3.11 Indicate pretreatment devices, such as grease traps, etc. ____

Additional Comments:

FREDERICK COUNTY
DUSWM

PROJECT NAME: _____
FREDERICK COUNTY CONTRACT NO.: _____
CONSULTING FIRM: _____
PROJECT MANAGER/DESIGN ENGINEER: _____
CHECKED BY: _____ DATE: _____STATUS: (Initials = completed, N/A = not applicable, * = see attached explanation)

==========

SITE PLANS

SUBMITTER		COUNTY REVIEW
	1. General	
____	1.1 Title	_____
____	1.2 Vicinity Map	_____
____	1.3 Engineer's Name, etc.	_____
____	1.4 Developer's Name, etc.	_____
____	1.5 Project scope (No. of equivalent dwelling units, total square feet of office space, etc.) in tabular form	_____
____	1.6 Existing, proposed and future utilities shown	_____
____	1.7 When other than FrCo owned water and sewer, identify as private, municipal, etc.	_____
____	1.8 Indicate if water and sewer is FrCo owned in private or non-dedicated streets	_____
____	1.9 Show proposed facilities such as swimming pools, clubhouses, etc.	_____
	2. Water	
____	2.1 Water service provided to all lots, buildings and outparcels	_____
____	2.2 Water meter vault shown to scale	_____

____	2.3 Siamese connections located	_____
____	2.4 Fire hydrants spaced and shown	_____
____	2.5 Cross connection control provisions are indicated	_____
____	2.6 Site improvement plans included	_____

3. Sewer

____	3.1 Obtain pretreatment permit or waiver	_____
_____	3.2 Monitoring manhole shown for all commercial, industrial, business, etc. properties. These manholes are required regardless of a pretreatment permit or waiver.	_____
____	3.3 Site improvement plans included	_____

4. Miscellaneous

_____	4.1 If the site plan includes construction design information, the Improvement Plan checklist must be submitted.	_____

Additional Comments:

FREDERICK COUNTY
DUSWM

PROJECT NAME:
FREDERICK COUNTY CONTRACT NO.:
CONSULTING FIRM:
PROJECT MANAGER/DESIGN ENGINEER:
==========

IMPROVEMENT PLANS

Consultant	Improvement Plans	DUSWM
_____	Cover Sheet For City sewering - add a note to replace the sewer service area note, "Wastewater Treatment Capacity is allocated in accordance with the Co/City/MDE Flow Allocation Agreement (1990) and amendments thereto".	_____
_____	Sheet Index Map - show streets, w/s mains and appurtenances, 4 or more plan view sheets. (G0105)	_____
_____	Sheet Index Schedule - for 3 or more total sheets.	_____
_____	Title	_____
_____	Contract number	_____
_____	Developer's name, etc.	_____
_____	Engineer's name, etc.	_____
_____	Number of lots or EDU's or townhouses, etc. being served by contract	_____
_____	Tax ID number.	_____
_____	DUSWM signature block.	_____
_____	Location Map (1"=600') with 3 grid ticks.	_____
_____	Vicinity Map (1"=2000') when necessary.	_____
_____	Water and Sewer Classifications.	_____
_____	Provide water demand calculations to substantiate proper water meter sizing.	_____
_____	All Sheets	_____
_____	Development Review signature block. (G0110)	_____
_____	PE seal with certification statement, signed and dated. (G0109)	_____
_____	Maximum sheet size = 24"x36".	_____
_____	Title block.	_____
_____	General	_____
_____	100 year flood plain and any wetlands indicated on both plan and profile. (G0157)	_____

One phase per contract number in one set of plans. October 2015.

Is the complex considered "condo"?

Require a Contract Quantities Table, W/S Service Connection Table, Water Service Location Table and Sewer Service Location Table, pgs A-99 thru A-102.

Add a column to the Sewer Service Connection Table calling out the grade at top of c/o, this is used to calculate the depth of the c/o. No c/o's deeper than 12.0'.

List lot phasing in table form and show lot phasing on a single page master map.

Benchmark with description and location references. (G0151)

Ex W&S shown with contract numbers and ex esmts shown with liber and folio. (G0125)

Ex and prop esmts, R/W's and roads shown with width dimensions. State roads with Rte # and MSHA plat #.

Ex non-w/s utilities, (storm drains, gas, cable, etc) shown in plan/profile with sizes, inverts and proper clearances.

Ex bldgs, structures, etc shown and identified.

For ex bldgs to W or S - either NTP or PIA execution is dependent upon payment of tap fees.

FF/basement/slab elevations shown.

If MSHA Public Utilities Permit applied for, under section IV the contractor shall be named as "Traffic Control Mgr".

Indicate and Request Permission of W/S esmt encroachments by Storm Drains.(G0135)

Lot and parcel numbers shown.

North arrow on all plan views. (G0147)

Pipe sizes & material shown in plan and profile as 6"W (DIP) or 8"S (SDR-35 PVC) and service connection indicated as 1" WSC or 6"SSC.

W/S main alignment within a min 30' wide esmt shall be 10' offsets from edge. 10-10-10 (W0044/S0047)

Property owner and adjacent property owners shown.

Proposed buildings and structures shown and identified.

Proposed w/s with solid lines and ex w/s with dashed or ghosted lines.

Has the Preliminary/Site Plan been approved by P&Z?

Show the house and driveway locations for each lot.

Has the Site Plan been approved by DUSWM? NOTE-Approval of Improvement Plans is dependent upon Site Plan approval.

Special instructions req'd for tapping or abandoning ex mains or for water meter/service removal.

Special instructions req'd for terminating pipes with caps, etc.

City Public sewers within and outside the public R/W must have esmts deeded to FredCo.

Esmts shall be configured from straight line segments (except for R/W shapes). (W0045/S0048)

3 State grid ticks required on each plan view sheet. (G0152)

WHC's/SHC's shown to R/W or esmt limits.

SHCs shall be min 10' downstream of WHCs. (In relation to sewer flow, if on the same lot). If on different lots, upstream/downstream relationship does not matter.

W&S mains are to be stationed along centerline of pipe. (G0159)

Where continuity of view is interrupted, indicate the sheet number where view continues.

Where W&S mains are <10' apart horizontally the water main shall be min 6' above the sewer. Where W&S mains are >10' apart horizontally the water main shall be min 1' above the sewer. (W0132)

Look out for lot number redundancies (ex vs. prop).

Provide contour lines (ghosted) along water meter and c/o locations to reveal drainage patterns, drainage ditches, etc.

IP Grading.doc (Mandatory)

Include ALL std details req'd for this project. REVIEW FEES ARE NOT TO APPLY FOR SHEETS THAT CONTAIN ONLY STANDARD DETAILS TO FULFILL THIS REQUIREMENT.

Design engineer to prepare and submit MDE or MSHA Utility permit application

Forms/packages, as needed, to DUSWM prior to plan approval.

Water Plan View

A W&S esmt must be proposed around the meter vault. Min 20'x30'. See dtl #112.

Waterline bacteria testing required. See General Notes.

Preliminary plan compliance - except for minor changes in alignment. (G0166)

All County owned water mains shall be located within public R/W or public w/s esmts. (G0167)

Will the bldgs be sprinklered?

All valves, tees' bends, etc are called out as to size and type. (G0169)

Esmts and R/W width sizes shown. Min esmt width is30'.

Commercial bldgs shall provide for backflow prevention.

Meter shown (over 1" show vault and bypass piping to scale).

No more than 10 units may be served by a 4" waterline.

No more than 25 units shall be served between valves for 12" dia and smaller.

Show pipe line sizes.

No more than 1 public fire hydrant is permitted on an unlooped 6" main.

Show proper valve spacing. 4"=400', 6"=800', 8"-12" residential=1000', 8"-12" other=1200',

16" (w/ service conn)=1200', 16"(no service conn)=2000' and over 16"=3000'. (W0086)

Require WSC sizes as typical on plan view or specify in notes.

Blowoffs - utilize std dtl #116.1.

Require radius of curvature to be indicated for main deflection.

Require service to ALL existing or proposed lots.

Require stationing to be shown at desired intervals.

Require 1" service to ALL new SFRs, THs and Condos. (std dtl #110.4).

Require water pressure zones to be shown.

For ALL jack & bore - provide valves on both ends of crossing.

18" min between valve and tee or cross. (Mandatory) 3 valves at tee, 4 valves at cross.

Min allowable utility crossing angle = 45 degrees.

For ALL regional PRV's, note on plans, "Before startup - contact Brad Nee at 301 600-3414 for PRV adjustment."

No valves under curbs or sidewalks.

TS&V shall be MJ Ductile Iron.

Fire hydrants (SFR) provided at each intersection or 500'. Coverage -most distant corner of bldg.

Fire hydrants (MFR) provided at each intersection or 300'. Coverage-most distant corner of bldg.

Fire hydrants (on-site, private) shall be a different color than public hydrants.

Residential water meter location min 5' from adjacent lot line.

ALL "public" valves & fittings to be restrained joints by use of mega-lugs. Note on plans.

Pipes 24" diameter and larger shall be drawn to scale.

Require a restrained valve, besides a blowoff, one stick back from the end of the water main

which is proposed to be extended for a future phase. (if residences involved)

Double service corp stops require min 18" separation (Mandatory)

Directly opposing corp stops not permitted, req min 18" separation from other side (Mandatory)

When County water is connected to a property with a private well, All wells on the property must be permanently sealed and abandoned pursuant to Health Dept & State law. (W0157)

Water Profile View

Require air release valves at ALL high points, when no service connections are within 25'.

Require a dewatering fire hydrant at ALL low points.

At stream crossings the water main protected as required by FredCo and stream protected according to State agencies.

Check the Pressure Zone elevations.

Be aware that for ARV's a min 6' depth from grade to top of pipe is required.

Be aware that the depth from grade to CL of pipe entering a meter vault is 7.0'+/-.

Lower the main or lateral at the connection point to the lot to accommodate depth of the waterline entering the meter vault. DUSWM does not like Vertical Bends.

Stream Crossing (more than 10' wide)- 3.5' min depth, restrained joints, valve at each end, pipe

thickness = 2 class upgrade. (W0163-W0168)

Require WSC's, including lot # to be shown, stationing is not required. (G0180)

Req ALL valves, tees, bends, hydrants, etc be shown/called out with size, type and sta. (G0180)

Require ALL water main crossings with other utilities to be properly shown and called out with min clearance dimensioned.

Req structural fill to be x-hatched and labeled with compaction type AND joint restraints req'd.

Show ex, proposed and future grades. (G0177)

If the water main is under the sewer, then encase the sewer. (W0132)

Cross check the elevations of tees/crosses/connections on different profiles.

Require min 1' clearance between water main and ANY crossing utilities.

Min depth for DIP pipe is 3.5' (W0054), max depth to crown is 7.5'. Try to maintain min depth.

Show pipe material type/class on profiles (W&S).

Require pressure regulator to be installed when the water pressure exceeds the allowable pressure to the property. (W0060)

Pipes shall be drawn to scale vertically.

Sewer Plan View

MH lids for privately maintained SS to delete "FrCo" from dtl #5.1.

Anything on-site to be reviewed by B. Mitchells group except for MMH location/profile.

Televising of the "public" gravity sewer mains and laterals is required, plus include the SOP.

Be Sure the SOP is the 'red dye' SOP.

All County owned sewer lines shall be located within public R/W or public w/s easements.

Mainline (public) sewers to be min 8" diameter. (S0053)

SHCs to be min 6" diameter. (S0054)

Requires SHCs to be shown at acceptable locations.

Monitoring manholes to ALL commercial properties, per bldg. (S0118)

Monitoring manholes must have independent waste streams.

Oil/water separator req'd for repair garages, car washes or engine/undercarriage cleaning.

Require pipe line sizes to be shown.

Pipes 24" diameter and larger shall be shown to scale.

Pipes greater than 24" dia shall use a 72" dia manhole

Require sewer treatment plant service area to be shown.

For steep slopes in undeveloped areas, bench the esmt for vehicle access.

Require SHCs to be perpendicular to the main.

C/o location min 5' from adjacent property line.

Commercial on-site c/o's within a traffic area use std dtl #208.1.

Require SHCs size as typical.

Min allowable utility crossing angle = 45 degrees.

Angle created by multiple pipes entering a manhole must be greater than 50 degrees.

If an existing manhole cone is rotated, the inside steps must be relocated.

Manholes within 8' of curb shall have watertight covers. (S0112). Refer to EJIW notation.

No manholes in sidewalks.

Requires esmts and R/W width sizes to be shown.

Flow direction arrows to be shown. (G0189)

Manholes in flood plains to have watertight lids "WT". (S0111). Refer to EJIW notation.

Manholes with numbers to be shown, numbering starts at low invert. (S0084/G0188)

Manholes to be located in street or accessible with a vehicle.

Monitoring manholes flow to be stabilized a min of 25 pipe diameters upstream. (S0118)

Monitoring manholes to have straight-thru flow (no bends). (S0118)

Monitoring manholes to be located in non-traffic areas (no parking lots/spaces or driveways).

Proper manhole spacing: 15" or less=400', 18" or larger=500'. (S0091)

Service to be provided to ALL ex or prop lots, bldgs or parcels.

No more than 2 SHCs per manhole, unless terminal manhole, then 3 within 180 degrees. (S0088)

Pipe connections cannot be within 1' of manhole.

Sewer cannot be within 10' of ex or proposed well without a special design to protect the well.

No manhole stubs permitted.

Lamphole c/o (#208.1) for terminal min segment length = 150'. (S0090)

Lines into and out of a manhole to be min 90 degrees.

C/o inverts at the esmt line or R/W line to be shown on plan view or in table form.

Force main pipe material type for 3" and smaller to be SDR-21, 4" and larger DIP. (PS0231)

Grease trap to enter the flow upstream of the monitoring manhole. Domestic waste MUST NOT

flow thru the grease trap.

For kitchens or food prep - require a grease trap as close as possible to the grease source.

PVC pipe connections to ex manholes-grout not permitted, utilize a flexible joint (Std dtl#210.1)

Min separation between sewer main and curb to be 4'.

Sewer Profile View

Min 0.10' invert drop thru manholes, max 0.50'.

Drop manhole utilized as appropriate.

SHC slope=2%-5%.

Provide the elevation of stream bottom that parallels within 50' of proposed sewer. (G0208)

Require areas of structural fill to be cross hatched and labeled.

Req distances between MH centerlines to be shown. Starting with lower MH as 0+00. (G0200)

Require outside drop manholes to be labeled as "E" or "F". (S0096)

Show ex, prop and fut grades. (G0198)

Include in the Sewer Service Connections Table a column for the "grade elev at c/o"-to calculate

the depth of the c/o. No c/o shall be deeper than 13.0'or else utilize a drop house connection.

Basement floor elevation minus 2' and distance of nearest wall to c/o at 2% slope.

If water main under sewer, (with absolutely no recourse) encase sewer (with no SHC's at main).

Inverts to SHCs into manhole must be min 0.10' above outfall. (S0132)

Sewer pipe sizes shown along with % of slope and pipe material type. (G0199)

Pipes, manholes, etc - horizontal and vertical shall be to scale.

DIP sewer pipe - not allowed, use C-900.

SHC wyes at the main to be turned up 45 degrees. Note on profile. (Mandatory)

Req manhole numbers to be shown. Lowest elev has lowest number. "WT" if applicable. (S0084)

Require rim elevations to be shown. (G0206)

Min depth for PVC pipe is 3.5'. For depths greater than 14' use PVC SDR-26.

Min slopes: 8"=0.40%, 10"=0.28%, 12"=0.22%. Terminal sewers are min double.

Requires stations and symbols for SHC's to be shown. (G0201)

ALL sewer crossings with other utilities shown with min 1' clearance.

For commercial properties c/o's when on-site must be spaced max: 4" dia=75', 6" or larger=100'.

MHs in unimproved areas = rim elev is 1' above grade. (S0087) show true rim elev (not ground +1).

Provide concrete anchors on slopes greater than 20%. No mainline slopes >20% without involving Department Head in the discussion.

Must show Sewer Drop Service Connections (SDSC) to raise c/o invert at esmt line to max 12.0' or for slopes greater than 5%.

Monitoring manhole (std dtl #201.7) to have no drop. Invert in=invert out. (S0121)

Monitoring Manhole - Slope of pipe entering to be 1%-2%. (S0118)

Sewer mains at manholes with different diameter pipes shall match crown of pipe elevations. (S0114)

Junction manholes appearing on multiple profiles must show the same inverts and rim elevation.

All SHC pipes connecting into new manholes must have the same invert. (S0107)

No manhole drops allowed for pipes greater than 15"diameter. (S0099)

Vent tops to be min 1' above 100 yr floodplain and be protected from flood debris and vandalism.

Vents are required a min of every 1500' when "WT" manholes are utilized consecutively.

ALL sewer service drop connections must be called out and identified.

Slopes of 10% or more - the applicable holes shall conform to that slope angle to within 5 degrees.

Force mains that discharge into a transition manhole are from a rising grade. (PS0233)

For non-metallic force mains an insulated #8 AWG trace wire shall be furnished. (PS0238)

Inside drop connections are an approved option. Age of manhole/location of steps crucial.

_____	If an inside drop connection is proposed, the plans must include std dtl #202.1 AND the installation	_____
_____	2 or more inside drop connections must use a 72" manhole.	_____
_____	If a drop connection is proposed to an existing manhole, field verify that the inside steps and MH joints do not conflict with the connection. Edge of cored hole must be minimum of 9" from joint.	_____

APPENDIX C
(Design Tables, Curves, Forms, etc.)

Water Storage Requirements

Fire Hydrant Design Flow Rates

Depth of Cover and Manning's "n"

Flow Factors

WATER STORAGE REQUIREMENTS

The DUSWM will evaluate water storage requirements based on but not limited to the following items:

1. Projected water demands (average, maximum, fire, etc.)
2. Integration with the existing system
3. Water aging analysis

DUSWM will work with the engineer of record regarding necessary calculations and modeling as required for the given scenario.

FIRE HYDRANT DESIGN FLOW RATES

USE	FLOW RATE (gpm)
Residential (one and two-family)	1,000
Residential (multi-family)	1,250
Commercial	1,500
Industrial	1,500
Educational/Institutional	1,500

Notes:

1. Flow rates are to be accommodated while maintaining a minimum residual pressure of 20 psi at the highest point in the supplying system.

2. Fire flow rate are to be combined with maximum daily rates of flow in the distribution network

3. Storage tanks in the system shall be considered at their minimum elevation (elevation at which tank calls for water) when determining the fire flow residual pressure.

4. These flow rates are to be used in the design of public water mains, whether developer or County funded. The use of a property may require a higher flow rate that is to be accommodated by on-site (private) storage/pumping systems.

DEPTH OF COVER AND MANNING'S "n"

Type of Pipe	Minimum Structural Cover (feet)	Mannings "n"
PVC (Sewer)	3.5	0.009
Ductile Iron	2	0.012
Ductile Iron (cement lined)	2	0.013
Ductile Iron (epoxy lined)	2	0.011
Reinforced Concrete	3	0.013

FLOW FACTORS

Type of Development	(FF)
Dwelling Unit, detached	# Units x 350 = gpd
Townhouses	# Units x 300 = gpd
Apartments, multi family	# Units x 300 = gpd
Apartments, elderly	# Units x 200 = gpd
Mobile Homes	# Units x 175 = gpd
Office Buildings	Gross Sq. Ft. x 0.20 = gpd
Medical Office Buildings	Gross Sq. Ft. x 0.175 = gpd
Warehouses	Gross Sq. Ft. x 0.021 = gpd
Retail Stores	Gross Sq. Ft. x 0.048 = gpd
Supermarkets	Gross Sq. Ft. x 0.20 = gpd
Drug Stores	Gross Sq. Ft. x 0.13 = gpd
Beauty Salons	Gross Sq. Ft. x 0.35 = gpd
Department Store with Lunch Counter	Gross Sq. Ft. x 0.08 = gpd
Department Store without Lunch Counter	Gross Sq. Ft. x 0.04 = gpd
Banks	Gross Sq. Ft. x 0.044 = gpd
Restaurants	# Seats x 24.2 = gpd
Service Stations	Gross Sq. Ft. x 0.18 = gpd
Laundries and Cleaners	Gross Sq. Ft. x 0.31 = gpd
Laundromats	Gross Sq. Ft. x 3.68 = gpd
Car Wash (without Recycle)	Gross Sq. Ft. x 4.90 = gpd
Hotels	Gross Sq. Ft. x 0.256 = gpd
Motels	Gross Sq. Ft. x 0.224 = gpd
Hospitals	# Beds x 346 = gpd
Theaters	# Seats x 1 = gpd
Nursing Homes	# Beds x 130 = gpd
Dry Goods Stores	Gross Sq. Ft. x 0.048 = gpd
Shopping Centers	Gross Sq. Ft. x 0.172 = gpd
Auto Dealership	Gross Sq. Ft. x 0.078 = gpd
Barber Shop	Gross Sq. Ft. x 0.20 = gpd
Carry out (Except Major Chains)	Gross Sq. Ft. x 0.20 = gpd
Carry out (Chain)	# Seats x 10 = gpd
Church	# Sanctuary Seats x 4 = gpd
Garage (Auto/Truck Repair)	Gross Sq. Ft. x 0.014 = gpd
Library	Gross Sq. Ft. x 0.10 = gpd
Bakery	Gross Sq. Ft. x 0.15 = gpd
Racket Club/Tennis Club	# Courts x 300 = gpd
Pool (with Hot Showers)	# Members x 6 = gpd
Pool (without Hot Showers)	# Members x 4 = gpd

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Flow factors are for development planning purposes only. Flow factors include inflow/infiltration. Actual capacity charge will be determined at the time of application for building permit. Use of these flow factors shall not be used in lieu of actual fixture counts (as defined in the DUSWM Rules and Regulations) to determine capacity charges or any other fees.

Flow Factors (Continued)

Zoning	Design Flow Uses	(GPD)
R-1		
R-3		
R-5	General:	100/person
R-8	Single Family:	370/d.u.
R-12	Townhouse:	300/d.u.
R-16	Apartment:	300/d.u.
PUD		
MH		
VC	General:	2000/acre
GC	Motel:	130/unit
HS	Office: 30/employee or whichever greater	0.20/net sq. ft.
LI		
GI	General:	7500/acre
MM	Warehouse:	750/acre
ORI	Other: Varies with Industry	
School	General:	16/person

Flow factors are for planning purposes only. Flow factors include inflow/infiltration. Actual capacity charge will be determined at the time of application for building permit. Use of these flow factors shall not be used in lieu of actual fixture counts (as defined in the DUSWM Rules and Regulations) to determine capacity charges or any other fees.

REFERENCES

American Society of Civil Engineers and Water Pollution Control Federation, *Design and Construction of Sanitary and Storm Sewers*, 1969.

Sanks, Tchoboanoglous, Bosserman, Jones, *Puming Station Design*, 2006

Anne Arundel Department of Public Works, *Anne Arundel County Design Manual,* January 2001.

Baltimore County Department of Public Works, *Baltimore County Design Manual*, January 17, 1983.

Howard County Department of Public Works, *Howard County Design Manual Volume II Water and Sewer*, October 1980 and amendments through October 1990.

Loudon County Sanitation Authority*, Sewer System – Standards and Extensions*, April 13, 1979.

Washington Suburban Sanitary Commission, *WSSC Design Manual*, March 1983.

Hydraulic Institute, *Standards for Centrifugal, Rotary and Reciprocating Pumps*, 14th Edition (1983).

American Society of Mechanical Engineers, *Centrifugal Pumps – Performance Test Codes*, 1973.

Frederick County Codes, include:
Building Code of Frederick County
BOCA National Building Code
Frederick County Plumbing Code
National Electric Code
NFPA Life Safety Code
Maryland Building Code for the Handicapped

Code of Maryland Regulations (COMAR)

A Report of the Committee of the Great Lakes – Upper Mississippi River Board of State Sanitary Engineers, *Recommended Standards for Sewage Works*, 1978.

A Report of the Committee of the Great Lakes – Upper Mississippi River Board of State Health and Environmental Managers, *Recommended Standards for Water Works*, 1987.