CARROLL COUNTY
DEPARTMENT OF
PUBLIC WORKS
BUREAU OF UTILITIES

CARROLL COUNTY DESIGN MANUAL
WATER AND SEWER

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SECTION 1.1 – PROCEDURES AND GENERAL REQUIREMENTS

Article 1-1. GENERAL INFORMATION

1. Design Standards

    a. These Design Standards are written in accordance with the requirements of Chapter 51 of the Carroll County Code (See **Appendix A** for Chapter 51). They are intended to be compatible with all applicable regulations of the Federal Government, COMAR, and the regulations and guidelines of the Natural Resources Conservation Service, the Maryland Departments of Environment and Transportation, The Maryland State Highway Administration, the Carroll County Bureau of Permits and Inspection, the Carroll County Bureau of Development Review, and the Carroll County Bureau of Resource Management.

Article 1-2. PURPOSE

1. Purpose of the Manual

    a. The purpose of this Manual is to present procedures, standards, and criteria to be used by design professionals in the preparation of designs requiring the approval of the Carroll County Bureau of Utilities. This Manual, together with the County Code, Bureau of Utilities Standard Details and Specifications, and the Carroll County and National Standard Plumbing Codes are used by this agency in the review of all submissions requiring their approval. The procedural aspects presented are representative of current Bureau of Utilities practices, which to some degree may be considered fluid as these Standard Specifications and Details are in continuous evolution, subject to both administrative and legislative actions.

        (1) This Manual is intended to guide the design of public works projects within the County. Its suitability for other purposes is unintentional and the County assumes no liability for use of the enclosed material for purposes other than its intended purpose. This Manual is to provide an outline of requirements for the standardization of all designs prepared for public and private construction requiring the approval of the Carroll County Bureau of Utilities.

Article 1-3. AUTHORITY/AUTHORIZATON

1. Manual Authority and Authorization

    a. The material presented in this Manual is in accordance with the authority and responsibility delegated by ordinance, resolution, and executive or administrative order to the various County agencies named herein.

Article 1-4. EXCEPTIONS/WAVIERS/APPEALS

1. Waivers or variances of these design guidelines

    a. Waivers or variances of these design guidelines may be approved by the Chief of the Bureau of Utilities or designee, based on a justification analysis which will include but not

be limited to life-cycle costs, maintenance requirements, context sensitive considerations or other local considerations. A request for a waiver is to be addressed to the Chief of the Bureau of Utilities and shall, at a minimum, contain a narrative indicating the design objective and the justification for the request. Approval or denial of the waiver request will be by return letter signed by the Chief of the Bureau of Utilities.

Article 1-5. JURISDICTION

1. The Carroll County Department of Public Works (DPW) has the complete responsibility for the design, construction, operation and maintenance of public water and sewer systems within the service areas so designated by the Water and Sewer Master Plan. The design and construction of public water and sewer systems within its jurisdiction shall conform to the requirements of Chapter 51 of the Carroll County Code (See **Appendix A** for Chapter 51) and those provided in this Manual.

    a. Public/Private Responsibility:

        (1) Typically, the Bureau of Utilities' responsibility for water and sewer facilities ends at the property line, right-of-way, 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.

    b. Municipalities:

        (1) Several municipalities within the County own, maintain and operate their own water and / or sewer systems and have adopted standards that differ from the County's standards. It is the design engineer's responsibility to contact the respective municipality to obtain and comply with all necessary design and construction standards.

        (2) The following municipalities own and operate their own water and sewer systems: Manchester, Mount Airy, New Windsor, Taneytown, Westminster, and Union Bridge. The Town of Hampstead owns and operates the town water system while Carroll County owns and operates the sewer system for the town.

    c. State and Federal:

        (1) All construction contract documents for the extension or alteration of water and sewer systems within the State of Maryland are subject to the guidelines contained in the latest volume of the Maryland Department of the Environment's (formerly the Department of Health and Mental Hygiene) Design Guidelines for Sewerage Facilities. Other State and Federal agencies exercising control over water and sewer projects with respect to locating and siting of facilities include the U.S. Army Corps of Engineers, Maryland Department of Natural Resources, Soil Conservation Service and Federal and State Highway Administrations. Control is exercised when the project will impact the environment or will occupy their facilities or areas of jurisdiction.

Article 1-6. ABBREVIATIONS

1. Whenever in this chapter or other chapters, the following abbreviations are used, they will represent:

AASHTO	American Association of State Highway and Transportation Officials

ACP	Asbestos Cement Pipe
ANSI	American National Standards Institute
ARD	Age Restricted Development
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
AWWA	American Water Works Association
BGE	Baltimore Gas and Electric Company
BOU	Bureau of Utilities
CAD	Computer Aided Drafting
CIP	Cast Iron Pipe
CIPP	Cured-in-place Pipe Lining
COMAR	Code of Maryland Regulations
DHC	Drop House Connection
DIP	Ductile Iron Pipe
DPW	Department of Public Works
FCP	Forest Conservation Plan
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FSD	Forest Stand Delineation
GIS	Geographic Information System
GPAD	Gallons Per Acre Per Day
GPCD	Gallons Per Capita Per Day
GPM	Gallons Per Minute
HDD	Horizontal Directional Drilling
HDPE	High Density Polyethylene
HGL	Hydraulic Grade Line
MCC	Motor Control Center
MDE	Maryland Department of the Environment
MGD	Millions of Gallons Per Day
MOSHA	Maryland Occupation Safety and Health Administration
MTBM	Micro-tunnel Boring Machine
NAD	North American Datum
NAVD	North American Vertical Datum
NOI	Notice of Intent
NSF	National Sanitation Foundation
NFPR	National Fire Protection Association
NPSHR	Net Positive Suction Head Required
OSHA	Occupational Safety and Health Administration
PCCP	Pre-stressed Concrete Cylinder Pipe
PCF	Pounds Per Cubic Feet
PLC	Programmable Logic Controller
PRV	Pressure Reducing Valve
PSI	Pounds Per Square Inch
PVC	Polyvinyl Chloride
RCP	Reinforced Concrete Pipe
RPM	Revolutions Per Minute
RSGV	Resilient Seated Gate Valve
RTK	Real Time Kinematic
RTU	Remote Telemetry Unit
SCADA	Supervisory Control and Data Acquisition

SHC	Sewer House Connection
SPT	Standard Penetration Test
SSC	Sewer Service Connection
VCP	Vitrified Clay Pipe
VFD	Variable Frequency Drive
WHC	Water House Connection
WSC	Water Service Connection

Article 1-7. DEFINITIONS

Design Professional: A professional engineer or surveyor, registered in the State of Maryland, who is responsible for the design of the project.

Water and Sewer Master Plan: The latest approved version of the "Carroll County Water and Sewer Master Plan".

Article 1-8. PROJECT TYPES

1. Developer Projects:

    a. A Developer Project arises whenever a land developer engages in the subdivision of land or the development of a parcel of land, as set forth in the County Subdivision Regulations. When the proposed development is designated in an area according to the County Water and Sewer Master Plan, (which designates when and what public water and or sewage facilities are to be constructed) requiring water and sewage facilities for each lot or parcel created or developed through the subdivision of land development process, the Developer will be required to completely underwrite the cost of construction of these facilities as set forth in this manual and in conjunction with the requirements set forth in the County Code and shall include the preparation of an engineering report, the development of construction plans and specifications, the easement documents and the stakeout and inspection of the construction work.

2. Capital Improvement Projects:

    a. A Capital Project may arise by any of several administrative means. The common identifying feature distinguishing a Capital Project from a Developer Project is that funds for the implementation of the Capital Project are allocated through the regular budgetary processes within Carroll County. Capital Projects may involve the installation, modification, or repair of water and or sewage system components including but not limited to transmission, collection, storage and treatment facilities and shall generally include the following items:

        (1) Reports

        (2) Right-of-Way Plats

        (3) Construction Specifications

        (4) Contract Drawings

        (5) Design Data and Computations

        (6) Estimate of Quantities

(7) Construction Cost Estimates

Article 1-9. SYSTEM DESCRIPTION

1. General:

a. Public water and sewer service is restricted by the Carroll County Code to those properties located within the existing and priority water and sewer service areas as shown in the Water and Sewer Master Plan. Accurate and current maps showing this area are available from the Department of Planning.

(1) Water System:

(a) The County water system consists of a network of treatment and pumping facilities, distribution mains and storage facilities. All these facilities are designed to provide a hydraulically balanced system to accommodate fluctuations in consumer demands and to provide adequate flow for fire suppression in conjunction with other system requirements. Drinking water quality is regulated by the Environmental Protection Agency (EPA) and the Maryland Department of the Environment (MDE). 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 at the point of use. The County assumes full responsibility for the operation and maintenance of its water system.

(b) See Carroll County, MD Code of Ordinances, Chapter 91 – Fire Protection for further requirements.

(2) Wastewater System:

(a) The County wastewater system consists of a network of collectors and interceptor sewer pipes, pumping stations and treatment facilities. Collector pipelines are those lines that are installed adjacent to individual properties to provide a direct connection and are designed to serve multiple customers. Interceptor pipelines are major pipelines which follow drainage courses and accept flow from the collector sewers and convey flow directly to treatment facilities or interceptor pump stations. Pump stations and force mains are employed in approved permanent locations, facilitating servicing areas not normally serviceable by gravity sewers, and serve as collection points for multiple drainage areas to transport wastewater to major interceptors.

(b) As a policy, the Carroll County wastewater system is intended to collect, transport and dispose of wastewater associated with human habitation of residential or employment units. The wastewater system is reserved for these types of wastes only. Storm water flows are not permitted to be introduced into the wastewater system. Industrial wastes resulting from manufacturing or processing operations are not automatically accepted into the system and must be handled by the originator in accordance with the Carroll County Code and other applicable laws and regulations.

(3) Water and Sewer Charges:

(a) The Carroll County Board of Commissioners establish charges for water and sewer services. Current rate schedules can be obtained at County offices. Charges are made for services under the following categories:

A. Connections

B. Water Meters

C. Meter Transceivers

D. Quarterly Water & Sewer User Charges

E. Front Foot Benefit Assessment and/or Maintenance Charges

F. Surcharges

G. Special Charges

Article 1-10. PROJECT DEVELOPMENT

1. Development of Project

a. As previously described water and sewer projects fall into two categories, Developer projects and Capital Projects. How these projects arise, and the requirements associated with each are described below.

b. Developer Projects:

(1) A Developer Project arises whenever a land developer engages in the subdivision and/or development of land which falls within either the existing or priority categories of water and/or sewer service areas as identified in the water and sewer master plan. When a land developer desires to provide public water and sewer services to their proposed development, they shall check with the Planning Department where the Water and Sewer Planner will check the Water and Sewer Master Plan to evaluate whether the proposed development area is properly classified for such a request. If the area is not properly classified, the developer may submit a request for a plan amendment for the area to be reclassified.

(2) The existing system must have adequate capacity for the proposed project and the project must be in conformance with the Water and Sewer Master Plan. 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 system capacity is in question, the Developer may be required to employ an engineer to determine the system capacity and the improvements required to provide necessary system capacity. The Developer shall be financially responsible for the design and construction of all necessary improvements to the public water and sewer system required as a result of the proposed development. The Developer shall also ensure that there is no adverse impact on the existing public water and sewer systems as a result of the proposed development. The capacity of downstream collector sewers shall be reviewed by the Developer to ensure adequate capacity. Adequate internal and external looping of the public water system for pressure, redundancy, and stagnation prevention shall be provided.

(3) Design and construction of the system shall be sized to serve the drainage area in which the project is located if areas adjacent to the proposed development are included in the latest approved Water and Sewer Master Plan.

(4) Plans shall be submitted to the Bureau of Development Review through the appropriate process based on the type of development being proposed for County agencies review and comments. Preparation, submission and approval of appropriate deed of easements, fee simple property transfers, and PWA recordation must be completed to satisfy approval for construction.

c. Capital Improvement Projects:

(1) The Bureau of Utilities may initiate capital projects through staff planning based on its knowledge of requirements necessary to alleviate existing or projected problems in the overall operations of the systems.

(2) After preliminary engineering work associated with the identification of capital projects has been completed by the Bureau of Utilities staff it is typical for the County to hire consultant engineers to provide the detailed engineering for water and sewer projects. The Consultant engineer selection shall be made in accordance with County regulations and policies. Contracts with consulting engineers will specify the scope of work, the schedule to be followed, and all other details normally associated with contractual procedures. Any deviation required to the consultant's scope of work will be addressed via change order to the engineering agreement. Unless otherwise specified the project will advance through plan review procedure in the same manner as described for developer projects.

(3) In the initial phase of the project the Design Engineer will be asked to submit a proposal outlining the design effort, schedule of completion of design and a summary of the costs to complete the design of the specific project. Additionally, during the initial phase of a project, the Design Engineer may be directed to prepare a study and a report for the project that will include the following information.

(a) General description and history of the problem under study and the proposed project.

(b) Existing conditions that justify or mitigate the need for the project.

(c) Water and Sewer Design Calculations.

(d) Pumping Station Criteria.

(e) Materials for Construction.

(f) Examination of alternative solutions to the problem under study including pros and cons of each alternative along with associated cost analysis.

(g) Items included to meet the specific design criteria set forth by the County.

(h) Recommendations including a complete cost estimate for the recommended improvements.

(i) All other information as requested by the County to more fully evaluate the project aspects.

(4) The design engineer's point of contact for issues relating to water and sewer projects shall be with the Bureau of Utilities Capital Improvement Plan (CIP) Project Manager. The CIP Project Manager shall be responsible for monitoring the project and coordinating details to ensure that the engineer's work satisfies County requirements.

Article 1-11. CONSTRUCTION PLANS AND SPECIFICATIONS

1. General:

   a. Contract documents for construction projects must communicate the scope of work for the project and all details necessary for the project to be constructed in the field. Specifications shall define contractual relationships and conditions as well as material and workmanship quality and shall be in accordance with Bureau of Utilities Standards. The Design Engineer is responsible for adequately designing, detailing, and specifying through the Special Provisions and Technical Specifications, all contract-specific materials and methods of construction not described in the Standard Specifications. The work and scope definition must be complete to the extent that an inspector has adequate basis for accepting or rejecting the constructed work product.

2. Purpose:

   a. The primary purpose of construction plans is to show the size, horizontal and vertical location and type of materials and structures to be installed as part of a water and sewer system. Drawings and specifications shall be developed in enough detail to depict the elements and their spatial relationship with both existing conditions and planned future improvements.

   b. This section sets forth requirements for information to be placed on construction plans. When completed according to County standards and properly implemented in construction, the original plans for water and sewer facilities form a permanent record of the work and the materials employed to complete the project. When modified with as-built notations the plans shall provide a comprehensive and accurate overview as to where facilities are located, material used and their relationship to other improvements. To allow the Bureau of Utilities to complete required maintenance including emergency repairs, it is necessary that all plans be clearly drawn, scalable, and show all information necessary to establish a permeant record. All construction plans shall clearly designate facilities or portions of facilities that are proposed to be privately maintained by the developer, landowner or other agency.

3. Drafting and Graphic Standards:

   a. All water and sewer construction projects shall be prepared on 22 inch x 34 inch paper or mylar (depending on the submission phase). Borders shall be 0.5 inch minimum with a minimum 1 inch border on the left side of the sheet. A standard title block should be in the lower right corner.

   b. All drafting and lettering shall be uniform, neat in appearance and large enough to be read when reduced to half scale. Refer to the various checklists provided by this agency, the Bureau of Development Review and the Bureau of Engineering for detailed drafting requirements.

   c. The Standard Abbreviations shall be used wherever possible. Non-standard symbols and

abbreviations necessary shall be clearly defined in a legend on the title sheet or for a project involving multiple disciplines, such as mechanical, electrical, structural and architectural, on the first sheet of each discipline in which they are used.

d. For site plans that include only a minor amount of proposed public water and/or sewer work (Such as projects that only include a proposed water and sewer lateral and associated meter vault.) water and sewer plan sheets may be incorporated into the overall site plan set. All other projects that include proposed public water and sewer mains must provide standalone water and sewer plan sheets. Such plans shall incorporate all drafting/design standards included in the following sections.

4. Plan Cover Sheet:

a. Vicinity and Locations Maps:

(1) The first sheet of all projects shall include a minimum 1 inch = 600 feet scale vicinity map with three unique sets of grid coordinates arranged to form an "L" and shall have sufficient road names and other features to allow easy recognition of the site. When the 600 feet scale location map exceeds the size of the sheet, the map shall be drawn at a scale of 1 inch = 1,000 feet. When a set of contract plans contain only one or two sheets the vicinity map shall be placed at the upper right portion of the first sheet. The vicinity and location maps shall include a north arrow, proposed project boundaries, proposed work, and boundaries of adjacent existing and/or future contracts. If applicable plan coverage of each sheet of the construction plans shall be shown on the vicinity map with its corresponding sheet number for reference. If the project is divided into two or more contracts, each associated contract shall be identified on the vicinity map.

b. Information:

(1) Provide a project title centered at the top of sheet. Include the election district, tax map, block and parcel number water/sewer contract number directly below the title. All relevant general, water and sewer notes (See **Appendix B** for notes.) shall be include on the left side of the sheet. For projects with more than three sheets total, a complete sheet index shall be included on the right-hand side of the sheet. Include all necessary signature blocks on the right side of the drawing below the list of drawings. Below the vicinity map provide an informational block containing the following: number of lots and parcels serviced, number of water house connections, number of sewer house connections, use of building/structures. If space permits the initial plan shall also include a tabulation of materials with columns for bid quantity, as-built quantity and material/supplier.

5. Information Required on Each Plan Sheet:

a. Title Block: Each sheet shall have a title block along the lower border of the sheet. The title block shall include the project name, sheet title, bar scale, date, sheet number and revision box. The revision box shall document all revisions after the Designer's seal and signature has been affixed to the plan. Sheets shall be numbered sequentially starting with 1 for the first sheet.

b. Seal and Signature: The professional engineer's seal, original signature, date signed, and registration number belonging to the designer responsible for the design, registered in the State of Maryland, shall be shown on the title block of the first sheet and each finished sheet

of the set of plans.

c. Benchmarks and Traverse Points: A tabulation of benchmark descriptions and elevations shall be shown on the sheet that the benchmark occurs. A minimum of two benchmarks shall be shown on each plan sheet. For Capital Projects, traverse point recovery diagrams with dimensions shall be shown for each traverse point on the sheet where the traverse point occurs. Traverse referencing shall be made to permanently fixed objects that will not be disturbed during construction of the proposed project. Whenever possible, permanently fixed objects shall be clearly identified and coordinates of each point shall be either shown at the traverse point in a neat manner, or in tabulation form, on each plan sheet for which the traverse points occur. Bearings and distances between traverse points shall be shown. The traverse shall be assigned continuous stationing, with stations shown ever 100 feet and at traverse points, and equalities shown at each intersecting point for spur lines and loops.

d. North Arrow and Grid Ticks: Each plan sheet shall have a north arrow. Plan sheets shall be oriented so that the north arrow points toward the top or toward the right side of the sheet. Each plan sheet shall show a minimum of three coordinated grid ticks based on the Maryland State Plane Coordinate System and all bearings shall be related to grid north. Two grid ticks shall be on the same N-S or E-W line forming a right triangle alignment.

e. Contract Limits: The limits of the contract shall be clearly shown on all plans.

f. Match Lines: Match lines with a minimum length of 4 inches shall be used wherever the plan is continued on the same of another sheet. Data shall be cut off at the match line. Duplication of data on matching sheets is not permitted.

g. All water and sewer construction projects that require sediment control shall have detail sheets with required notes dedicated to sediment control. Existing and proposed contour lines shall be shown on the erosion and sediment control plans in accordance with the requirements of the Carroll County Soil Conservation District. Sediment and erosion control sheets shall contain Developer's and Engineer's certifications.

6. Drafting Design Requirements:

a. Existing, Proposed, and Future Conditions:

(1) Existing indicates those utilities, easements, structures, roads, etc. that have been previously constructed and exist at the time the plan set is submitted for review.

(2) Proposed indicates those utilities, easements, structures, roads, etc. that are intended to be constructed as defined by the plan set being developed.

(3) Future indicates those utilities, easements, structures, roads, etc. that are either planned for construction subsequent to the proposed work or under concurrent design by others.

b. Linework: Proposed conditions of work are to be drawn with bold lines. Lightened and/or dashed lines shall be used for existing and future conditions with labels or legend providing clear reference to intended status.

c. Field Survey: To develop the required information to scale, the Design Engineer shall establish accurate horizontal and vertical control points along the route or on the site area. The Vertical Datum shall be NAVD88.

d. Limits of Area to be Shown: The limits of the area to be shown may vary to some degree on various types of projects. In general, for capital projects the area covered is usually a 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 roads. For developer projects the limits of the area shown shall include at a minimum all features within a 100 foot radius from any proposed construction.

e. Utilities: All utilities, structures, topography, landscape and cultural features must be clearly and completely depicted.

f. Size: Horizontal (Northing and Easting) and vertical (elevation) location of all existing, proposed, and future surface and sub-surface utilities including, but not limited to, water, sewer, gas, electric, cable as well as their respective right-of-way and/or easements shall be shown.

g. Test Pitting: It is incumbent upon the design engineer to determine, prior to construction plan approval, the location of existing utilities or underground structures by means of test pitting.

h. Borings: If special subsurface or boring information is available or required it shall be indicated. Also, any structural fill requirements shall be indicated. Structures and Other Features: All buildings and other structures as well as all associated improvements including wells, septic tanks, drain fields etc. within and immediately adjacent to the project site shall be shown on the plans. All roadway pavements, curb lines, centerlines, markings, driveway entrances, walkways, fences, walls etc. including types of materials, widths, heights and other descriptive data adjacent to the project site shall be shown on the plans.

i. Property and Site Information: In new developments water and sewer plans shall show all proposed improvements including curbs, storm drains, streets and lots. Construction drawings will clearly show all existing features that are to remain undisturbed.

j. Peripheral Easements: To ensure 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.

k. Encroachments: Encroachment of utilities not under the jurisdiction of the County shall be avoided wherever possible.

l. On-Site Water and Sewer: The water and sewer laterals on private property beyond the right-of-way or proposed utility easements are privately owned and maintained. The construction of these lines is inspected by Bureau of Permits and Inspections staff. The interface between the County and private mains/laterals must be clearly indicated and noted on the plans. Each recorded lot shall have a single public meter/water house connection and a single public sewer house connection. Condo properties comprised of multiple units on a single lot shall have a single public water meter single public sewer lateral. Individual units shall not be provided individual meters or connections.

m. Non-Dedicated Street Water and Sewer: Certain townhouse developments may be planned with streets that are to remain privately owned. The Bureau of Utilities will have authorization to access and maintain the system through appropriate deeded easements that shall be clearly indicated on the plans.

n. Trees: Existing trees shall be removed from proposed easements. All proposed trees shall be kept a minimum of 12 feet from all Bureau of Utilities infrastructure.

o. Streams and Water Courses: Water courses such as streams, swales, and ditch lines shall be shown and located and shall include width, depth and/or water depth, at the proposed utility crossing. Contours shall be shown on both sides of the water course and extend at least 100 feet beyond the parallel alignment of the proposed facility.

p. Floodplain: The 100 year floodplain delineation shall be shown on the plans.

q. Vehicular Access: 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.

r. General Items:

(1) Limits of Work: The project's work limits and access road shall be clearly indicated.

(2) Right-of-Way: Right-of-way, easements, paving shall be shown in both the plan view and on water and sewer profiles. Maryland state roads shall be identified by route number and Maryland State Highway Administration plat number.

(3) Scale & Profiles: Water and sewer plans shall be drawn on a scale of 1 inch = 50 feet. Water and sewer profiles are typically drawn to accompany the plan layout and shall be shown below the applicable plan layout on each sheet. For Developer Projects, the complete layout of the piping system may be shown in the plan view drawing. Profiles shall then be shown on a separate sheet and cross-referenced to the appropriate plan. Profiles shall be drawn to a horizontal scale of 1 inch = 50 feet and a vertical scale of 1 inch = 5 feet.

(4) Profile Axis: Both sides of a profile view must show a vertical axis with major ticks at 5-foot elevation intervals. Major ticks shall be labelled with appropriate elevation.

(5) Pipe Material: The type of pipe material and class shall be indicated in the general notes, plan and profile views and the quantities table. Changes in the pipe class shall be shown with the limits defined on the pipeline profile.

(6) Detail Numbers: When Standard Details are used, the detail numbers shall be indicated in both the plan and profile view or in a general note.

(7) Stationing: Water and sewer mains shall be stationed on separate profiles from a vertical plane through the centerline of the piping. 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.

(8) Ground Line Delineations: The ground line on the profile shall represent the elevations along the centerline of the pipe. Where the proposed street grade differs from the existing grade by 1 foot or more, the existing grade shall be indicated by a dashed line and the proposed 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.

s. Water Components:

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

(2) Appurtenance Symbols: Fittings, valves, hydrants, and other appurtenances shall be shown by symbols and identified by size and type on both the plan and profile view.

(3) Water House/Service Connections (WHC/WSC): WHC/WSC shall be shown as a pipe from the main to the meter at the property line, edge of right-of-way or easement. The WSC size must be defined in the general notes or labelled in the plan view.

(4) Meter Vaults: For large commercial meters, show the meter size, vault footprint, and bypass piping, all to scale and within a minimum 20-foot x 30-foot easement. Include vault Standard Detail number.

(5) Crossings: For road, stream, irregular terrain, etc. excavations and crossings, shall show method of construction in both plan and profile view. A larger scale may be needed for clarity. Also show any special construction needed to protect water mains when in close proximity to sewer or other utilities etc.

(6) Alignment: Horizontal (Northing and Easting) and vertical (elevation) alignment must be configured to follow changes to street alignments 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.

t. Water Profiles:

(1) Profiles shall be at the same horizontal scale as the plan and shall include pipe size, material type. Main pipe, air release structures, meter vaults, etc. shall be shown to profile scale.

(2) Grades: Grades shall be shown for all existing, proposed, and future conditions.

(3) Dimensioning: Profile dimensioning shall refer to pipe invert.

(4) Labelling: Indicate lot number and location for each WHC/WSC. Show valves, fittings, etc. by symbol on the lines.

(5) Crossings: For all crossings of water mains indicate station and dimension clearance.

u. Sewer Components:

(1) Video Inspection: All public gravity sewer lines, including laterals shall be televised as a condition of inspection in order to obtain acceptance of sewer lines. Prior to televising the sewers shall be flushed to clear debris and to readily discover standing water. All televising shall be referenced to the specific section of the line being inspected (lateral shall be referenced by lot number) and provided in digital format to the Bureau of Utilities for review. The video results must be viewed and approved by

the Bureau of Utilities prior to acceptance of the sewer line.

(2) Location: All County owned sewer mains, appurtenance and service shall be located in a public right-of-way, on County owned property, or within an appropriate easement.

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

(4) Flow Direction: Indicate flow direction with arrows shown above pipes.

(5) Appurtenance Symbols: Fittings and appurtenances shall be shown by symbols and identified by size and type on both the plans and profile views.

(6) Sewer House/Service Connections (SHC/SSC): SHC/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, edge of right-of-way or easement.

(7) 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.

(8) Crossings: For road, stream, irregular terrain, etc. excavations and crossings shall show method of construction in both the plan and profile view. A larger scale map may be needed for clarity. Also show any special construction needed to protect sewer main when in close proximity to storm drains or other utilities.

(9) Alignment: Horizontal (Northing and Easting) and vertical (elevation) 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 additional manholes.

v. Sewer Profiles:

(1) Profiles shall be at the same horizontal scale as the plan and shall include pipe size, material type. Main pipe, manholes, structures, etc. shall be shown to profile scale.

(2) Grades: Grades shall be shown for all existing, proposed, and future conditions.

(3) Stationing: Begin stationing 0+00 at each manhole axis and proceed upgrade to next manhole axis.

(4) Labelling: Indicate lot number and show location/station and station for each SHC/SSC.

(5) Cleanout Invert: Each cleanout invert in plan view shall be labelled with its corresponding station. Such data shall also be provided in tabular form on the plans.

(6) Service Drop Connections: Determine when drop service connections are required and label them as “SDC”.

(7) Manhole Inverts: Indicate invert elevations and whether in or out at all connections to

manholes.

(8) Drop Connections: Determine when drop manhole connections with mainline are required and identify on the profile.

(9) Manhole Numbers: Indicate manhole number and rim elevation. Also provide a watertight cover if manhole is in area susceptible to flooding manhole

(10) Crossings: For any crossings of sewer mains and sewer or other utilities indicate station and dimension clearance. (See SECTION 1.2 – WATER & SEWER DESIGN CRITERIA for minimum clearance requirements.)

w. Facilities and Related Structures:

(1) General: 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, pressure reducing valves, control buildings, etc. A facility typically has some form of electrical equipment and / or other automatically operated mechanical components.

(2) Schematics and Sketches: Drawings and specifications for facilities typically involve unique and non-recurring design features that require more individualized design, research and coordination with multiple technical disciplines. Construction drawings can proceed after conceptual design decisions associated with sketch plans have been approved.

(3) Scale: Other than schematic drawings and reproductions of package components plans shall be made to true scale.

(4) Requirements: All requirements found in Chapter 1 herein are applicable as a minimum for facility plans.

(5) Safety: Hazardous conditions shall be avoided. Railings, ingress and egress and required safety equipment shall be included. Project shall meet all OSHA, MOSHA, and County safety requirements.

(6) Site Plan: Shall show location of 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. Plans shall include grading plan, landscaping plan. Scale shall not exceed 1 inch = 20 feet without authorization by the Bureau of Utilities.

(7) Mechanical Plans: Shall include at a minimum the following components when/if relevant; Plan and profile and sectional views of piping and equipment installation; Installation and support requirements for all equipment; HVAC/Ventilation/Space heating; Sleeves and seals at wall and floor penetrations; Potable water and drain piping; Floor drains; Backflow preventors; Dimensional relationships between components and structures. Consideration shall be made to minimize vibration and noise from rotating machinery and air movement as well as space for maintenance access.

(8) Electrical Plans: Shall include at a minimum the following components when/if relevant; Schematic diagrams including power schematics, control schematics and instrumental schematics; Wire types and sizes; Electrical power service installation including meter, type of voltage and phasing; Conduit materials, sizing and routing; Circuit breaker directories; Generator specifications including location, type and installation. Panel box specifications such as type, size and mounting details; On-site alarms and controls; SCADA of data and

alarms; Running time meter, ammeters etc.

(9) Architectural Plans: Details shall be carefully coordinated with other work efforts to show all information required for fabrication, construction, and installation of all items detailed. Handicap Requirements shall be addressed on a case by case basis. All Americans With Disabilities Act requirements must be met.

(10) Structural Plans: Shall include details of cast-in-place concrete pads, floors and walls; Implementation of and results of soil tests and reports; special excavation and backfilling requirements.

(11) Hydraulic Details: Shall include number of EDUs, flow rate capacities, peaking factors, pumping information and curves, critical pressure parameters, etc.

(12) Process Details: Shall include schematic diagram of biologic and chemical processes; plan view and profile view of processes; odor control provisions if required; chemical handling and disposal provisions.

(13) 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, vacuum trucks, mobile cranes, backhoes, etc.

7. Construction Specifications

a. Carroll County's Standard Specifications are set forth in this manual. Non-standard specifications, special provisions, proposal form, contract and bond forms and other designated items, when required by the County, shall be developed by the Design Professional specifically for each project and shall be published in booklet form. A draft of the project specifications shall be submitted with each plan submittal for review by the County. These requirements apply to both Developer and Capital Projects.

b. It is incumbent on the Design Professional to include all conditions to the contract and work required not otherwise covered, such as special construction methods, materials, measurement, payment, etc. to provide a complete document.

c. Upon completion of the construction plans the Design Professional shall provide necessary non-standard specifications to accompany the plans. The Design Professional shall submit three completed copies of the non-standard portions of the specifications at time of final plan approval. Final specifications shall have the Professional Engineer seal, signature and date of signature on the title page.

d. Water and wastewater treatment plants and water storage facilities involve unique and non-recurring design features. They are considered beyond the scope of this manual. These types of projects shall involve specific design criteria and other requirements as determined by the Bureau of Utilities for each project.

8. Proposals

a. Proposals may be designed for a single lump sum payment, a series of unit priced items or a combination of the two. Carroll County employs a combination type of proposal where some items of work are bid and paid without regard to measurement while other items are bid and

paid on the basis of a unit of actual measurement multiplied by the corresponding unit price bid by the Contractor or fixed by the contract. The basis of measurement and payment is described in the Standard Specifications and/or in the project specifications.

b. Proposals may be divided into parts to facilitate cost accounting procedures required to allocate costs by projects, administer charges and account for cost participation of various parties involved in the financing.

c. The proposal form for pipeline projects shall contain a statement by the Contractor indicating the type of pipe intended to use for the project. The time period in calendar days permitted to complete the work shall be included. The amount of liquidated damages to be charged per day, in the event the work is not completed within the prescribed time period shall also be included.

d. Pipeline and other types of projects often contain several contingent items of work or materials to be employed which may develop during construction that cannot always be anticipated or that can be anticipated without being qualified. To facilitate the employment of additional materials and the authorization of incidental items of work, all contracts shall contain a list of fixed price contingent items, which are not bid items, which have an assigned unit price and quantity as applicable. These items shall be utilized to enable the Contractor to be paid an equitable sum of money when the particular item of work or the furnishing of materials is authorized and directed during construction. Modifications of this list or modifications of the fixed prices shall not be made by the Designer except with the full concurrence of the Bureau of Utilities.

9. Checklists

a. The Designer shall fully complete the “Final Construction Plan” checklist for each water and sewer project as applicable. The Designer shall verify that all information detailed on the checklist is shown on the plans. A copy of the checklist may be provided to the Design Professional together with their notice to proceed or the Designer may request a copy from the Bureau of Utilities. For all Capital Projects as well as Developer Projects a copy of the checklist shall be completed and attached to each set of plans when submitted for review.

10. Permits and Approvals

a. State and Federal

(1) MDE Permit: MDE must approve certain plans and issue water and sewer construction permits. Design review fees must be paid, if developer funded, before MDE will begin their review.

(2) Miscellaneous: Plans must be submitted, and approvals obtained from other state and federal agencies as required. Permits from the following agencies may be required based on the specifics of the proposed project.

(a) Maryland Department of the Environment

(b) Army Corps of Engineers

(c) Maryland Historic Trust

(d) State Highway Administration

b. Soil Conservation: Approval and signatures must be obtained by the Design Engineer from the Carroll Soil Conservation District.

c. County

(1) For all projects, 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, electrical work or work within a county road requires permits from the County.

d. Other

(1) Utility Companies: Telephone, electric, television, cable, natural gas, etc. must issue all permits when their jurisdictions are encountered.

(2) Railroads: Any railroad crossing or parallelism is subject to a permit and/or a licensing agreement from the affected railroad. Many times, "riders" are attached to railroad permits, typically by telecommunication companies that jointly occupy railroad right-of-ways. In cases such as this, separate side permits are required in addition to the railroad permit.

Article 1-12. PUBLIC WORKS AGREEMENT

1. As required in CARROLL COUNTY, MD Code of Ordinances, Chapter 51 (See **Appendix A**).

Article 1-13. RECORD PLAT EASEMENTS

1. All water and sewer mains and/or appurtenances that are outside of the proposed public road rights-of-way shall be labeled on the subdivision record plat as a water and/or sanitary sewer easement.

2. The easement shall have a minimum width of 20 feet.

3. If construction easements are required, they shall be shown as revertible easements. They shall revert upon final inspection of the water and/or sewer system.

Article 1-14. CONTRACT PROCEDURES

1. Final Contract Drawings and Specifications shall be submitted to the County for signature and approval and to the Carroll County and State Health Departments for approval before the taking of bids and letting of any contract for construction of water and sewerage facilities within the jurisdiction of the County.

2. After approval by the County, the Carroll County and State Health Departments should receive copies of the final Plans and Specifications as required for issuing construction permits.

Article 1-15. CONSTRUCTION PROCEDURES

1. All construction shall be in conformity with the approved Plans and Specifications.

2. The County retains the right to inspect water and sewerage facilities during construction and, if deemed necessary, the County shall provide an inspector during the construction of the water and sewerage facilities at the Developer's cost.

3. If, in the opinion of the County, inspection is required, the Developer shall pay all costs of such inspection, as may be necessary, to ensure compliance with the Standard Specifications and Details of the County.

Article 1-16. RECORD/AS-BUILT DRAWINGS

1. Once water and sewer plans have been signed by the County, the original water and sewer plans and all prints thereof become property of Carroll County. During construction, the Contractor and the County's inspector, acting together, shall maintain a set of as-built or redlined prints. Upon the completion of construction, the original water and sewer plans shall be revised to reflect as-built conditions.

2. The Designer shall complete modifications to the plan to reflect as-built conditions which shall also include at minimum the following water and sewer information.

    a. Horizontal (Northing and Easting) and vertical (elevation) location, also inverts and rim elevations on all manholes.

    b. Horizontal (Northing and Easting) and vertical (elevation) location on all water valves.

    c. All water and sewer laterals shall be noted with the stationing along the utility, length of the lateral to the edge of right-ot-way, and depth of the lateral at the right-of-way.

3. Where new facilities have been constructed, an as-built survey of the project shall be performed and delivered to the County upon completion of the project.

4. The Design Professional shall furnish to the County one set of digital As-built drawings of the work within 90 days of receiving the Contractor's certified As-built Drawings from the Owner.

END OF SECTION

SECTION 1.2

TABLE OF CONTENTS

WATER AND SEWER DESIGN CRITERIA

SECTION 1.2 – WATER & SEWER DESIGN CRITERIA

Article 1. GENERAL

1. The following design criteria shall be used unless exceptions are approved in writing by the County. Where special design criteria are required, the Applicants should consult with the County prior to preparation and submission of plans.

2. Regulatory Agencies

   a. All designs shall conform to good engineering practice and all proposed water construction projects shall meet the requirements of the Maryland Department of the Environment (MDE), OSHA, and the Maryland Department of Labor, Licensing & Regulation, and shall conform to the requirements contained herein.

   b. The design criteria contained herein shall be used unless exceptions are approved in writing by the County. Where special design criteria are required, the Applicant must consult the County prior to the preparation and submission of plans.

Article 2. DEFINITIONS

1. Approved Equal: A product that is brought before the County for evaluation and has been determined to be substantially equal or superior to a product listed in the specifications.

2. Applicant: Entity requesting to connect to, modify, or install utilities to connect to the public water and sewer system.

3. Average Daily Demand: The mean average volume of water required over a 1-day period for delivery by the water system.

4. Average Daily Flow: For existing facilities, it's the current average daily flow based on the last three years data. This is done by averaging the daily flow for each year, then averaging the three years. For a proposed facility, it's the project initial flow.

5. Construction: The process of building, altering, repairing, improving, or demolishing any structure, building or other improvement to real property.

6. County: The Carroll County Bureau of Utilities, also known as the utility Owner.

7. Design Average Flow (Design Capacity): Average daily flow a facility is designed to successfully process

8. Designer or Design Professional: A professional engineer or surveyor registered in the State of Maryland, who is responsible for the design of the project.

9. Easement: A grant of a right of use of the property of an owner for a certain purpose at the will of the grantee.

10. Installer: Contractor, Developer, or Excavator who is responsible for the installation of utilities.

11. Peak Hourly Flow: The largest volume of flow occurring within 1-hour period in the record examined.

12. Maximum Daily Demand: The largest volume of water required over a 1-day period for delivery by the water system.

13. Right-of-Way: The right, acquired by a legally executed and recorded document, permitting the County to use a clearly defined strip or parcel across the land of others for the installation, construction, reconstruction, maintenance, repair, operation, and inspection, with the right of ingress and egress for a specified utility or facility, in perpetuity.

14. Standard Specifications: Specifications set forth by the County to describe standard elements of construction, methods, and materials for use on construction projects.

15. Standard Details: County details showing standard elements of construction, methods, and materials for use on construction projects.

Article 3. WATER MAINS

1. Design Flow

    a. The following water design criteria shall be used unless exceptions are approved in writing by the County. Where special design criteria are required, the Applicants should consult with the County prior to preparation and submission of plans. The design criteria for water demands for planning purposes are as follows:

        (1) Residential houses and apartment units: 250 gallons per day (GPD) per home or unit.

        (2) Age restricted units: 100 GPD per unit.

        (3) Other demand for areas in the Priority Service Area are projected based on acreages of commercial and industrial zoning. Water and sewer demand are projected at 700 gallons per acre per day for business/commercial zoning and at 800 gallons per acre per day for industrial zoning (exclusive of industrial wastes).

        (4) Industrial or special water and sewer demands will be established for each installation.

        (5) Allowances shall be made for vacant lots in accordance with zoning regulations and engineering judgment.

        (6) Fire demands: As determined by Carroll County Ordinance 91 (Fire Protection)

2. Size of Mains

    a. Adequacy of main sizes shall be determined based on a total flow requirement of fire demand in accordance with ISO methodology plus maximum daily demand plus special requirements.

b. Water mains serving hydrants shall be a minimum of 8 inches in diameter. The minimum size of all water mains in the distribution system is 6 inches.

c. A design C value of 120 is required for all pipeline materials.

d. Fire hydrant branches are to be no longer than necessary. The maximum permissible length is 50 feet unless a longer length is approved by the County. A gate valve shall be provided on each fire hydrant lateral at the hydrant as depicted in the Standard Details.

3. Depth of Mains

a. The minimum depth of ground cover over water mains shall be 4 feet (48 inches) measured from the outside top of pipe to the actual ground surface in existing developments. In new subdivisions when grading and paving is to be accomplished as part of the project, the cover shall be measured from the top of the pipe to finished grade. The maximum depth of backfill over pipes shall be 8 feet. In areas outside of existing or planned streets the Designer shall investigate and make suitable allowances for likely changes to existing topography. Such as changes from erosion of stream beds or grading of lots.

4. Location/Alignment of Mains

a. General

(1) The Designer has the responsibility to identify where factors of design and planning may conflict with the guidelines and requirements of other agencies. Consideration must be given to space requirements for future utilities, particularly sanitary sewers, and storm drains.

(2) When plans of existing facilities are insufficient to accurately locate existing underground obstructions, the Designer shall request permission from the County to perform test pit excavations to uncover the subject facilities so that the horizontal and vertical positions of existing utilities can be accurately determined. If such permission is granted, the Designer shall be responsible for providing all traffic control and public safety measures necessary to locate the utilities and restore the surface. The Designer shall coordinate the test pit operations and provide a field survey crew to physically locate the subject facility.

(3) In Development projects where all new facilities are to be constructed mains shall normally be located within the right of way lines of public streets. Water mains in new subdivisions generally shall be laid 7 feet off the centerline of the street towards the high side. If it is necessary to locate a main on private property, the Applicant shall provide a water main easement in the name of the County. The easement shall consist of a 20-foot-wide permanent easement, normally centered on the pipeline, and an additional 20-foot-wide temporary construction easement.

(4) In existing developments where roads are paved, and without curbs, the water main shall generally be placed outside the edge of paving and inside the right-of-way line in a location having the least conflict with existing utilities. This alignment shall be on the high side of the street when possible, reserving the low side for sewer installation where applicable.

(5) Distribution main networks shall be looped, and dead-end mains shall be avoided. The maximum length of non-looped 6-inch mains shall be 600 feet. Then maximum length of non-looped 8-inch mains shall be 2,500 feet. When dead-end mains cannot be avoided, hydrants shall be provided at the ends of the mains.

(6) Water distribution mains for institutional, commercial, and industrial areas shall be a minimum of 8 inches except for fire hydrant leads and service connections.

(7) Distribution mains may be designed on a curved alignment to reduce the number of bends. The maximum joint deflection angle for pipe 12 inches and smaller is 4 degrees. The maximum joint deflection for pipe 14 inches and larger is 2 ½ degrees.

(8) Distribution mains shall be located not less than 15 feet from buildings, except as approved by the County.

(9) Design of the horizontal and vertical layout of water mains shall follow sound engineering principles. Utility crossings and localized high spots shall be minimized. Maximum horizontal separation of utilities shall be provided for ease of future maintenance and health and safety reasons. At no point is the clearance between other utilities to be less than 1-foot.

(10) Alignments within existing areas (streets or roads), shall avoid high traffic volume roads if other options are available. Proposes alignments shall be designed to allow construction without the need to have road closings. When a water main must cross a County road, the Designer shall recommend whether to open cut, tunnel, or jack and bore the utility across the roadway on a case-by-case basis. The Chief of the Bureau of Utilities shall make the final decision as to the method to be used and the approved method shall be noted on the plans.

(11) In residential subdivisions where an easement is required between two adjacent lots for the extension of the water system, a water main shall be provided within the easement between the adjacent lots. The main shall extend the full length of the easement between the lots.

(12) If existing roadways are involved, the vertical alignment of the road must be evaluated for acceptable geometry and the main designed with respect to possible roadway improvements to avoid costly relocations. Acceptable geometry shall be determined by use of current roadway design standards. Where existing conditions are substandard, the Designer shall superimpose an improved grade on the profile and shall use this grade in the vertical positioning of the main where applicable to confirm proper cover shall be maintained.

(13) Locate house connections on the high side of the property.

(14) Residential laterals (WHCs) are to be located a minimum of 5 feet apart from the adjacent lot line and be perpendicular to the main whenever possible.

(15) Ensure that utility crossings maintain an angle of at least 60 degrees.

(16) For all jack and bore installations provide valves on both ends of the proposed crossing.

b. Relocation of Water Pipelines

(1) When selecting an alignment, the existing pipeline must be maintained and stay in service until the relocated pipeline is ready for final connection to the existing main. Connection must be designed to allow for a quick shutdown and transfer of services.

(2) The relocated pipeline shall have a minimum 10 feet horizonal clearance, centerline to centerline, from the existing main, if the existing main is to remain in service during construction of the new main.

(3) The relocated pipeline shall have a minimum 1-foot vertical clearance between the existing pipeline that will be abandoned by the relocation, measured from the outside of pipe.

(4) The relocated alignment shall not disturb the existing blocking or restraints on the existing pipeline that is in service. Pipe restraints shall be designed for the relocated pipeline. If shutdown time is limited, the design will require a quick type blocking for restraining the relocated pipeline.

(5) The design of the relocated pipeline must provide for continuous service from the existing pipeline until the relocated pipeline is placed in service. Once completed the existing pipeline shall be shut down and all tie-ins and transfers of WHCs between the existing pipeline and the relocated pipeline shall be made.

(6) The Designer must contact the BOU for information regarding limitations on shutdowns of existing pipelines. Conceptual approval from the BOU must be obtained if the Designer determines that existing pipeline must be replaced in the same location and alignment which may require an extended shutdown period or include provisions for temporary service.

(7) Existing pipeline, structures and/or appurtenances to be abandoned shall be clearly shown on the plans and indicate the limits of abandonment and description of the facility to be abandoned as well as the method of abandonment.

(8) If large portions of the service area will be affected by the relocation or when service will be interrupted for extended periods, the BOU may require the use of line stops to reduce or eliminate the disruption time.

c. Bends

(1) Water main alignments shall minimize the use of bends. The Designer shall try to align the pipeline by deflecting the pipe joints. Deflecting the joints on bends is not permitted.

(2) Allowable bends are as follows: 90 degrees, 45 degrees, 22.5 degrees, and 11.25 degrees.

(3) 90-degree bends in the horizontal plane shall only by used with BOU approval and are not permitted in the vertical plane.

(4) Bends which are designed to be rotated in both the horizontal and vertical planes require special pipe restraint. The Designer must submit design calculations to the BOU for review and approval.

d. Tees

(1) The connecting branch pipe must be perpendicular (90 degrees) to the mainline pipe.

(2) The Design Professional may use a tapping sleeve and valve when connecting to an existing main if the existing main is a minimum of one pipe size larger than the proposed main.

(3) Joint deflections are not permitted at the branch connection of the tee.

(4) Tees that are designed to be rotated greater than 5 degrees in the vertical plane may require special pipe restraint.

e. Crosses

(1) A cross is required for two perpendicular extensions which are in close proximity to each other. Tees shall not be used in lieu of crosses unless the connections are spaced a minimum of 10 feet apart.

(2) A valve shall be installed on each branch, strapped to the cross. The branch connections of the cross must be extended a minimum of one full length of pipe on both sides of the cross, with standard thrust blocking on the ends. If the branch connection of a cross cannot be extended, the Designer shall utilize two tees, properly spaced, with valves strapped to the tees and required standard thrust blocking.

(3) If the alignment from the cross requires using a reducer on one side of the cross, the Designer shall provide special pipe restraints for any unbalanced forces due to the reducer.

f. Reducers

(1) Reducers are required for reducing the pipeline size. The Designer shall avoid using reducers on short runs of pipe.

(2) Reducers may require special pipe restraint for unbalanced forces.

(3) When reducing the pipe size on pipelines 16 inches in diameter and larger pipelines, the profile must be examined to determine if the reducer will create a high point at the large end of the reducer. This must be corrected with the use of

an eccentric reducer.

g. Solid Sleeves and Mechanical Couplings

(1) Mechanical joint sleeves shall be used for buried conditions and mechanical couplings with tie rods shall be used in vaults and structures.

h. Connections (Tapping Sleeves)

(1) Where connections to existing mains are to be made, the BOU will determine during plan review whether the main shall remain in service requiring the use of a tapping sleeve and valve or whether a specific shut down period can be accommodated for making connections.

(2) If a tapping sleeve and valve is intended to be used the as-built plans shall be checked to ascertain the existing pipe class or thickness to design the appropriate compatible tapping sleeve and gasket. If the class and thickness cannot be identified, the designer shall test pit the pipeline to determine the pipe outside diameter. The main being tapped must be one pipe size larger than the proposed main. The location of the tapping sleeve on DIP or CIP shall be designed so that the centerline of the connecting pipeline is a minimum of 5 feet from the face of any existing bell joints. Tapping sleeves and valves shall be restrained or blocked in the same manner as a tee.

(3) The BOU prohibits the manipulation of valves by any party other than BOU staff. This practice shall be stated on all plans and specifications.

i. Water Mains Near Sewers

(1) Parallel Installation: Water mains shall be laid at least 10 feet horizontally from any existing or proposed sewer. The distance shall be measured edge to edge. In cases where it is not practical to maintain 10 feet of separation, the County may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the water main closer to a sewer, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer.

(2) Crossings: Whenever water mains must cross building drains, storm drains, or sanitary sewers, the water main shall be laid at such an elevation that the bottom of the water main is 18 inches above the top of the drain or sewer. This vertical separation shall be maintained for the portion of the water main located within 10 feet horizontally of any sewer or drain it crosses. The 10 feet is to be measured as a perpendicular distance from the drain or sewer line to the water line.

(3) Exception: When it is impossible to obtain the proper horizontal and vertical separation as stipulated in Items (1) and (2) above, both the water main and sewer line shall be constructed of ductile iron pipe having mechanical joints. Other types of joints of equal or greater integrity may be used at the discretion of the County. Where water mains must cross under a sewer, additional protection shall be provided by:

(100) A vertical separation of at least 12 inches between the bottom of the sewer and the top of the water line;

(101) Adequate structural support for the sewers to prevent excessive deflection of the joints and the settling on and breaking of the water line; and

(102) Centering the length of the water line at the point of the crossing so that the joints are equidistant and as far as possible from the sewer.

(4) The County shall be consulted when any of the above conditions cannot be met, to discuss the use of double casing or concrete encasement of sewer and/or water lines as possible alternatives.

(5) No water pipe shall pass through, or contact, any part of a sewer manhole.

j. Water Mains Near Gas Mains and Other Utilities

(1) Parallel Installation: Water mains shall be laid at least 10 feet horizontally from any existing or proposed gas main or other utility. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10-foot separation, the County may allow deviation on a case-by-case basis, if supported by data from the design engineer.

(2) Crossings: Whenever water mains must cross gas mains or other utilities, a minimum vertical separation of 18 inches shall be provided measured edge to edge. This vertical separation shall be maintained for the portion of the water main located within 10 feet horizontally of any gas main or other utility it crosses. The 10 feet is to be measured as a perpendicular distance from the gas main or other utility to the water main. Where the water main must cross under a gas main or other utility, adequate structural support for the gas main or other utility shall be provided to prevent excessive deflection of the joints and the settling on and breaking of the water line.

(3) The County shall be consulted when any of the above conditions cannot be met, to discuss possible alternatives.

5. Water Pressures

k. General

(1) Water pressure should normally be maintained in the range from 35 pounds per square inch (psi) to 100 psi at ground elevation. The required minimum pressure at ground elevation shall be 20 psi during fire flows.

(2) In areas where the static water pressure in the distribution system is less than 35 psi, booster pumps will be required. The provision of booster pumps is the Applicant's responsibility.

l. Design Pressure

(1) The design pressure for equipment and materials shall be at least equal to 150 psi plus a 100-psi surge allowance.

m. Fire Demands

(1) Where only hose streams are required, fire flow requirements shall be satisfied while maintaining 20 psi residual pressure at hydrants in the immediate vicinity of the fire. Where automatic sprinkler systems are involved, residual pressures must be adequate for their proper operation.

n. Booster Pumping Station

(1) The necessity of, design of, and construction of main line booster pumping stations shall be subject to County approval.

6. Cross-Connections

a. No water source of any type, other than the County water supply, shall be connected to customer piping served from the County water system. All potential cross-connections shall be eliminated. Backflow prevention devices shall be installed on all connections in accordance with the Carroll County Plumbing Code.

b. Backflow prevention devises shall be ASSE Listed, UL Listed, FM Approved, and approved by the Foundation for Cross Connection Control and Hydraulic Research at the University of Southern California (USC). Submittals shall include a copy of the USC approved opening flow rated characteristics of the backflow device.

7. Location/Alignment of Valves

a. The placement of valves in a water distribution system at strategic locations is essential to ensuring sufficient control of the system. It is the responsibility of the Designer to ensure that the valves are located so that minimal disruption of water service will occur during maintenance, future extension work and emergency conditions.

b. A minimum of four valves shall be used at crosses and three valves at tees.

c. Valves shall be provided on mains between intersections and on dead end mains at noted below.

Main Size	Maximum Valve Spacing
6 inches	800 feet
6 inches to 12 inches (Multi-Family Residential Use)	500 feet
6 inches to 12 inches (Residential Use)	1000 feet
6 inches to 12 inches (Other Land Use)	1000 feet
14 inches and Larger	1000 feet

d. For high traffic volume intersections, to avoid the disturbance of traffic flow and for ease of operation, valves shall be located outside of the intersection on the projection of the street right-of-way line.

e. Valves shall be installed so that generally not more than two blocks, or ultimately not more than fifty houses, whichever shall govern, shall be out of service in a shutdown of the distribution system.

f. When the existing County system requires several domestic services to be shut down during the installation of a connection, the County may require an additional valve to be installed next to the connection on the mainline pipeline to reduce the number of domestic services placed out of water during any future shutdown.

g. All water mains shall extend at least 40 feet beyond each valve located on a dead-end main, unless restrained properly and approved otherwise by the County.

h. A valve shall be installed on each hydrant branch pipe between the main and the hydrant and near the end of any main which may be extended.

i. When reducers are used, provide a valve on the smaller pipeline within 20 feet of the reducer.

j. Valve stem extensions are required when the top of the valve's operating nut exceeds 8 feet of cover.

k. The pipeline vertical alignment at valves should be designed to be as nearly parallel to the road grade as possible so that the valve may be installed perpendicular to the road grade. Any vertical alignment adjustments required to meet this condition shall be shown on the profile. If a valve is to be located on a pipeline where this condition cannot be met, the Designer shall check the pipe slope and depth of the valve to verify that the buried valve will be operable.

8. Valve Vaults

a. All piping within vaults shall have flanged joints.

b. A mechanical coupling or mechanical joint solid sleeve shall be included in the vault piping for the removal of the valve, pipe, and fittings within the vault. A mechanical coupling requires special pipe restraints. A mechanical joint solid sleeve requires the joints to be restrained using Megalugs or retainer glands. The Designer shall determine the appropriate form of restraint based on the pressure rating requirements for each type of restraining joint.

c. On the profile, the Designer must determine the invert of the pipeline using the design depth shown on the Standard Details for the valve vaults.

d. The valve shall be restrained in the closed position.

9. Pressure Reducing/Regulating Valves

a. A pressure reducing/regulating valve may be required due to excessive pressure and/or to regulate a more uniform pressure in the County's system. The Designer shall determine if the project requires installation of a system PRV and vault.

b. If a system PRV is required, the Designer shall determine the appropriate location for the PRV and submit the hydraulic analysis and proposed PRV location to the DPW for approval.

10. Air Release and Vacuum Valves

    a. Air release valves shall only be used as a last resort. Profile of water main shall be designed to have horizontal or rising slope to high point where a fire hydrant is located. If needed, air release and vacuum valves shall be installed at all high points on supply or transmission mains and on distribution mains as directed by the County. Air valves shall be installed in concrete manholes as depicted in the Standard Details.

11. Fire Hydrants

    a. Hydrants placed within developed sites are usually part of the public system however, in certain instances hydrants become part of the internal fire projection system. In such cases hydrants shall clearly be marked as private on plans and specifications. Private hydrants shall match the same specifications as public hydrants.

    b. All hydrant barrels shall be a minimum of 5 ¼ inches in diameter and the connection from the main to the hydrant and the valve shall be 6 inches in diameter.

    c. In dead-end mains or where required by the County, a fire hydrant shall be installed for flushing the main.

    d. Where elevation changes exist along the water main alignment, fire hydrants should be located at low spots for flushing the main.

    e. Fire hydrants are required, and the following hydrant spacing guidelines shall apply:

        (1) In residential areas, the closest point of any existing or proposed building shall be within 600 feet of a hydrant.

        (2) In commercial areas, the closest point of any existing or proposed building shall be within 400 feet of a hydrant.

        (3) In industrial areas, hydrants should be spaced according to the latest requirements of the State Fire Prevention Code, or at minimum every 300 feet.

        (4) Generally, a hydrant should be placed at each street intersection, and intermediate hydrants shall be installed if the distance between intersections exceeds 500 feet.

        (5) In checking distances between hydrants and buildings, measurements should be made along public streets, except where private entrances or parking areas are available for access.

        (6) As installed, breakaway flanges shall not exceed 6 inches above finished grade.

    f. Profiles will be required in the following cases:

        (1) When the fire hydrant lead crosses other utilities, except when it is clear from the profile of the water main that the hydrant lead has sufficient clearance.

(2) When the grade/ground line at the hydrant location and over the hydrant lead is not the same as the mainline pipe.

(3) When bends are required for the hydrant lead. Fire hydrant leads shall not have bends, offsets. etc. between the fire hydrant tee and the fire hydrant if possible.

g. If bends are required for fire hydrant leads, the Designer shall use smooth transition, restrained, s-bends specifically designed for hydrant use.

h. Hydrants shall be restrained at every joint with mechanical joint restraints from the tee through to the hydrant or by a combination of mechanical joint restraints, ¾-inch threaded steel bars and concrete thrust blocks. See Standard Details.

i. Fire hydrants shall be protected by bollards in area such as parking lots, where they are exposed to damage by vehicular traffic.

12. Blow-off Connections

a. Flush type hydrants, for use as a blow-off for maintenance activities, flushing and periodic removal of accumulated sediments shall be installed at the lowest elevation point of a water main system and at the end of all dead-end mains.

b. Fire hydrants shall be utilized for blow-offs when the location requirements for both types of hydrants are accommodated.

c. Flush type hydrants shall be located as close as possible to an existing or proposed sewer manhole to allow for the disposal of the chlorinated water into the manhole.

13. Tunnels and Casing Sleeves

a. Water mains are placed in tunnels or casing sleeves under railroads and highways or in other locations where open cut excavation is either not allowed or is excessive in cost and disruption.

b. Steel liner plates shall be hot dipped galvanized and coated with bitumastic material. Steel casing sleeves shall be lined with bitumastic material on the inside only.

c. The ends of casing sleeves shall be bulkheaded to prevent entry of foreign objects. The water main include within the casing or tunnel shall be anchored and designed for all internal and external forces which can be transmitted without consideration of the casing pipe. The water main within the casing shall have restrained joints. The casing pipe shall not be filled with concrete or grout but shall remain open and accessible for repair and replacement of the main. Joints in the main shall be placed immediately outside the bulkhead to allow flexibility and to relieve shear stresses on the pipe.

14. Borings

a. Bored crossings shall be done in accordance with MDSHA requirements.

15. Cathodic Protection

a. Water mains installed near utilities having cathodic protection or in areas with hydric soils shall themselves be protected. The methods of protection, which may include insulating couplings, polyethylene encasement, electrical connectors, test stations, and other facilities, shall be subject to County approval.

16. Customer Metering

a. Each customer shall be metered. Water meters other than single family residential home 1" meters are installed by the developer and are maintained by the County. (See SECTION 3.3 – WATER LATERALS)

17. Pipeline Abandonment

a. Water pipe less than 12 inches diameter to be cut and capped.

b. Water pipe 12 inches diameter and greater to be filled.

Article 4. WATER SERVICES

1. General

a. Water House Connections (WHCs) provide the connection from the distribution main to the consumer's system at a convenient point along the property line. The County's liability for WHCs stops at the property line or public right-of-way line. The County's responsibility stops at the meter vault with the meter and appurtenances being the responsibility of the County.

2. Materials

a. For WHCs 2 inches and smaller the pipe material shall be copper per Standard Specification.

b. For WHCs 4 inches and larger the pipe material shall be DIP per Standard Specifications.

3. Size of Lines

a. The sizing of laterals shall be in accordance with AWWA Manual of Water Supply Practice M22 *Sizing of Water Service Lines and Meters* and is subject to County approval. The Applicant shall provide justification for lateral sizing for County review and approval. Single unit residential laterals shall normally be 1 ½ inches in size with a 1-inch meter.

4. Depth of Lines

a. The minimum cover over laterals shall be 3 feet – 6 inches (42 inches). The maximum cover permitted over WHCs is 6 feet (72 inches).

5. Location of Laterals

a. Laterals extend from the water main to the property using flexible pipe terminating with a meter vault at the property or right-of-way line.

b. Laterals shall be installed at least 5 feet away, measured horizontally, from permanent structures and other utilities. Laterals shall also be installed above sewer utilities. If these minimum distances cannot be achieved, alternative methods for protecting the water utilities, as approved by the County, shall be used. Refer to SECTION 3.2 – WATER MAINS for additional requirements on utility separation.

c. A lateral shall be provided for each lot.

d. At the discretion of the County, a twin meter setting and vault may be allowed.

6. Water Meters

a. The Designer shall avoid locating outside meter settings within driveways or other paved surfaces whenever possible. The preferred location of the meter setting is in a grass area within the road right-of-way and outside of traffic bearing areas whenever possible.

b. Water meters shall generally be sized for a maximum loss of 25 psi through the meters but shall not be less than 1 ½ inches in size. Water meters shall be located on the property line or public right-of-way line.

c. Water meters shall be installed in accordance with the Standard Details; shall be provided with vaults and shall be provided with a valve or corporation cock installed on the water main side of each meter.

Article 5. SEWER MAINS

1. Design Flow

a. Average sewage flow shall be computed as follows:

(1) Houses in area by house count times 3.5 persons per house times one hundred (103) gallons per person per day.

(2) Apartment units in areas presently developed or being developed times three (3) persons per unit times one hundred (100) gallons per person per day.

(3) Institutional, commercial, and industrial establishments Average Sewage Flow (exclusive of industrial wastes) determined from a study of the establishment, or water usage as determined by the County.

(4) Allowances shall be made for vacant lots in accordance with zoning regulations and engineering judgment.

b. The peak flow of domestic, institutional, industrial, and commercial sewage shall be determined from the tables included in the *Maryland Department of the Environment (MDE) Design Guidelines for Wastewater Facilities* (flow projection Table 1 & 2 included in **Appendix C** for reference). If it can be established that the peak flow of

non-domestic sewage does not occur during peak domestic flow times, only a percentage of the industrial flow need be added.

c. Infiltration shall be determined by multiplying the tributary area in acres by an infiltration rate of not less than two hundred (200) gallons per gross acre daily.

d. Domestic Sanitary Sewer Requirements:

(1) Average Daily Requirement: 350 gallons per day per EDU (the County, at its own discretion, may apply a reserve factor more than the 350 gpd).

(2) Maximum Daily Requirement: 4.0 times average daily demand.

(3) The design flow shall be the sum of the peak flow and infiltration.

e. For extensions or improvements to the public sewer system serving more than 200 residential units, or for critical areas of the public sewer system, the BOU may require the Designer to provide hydraulic calculations on the proposed sewer system improvements and the effects of the proposed improvements on the existing downstream sewer system. Design data and computations shall include average and peak flow rates, infiltration/inflow rates and design flow rates.

2. Sewer size

a. Diameter and Slope

(1) The minimum sewer diameter shall be 8 inches.

(2) Minimal Allowable Slopes for sewer mains shall be as shown below. (ft./100 ft.)

8-inch Terminal Main	1.00
8-inch Main	0.40
10-inch Main	0.28
12-inch Main	0.22
14-inch & Larger	Slope required for 2.5 ft/s velocity at design flow.

The minimum slopes noted above are required to maintain a velocity greater than 2.5 ft./s based upon a Manning's "n" coefficient of 0.013 when the pipes are flowing full or half full.

(3) The minimum slope for all terminal sections of sewers shall be 1.0 percent.

(4) Laying pipes on slopes that provide minimum velocities shall be avoided whenever possible.

(5) Slopes producing design velocities greater than 10 feet per second shall be avoided whenever possible.

(6) Maximum grades for sewers shall be 20 percent. The Bureau should be contacted

directly if grades must exceed 20 percent. Epoxy-lined ductile iron pipe shall be used if grades exceed 20 percent.

(7) To reduce grades, the use of drop manholes shall be considered.

(8) For sewers having grade more than 20 percent, pipe anchors shall be provided as shown in the Standard Details.

3. Sewer alignment

(1) When plans of existing facilities are insufficient to accurately locate existing underground obstructions, the Designer shall request permission from the County to perform test pit excavations to uncover the subject facilities so that the horizontal and vertical positions of existing utilities can be accurately determined. If such permission is granted, the Designer shall be responsible for providing all traffic control and public safety measures necessary to locate the utilities and restore the surface. The Designer shall coordinate the test pit operations and provide a field survey crew to physically locate the subject facility.

(2) Sewers in new subdivisions shall generally be laid 7 feet off the centerline of the street towards the low side. Where curbs exist, the sewer shall be placed no less than 5 feet from the face of the curb.

(3) Where sewers in residential developments are constructed between or across lot lines the centerline of the pipe shall be constructed on the lot line between the lots or along the rear property line. Under no circumstances shall sewers or required easements cut across building envelopes. In such cases easements must be provided to allow adequate access to the sewer by maintenance personnel and equipment. Additionally, in such cases where an easement is provided between two adjacent lots for the extension of the sewer system in the future, a sewer main shall be provided within the easement between the adjacent lots. The sewer main shall extend the full length of the easement between the lots.

(4) Sewer alignments within existing streets or roads shall avoid high traffic volume roads whenever other options are available. Proposed alignments shall be designed to allow construction of the pipeline without the need for road closings. When a sewer main or lateral connection is required to cross a County road, the designer shall recommend whether to open cut, tunnel or jack and bore the utility across the roadway after considering the type of condition of the road, traffic volumes, disruption to traffic and possible conflicts with existing utilities.

(5) In existing developed areas, the alignment shall attempt to avoid the removal of trees or landscaped areas and construction within areas of steep slopes, wetlands, and other environmentally sensitive areas if possible.

(6) In new developed areas the landscaping design shall avoid placing landscaping within 10 feet of sewer and water mains.

(7) If existing roadways are involved, the vertical alignment of the road must be evaluated for acceptable geometry and the main designed with respect to possible roadway improvements to avoid costly relocations. Acceptable

geometry shall be determined by use of current roadway design standards. Where existing conditions are substandard, the Designer shall superimpose an improved grade on the profile and shall use this grade in the vertical positioning of the main where applicable to confirm proper cover shall be maintained.

(8) Sewers and appurtenances shall not be placed in existing or proposed future storm water management pond locations.

(9) The maximum distance between manholes shall be 400 feet.

(10) Terminal manholes shall be constructed at the end of sewers which will not be extended in the future, and where the distance to the last manhole exceeds that permitted for the use of a cleanout. Cleanouts may be used where the distance from the center line of the last manhole does not exceed 150 feet.

4. Depth of Sewers

a. All sewers shall be designed to provide a minimum cover of 4 feet above the top of the pipe.

b. Sewers shall be built to a sufficient depth to serve existing and proposed basements, provided sufficient gravity fall exists. The grade of the sewer house connection shall be a minimum of 2 percent unless special permission is given. In such cases, the minimum grade shall be 1 percent. Plans shall be so noted when less than 2 percent slope has been approved and connections shall be appropriately flagged by note. Design of collection sewers shall incorporate an allowance of 2 feet below cellar elevation plus 2 percent fall from the point of departure of the house service from the building to be serviced.

c. Under normal conditions, sewer lines with depths greater than 15 feet will not be approved. If greater depths of sewers are deemed necessary, the design should be thoroughly evaluated and discussed with the County prior to formal submission of the plans for approval. In all cases where subsequent approval is given by the County, the pipe shall be either epoxy-lined ductile iron or C900 DR18 PVC pipe.

5. Separation of Utilities

a. Parallel Installation

(1) A minimum 10-foot horizontal separation (measured from edge of pipe to edge of pipe) between sanitary sewer lines and water lines shall be required when the lines are constructed parallel (relatively) to one another. When this condition cannot be met, concrete encasement of the sanitary sewer line shall be required for the entire length of the line that fails to meet the 10-foot separation distance requirement, at the discretion of the County. However, under no conditions shall the horizontal separation distance between sewer and water lines be less than 5 feet.

b. Line Crossings

(1) A minimum 18-inch vertical separation between the top of the sanitary sewer line and the bottom of the water line shall be required when the lines cross one another.

When this separation cannot be met, concrete encasement of the sanitary sewer line shall be required for a minimum distance of 10 feet on either side of the point of crossing, and/or until the minimum 10 feet separation distance requirement is met (depending on the angle of crossing).

(2) Where a water main crosses below a sewer main, structural support must be provided for the sewer main to prevent any damage to the water main.

(3) These requirements shall apply to laterals (both water and sewer) as well as main line construction.

6. Stream Crossings

a. Where a sewer parallels a water course, the Designer shall ensure that the proposed sewer depth will be adequate to facilitate future crossings of the stream while maintaining a minimum 3 feet cover over any future stream crossings. The centerline of the adjacent stream bottom shall be indicated on the sewer main profile if the sewer is located within 25 feet of the stream.

b. Where sewer mains or laterals cross streams, the crossing shall be as near to 90 degrees as possible and the crossing pipe shall be set at an elevation to provide a minimum of 3 feet cover over the pipe. Epoxy-lined ductile iron pipe, Class 52, shall be used for the stream crossing and shall extend from manhole to manhole on either side of the stream.

7. Borings

a. Bored crossings shall be done in accordance with MDSHA requirements.

8. Connection to Existing Sewer

a. If a new manhole must be designed over an existing sewer the Designer shall refer to the Standard Details.

9. Pipeline Abandonment

a. Sewer pipe less than 12 inches diameter to be cut and a concrete plug installed.

b. Sewer pipe 12 inches diameter or greater to be filled.

Article 6. FORCE MAINS

1. General

a. Ideally, force mains shall be designed without intermediate high points and with the top of the force main being below the hydraulic grade line at the minimum pumping rate so that air release valves will not be required. If high points cannot be eliminated or if the design requires long relatively flat vertical alignments the design may require air release and air vacuum valves.

b. Force mains with intermediate high points above the gravity sewer discharge can create partial vacuum conditions in the force main under certain circumstances. The Designer shall provide appropriate air release and air vacuum valves to protect the force main against damage.

c. Downhill pumping is prohibited.

d. Force mains shall be located within the public road right-of-way whenever possible.

2. Diameter and Slope

a. The diameter shall be determined by the flow required to be conveyed and shall not be less than 4 inches. During the installation of a force main, the pipe shall be laid at a continuously increasing grade to each air release manhole or point of discharge. The Applicant shall provide sufficient construction control to assure that there are no sags or decrease in slope in the force main which could tend to accumulate and trap air.

3. Velocity

a. Design velocities in force mains shall be between 2.5 to 6 feet per second (fps). A minimum velocity of 3 to 3.5 fps shall be required to resuspend any solids within the force main that have multiple high and low points. The maximum velocity shall be based on the ultimate design pumping rate.

4. Depth

a. A minimum cover of 4 feet – 0 inches over the top of the pipe shall be maintained.

5. Separation of Utilities

a. Refer to SECTION 3.4 – SANITARY SEWERS for these requirements.

b. When installed parallel to an existing sewer pipeline 10 feet minimum horizontal clearance shall be provided.

6. Thrust Restraint and Blocking

a. Thrust restraints shall be provided at all tees, bends, wyes, pipe ends or other locations that could become disconnected in the event of a pressure surge.

7. Air Release and Air and Vacuum Valves

a. The use of air release valves and air and vacuum valves will only be considered if it is demonstrated that they are absolutely necessary and that no alternatives are possible.

b. The following requirements shall be followed regarding the placement of combination air and vacuum valves when necessary:

(1) Peaks in pipeline profiles.

(2) Abrupt increases in upward or downward slopes.

(3) Long ascents, descents, or horizontal sections – 1,500 ft to 3,000 feet intervals.

8. Blowoffs

a. Blowoffs are required where the force main contains a depressed section between two high points. Blowoffs shall generally include a valve in a vault and piping to an existing sewer manhole or a separate precast manhole with a sump or hose connection that a pump can be used to drain the force main to a gravity sewer manhole or tank truck.

9. Flushing Connections

a. Flushing connections may be required based on the overall length of the proposed force main. The connection shall be designed to allow the BOU to clean the force main in a manner appropriate to their equipment. Spacing of the flushing connections and size shall be determined by the BOU.

10. Transition Manholes

a. The termination of the force main in the transition manhole shall be designed so that the force main will be always flowing full and shall be designed per the following requirements.

(1) The invert of the gravity sewer shall be designed 1 inch above the crown or top of the force main.

(2) The interior of the gravity sewer pipeline after the force main discharges into the gravity system shall be lined to resist Hydrogen Sulfide corrosion if it is other than PVC pipe.

(3) All transition manholes shall have a watertight frame and cover.

(4) There shall be no branch laterals or SHCs at a transition manhole

Article 7. MANHOLES

1. General

a. Manholes between gravity sewers shall be placed at all pipe intersections and at intervals not greater than 400 feet. Manholes shall be placed at all changes in grade, pipe size,

alignment, at the terminal end of all sewers, at locations along the sewer where future extensions are planned and at transitions from private to public sewer mains.

b. Drop manholes are required if the invert of the incoming pipe is greater than 2 feet above the invert of the outgoing pipe. However, use of drop manholes shall be avoided wherever possible.

c. Unless otherwise noted, manholes shall be constructed of precast concrete with cast iron frames and covers, as shown on the Standard Details. The invert channels shall be smooth and semicircular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be with a smooth curve of as large a radius as the size of the manhole will permit. When a future extension from a manhole is identified in the design process a formed invert channel and a 5 feet long stubbed connection (capped) shall be provided from the manhole.

d. All manholes shall be adjusted to ¼ inch below finished grade in paved areas and 12 inches to 18 inches above grade in rights of way or unpaved areas or as approved by the County. If a manhole is to be in unpaved areas on residential properties, or at the discretion of the County, the cover shall be 2 to 3 inches above grade and the manhole shall be located in areas not subject to ponding or flooding. If the proposed construction includes an existing street or right of way in which the existing grade will be changed, the Applicant shall be responsible for adjusting all existing manholes to finished grade. All adjustments required shall be in accordance with methods approved by the County. Such approval must be obtained in writing prior to construction. When installing manholes in paved areas, temporary paving material shall be gently ramped up to lid and frame and maintained that way until final paving is completed.

e. When the pipe size entering and exiting manholes are the same, a minimum drop of 0.10 feet shall be provided between the invert in and the invert out. For pipelines of differing sizes, the pipeline crowns shall be matched.

f. Lift holes in manholes shall not extend through the entire width of the wall.

g. Exterior and interior surfaces of the manholes must be coated or lined, as described in SECTION 3.6 – MANHOLES.

h. Manholes shall be constructed in accordance with the Standard Details. Shop drawings shall be submitted for approval.

i. Manholes that are installed in field or wooded areas may, at the discretion of the County, be required to have a post installed adjacent to the manhole to serve as a marker.

j. Manholes shall be kept away from inconvenient locations such as curbs, ditches, gutters, swales, vehicular parking areas, athletic and playing fields.

k. Manholes placed in cross-country areas shall be set at a height of 1 foot above grade or as recommended by the Designer based on actual site conditions not to exceed 18 inches above grade elevations.

l. Manholes constructed within a 100-year floodplain shall be raised to the 100-year

floodplain elevation and shall be provided with a watertight frame and cover.

m. An intermediate landing is to be provided for all manholes greater than 18 feet in depth and at 10-foot intervals when the manhole depth exceeds 25 feet. Additionally, the Designer shall consider the following design requirements:

(1) Check manhole for flotation.

(2) Verify that the groundwater pressure on the precast concrete section joints will not exceed the requirements of ASTM C 443 and the Standard Specifications.

(3) Verify that the groundwater pressure on the pipe to manhole connections will not exceed the requirements of ASTM C 923 and the Standard Specifications.

(4) Identify any modifications necessary to the Standard Details because of the manhole depth and groundwater pressure.

2. Drop Manholes

a. All drop manholes shall typically utilize outside drop connections. Inside drop connection may be considered when there is imminent damage to existing utilities or structures in construction of an outside drop connection. Inside drop connections will require the approval of the BOU. There shall be no more than one inside drop connection allowed in any single manhole.

3. Connection to Existing Manholes

a. Existing manholes shall be cored, the invert channel formed, and a field gasket connector installed to secure the new sewer to the existing manhole. Where there is not sufficient clearance between the existing pipe openings in the manhole and the new pipe opening, the Designer may provide a design for the sewer to enter the existing manhole offset from the manhole centerline.

4. Manhole Linings

a. The designer must take into consideration the use of special invert and manhole lining materials when significant Hydrogen Sulfide concentrations are anticipated. Additionally, the use of drop manholes is discouraged when Hydrogen Sulfide is present or likely in the wastewater flow. The use of manhole liners shall be approved by the BOU.

Article 8. SEWER SERVICES

1. Location

a. The County owned portion of the sanitary sewer lateral/house connection shall be built to the property line or edge of the right of way. It is the practice of Carroll County to provide a sewer house connection at the time of initial sewer construction to all properties having frontage on the collector sewer.

b. All laterals/house connections shall be located to readily serve the basement or lowest floor of existing or proposed dwellings or buildings. All SHCs for unimproved lots shall

be located at the low point of the lot.

2. Design

a. General

(1) Sewer laterals shall be designed so that all units shall be served by a minimum 6-inch sewer lateral. Laterals shall be designed with a 2 percent slope and shall include a watertight cap or stopper. Where the rate of slope results in an excessively deep collector or if connection to an existing connector is not possible using 2 percent slope a reduction in the slope to 1 percent may be considered and approved on a case-by-case basis by the BOU. The maximum allowable grade for a sewer lateral shall be 5 percent. All SHCs designed on a grade less than or greater than 2 percent shall be noted on the plans. All sanitary tees shall be set in accordance with the Standard Details using 6-inch bends. The invert elevation of the 6-inch service lateral at the 45-degree bend shall be the same as the elevation of the crown of the main.

(2) Fittings (sanitary tees, risers, and bends) and sewer lateral pipe shall be furnished and installed in strict accordance with these specifications and all practices and precautions required for the main gravity sewers are equally applicable to the sewer laterals.

(3) Sewer lateral shall not be connected to manholes unless approved by County.

b. Depth and Alignment

(1) All laterals shall be provided with a minimum cover of 3 feet – 6 inches. A maximum cover of 7 feet shall be allowed. Laterals shall be constructed, generally, perpendicular to the sanitary sewer main. Laterals shall only be constructed at an angle other than perpendicular to the main when no other reasonable alternative exists, and/or at the discretion and approval of the County.

c. Type

(1) All laterals/house connections shall be of the single service type. Twin laterals/house connections are prohibited except at the approval of Chief of the Bureau of Utilities.

(2) A drop house connection shall be provided when the invert of the SHC at the collector sewer is greater than 2 feet higher than the invert of the collector sewer when the house connection is extended from the house at a 2 percent grade to the main.

d. Separation of Utilities

(1) Parallel Installation

(a) A minimum 10-foot horizontal separation (measured from edge of pipe to edge of pipe) between sanitary sewer lines and water lines shall be required when the lines are constructed parallel (relatively) to one another. When this

condition cannot be met, concrete encasement of the sanitary sewer line shall be required for the length of line that fails to meet the 10-foot separation distance requirement, at the discretion of the County. However, under no conditions shall the horizontal separation distance between sewer and water lines be less than 5 feet.

(2) Line Crossings

(a) A minimum 18-inch vertical separation between the top of the sanitary sewer line and the bottom of the water line shall be required when the lines cross one another. When this separation cannot be met, concrete encasement of the sanitary sewer line shall be required for a minimum distance of 10 feet on either side of the point of crossing, and/or until the minimum 10 feet separation distance requirement is met (depending on the angle of crossing).

(b) Where a water main crosses below a sewer main, structural support must be provided for the sewer main to prevent any damage to the water main.

END OF SECTION

SECTION 2

SECTION 2.1

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EXCAVATION, BACKFILL, AND PROTECTION

SECTION 2.1 - EXCAVATION, BACKFILL, AND PROTECTION

Article 1. GENERAL INFORMATION

1. The excavating contractor (excavator) shall excavate, protect, and refill all trenches and other excavations that may be necessary for construction of the work, or as indicated on the approved drawings and specified herein. Excavation shall be open cut or by trenchless methods subject to approval by the County. Excavations shall, in general, be excavated and backfilled by hand and machinery as the excavator may elect. Where hand excavation is required as shown on the approved drawings, there shall be no claim for extra compensation.

2. The County may require the excavator to determine the presence of rock at the County's discretion. Perform all excavation regardless of the character of the materials to be excavated or condition of the site.

3. Keep all excavations free from water or other liquids during progress of the work. Provide and keep in operation such pumps, drains, ditching, etc., as may be necessary to keep excavations dry and free from water or other liquids. The excavator is completely responsible for adequately controlling water present in the excavation. Disposal of water removed from excavations must be done in such a manner as not to cause damage to public or private property or to any portion of the work completed or in progress. During construction of sanitary sewers and water mains there shall be no discharge into existing sanitary sewers. Manage water on the site in such a manner as to not be in violation of MDE or Carroll County Bureau of Resource Management requirements.

Article 2. REMOVAL AND STORAGE OF SURFACE MATERIALS

1. Remove all surface materials, regardless of the nature, over the line of the trench and the site of the other structures; and shall properly store, guard, and preserve such of the said material as may be required for use in backfilling, resurfacing, repaving, or for other purposes. Pavement shall be cut with a saw, wheel, or pneumatic chisel along straight lines before excavating. All the curb, gutter and flagstone and all paving material which may be removed, together with all materials taken from the trenches, shall be stored in such parts of the roadway or such other suitable place, and in such manner as shall be approved and directed. The excavator shall be responsible for any loss of or damage to curb, gutter, and flagstone and to paving materials through their careless removal or neglectful or wasteful storage, disposal, or use.

2. Remove the paving for such width only as is necessary for the excavation of the trench, as shown on the approved drawings and standard details. No additional payment from the County will be considered for paving removed for a greater width than is deemed necessary, or removed on account of settlement, slides, or caves, or in making excavation outside the line of the work without the written order of the County.

3. When plans of existing facilities are insufficient to accurately locate existing underground obstructions, the Designer shall request permission from the County to perform test pit excavations to uncover the subject facilities so that the horizontal and vertical positions of existing utilities can be accurately determined. If such permission is granted, the Designer shall be responsible for providing all traffic control and public safety measures necessary to locate the utilities and restore the surface. The Designer shall coordinate the test pit operations and provide a field survey crew to physically locate the subject facility.

Article 3. CAUTION IN EXCAVATION

1. All excavations shall proceed with caution and shall use every means to determine the exact location of underground structures, pipelines, conduits, etc., prior to excavation in the immediate vicinity thereof. Excavator shall be held strictly responsible for the repair and/or replacement of any structure, pipeline, conduit, etc., above or below the ground, which may be broken or otherwise damaged by excavation operations.

2. The excavator shall, at its own risk and at no additional expense to the County, maintain, support-in-place, and protect all pipes, poles, cables, utilities, walls, buildings, and other structures or property in the vicinity of its work, whether above or below ground, of that may appear during excavation. The excavator shall be responsible for all damage, shall take all risks, and shall assume all expense for injury or damage, to any person or property of every kind and description, caused directly or indirectly by the work, whether such structures or utilities are or are not shown on the approved construction drawings. In the event that an existing utility line is damaged, notify the County immediately.

Article 4. TRENCHES

1. Trenches shall be excavated to the necessary width and depth as may be shown on the details or as directed. The sides of the trenches shall be practically plumb and under no circumstances will they be permitted to be sloped except within rights-of-way or other easements, and then only with the approval of the County. Bell-holes shall be excavated in the bottoms and sides of trenches wherever necessary to permit the proper making of joints. Any part of the bottom of the trench which may be excavated below the specified grade shall be corrected with screened gravel fill or other approved materials and thoroughly compacted.

2. Where pipes are to be installed near or above existing ground, the fill shall be placed and compacted to an elevation at least two (2) feet above the top of the pipe before the pipe trench is excavated.

3. No greater length of trench in any location shall be left open than is deemed necessary for the work. The County shall be empowered, at any time, to require the refilling of open trenches over completed pipelines. At no point shall a trench of over 150 feet remain open before backfilling.

4. If work is stopped on any trench, for any reason except by order of the County, and the excavation is to be left open for greater than 48 hours in advance of construction, the trench shall be refilled such trench at no cost to the County and shall not again open said trench until ready to resume construction activities. If the excavator refuses or fails to refill such trench the County shall be authorized to do the work and shall charge the expense thereof to the excavator.

5. The excavation of all trenches shall be fully completed at least 20 feet in soil and for at least 25 feet in rock in advance of pipe laying, unless otherwise authorized.

6. In roadway areas, the length of open trench shall be limited to only that length sufficient to advance the trench box or sheeting ahead of the pipe construction operation and to provide a minimum safe working distance between the backfilling operation and the pipe construction operation. No trenches are to be left open at night or weekends. Trenches shall be backfilled or plated in such a manner as to not impede pedestrians or vehicles.

7. Trenches left open and unattended shall be properly secured.

Article 5. ACCOMMODATION OF TRAFFIC

1. Traffic Control Plans shall be prepared and submitted to the County Traffic Engineer for approval.

2. During the progress of the work, sidewalks and crossings shall be kept open for the passage of pedestrians, unless otherwise authorized. Streets shall not be unnecessarily obstructed, and unless the County shall authorize the complete closing of a street, take such measures as may be necessary to keep the street-bed open for traffic at no expense to the County.

3. Construct and maintain such adequate and proper signs, lights, warnings, railings, bridges, and other safety devices over or in the vicinity of all excavations, as may be necessary or directed for the purpose of accommodating pedestrians or vehicles at no additional expense to the County.

4. When a road or street is closed, signs shall be erected at adjacent cross streets to warn traffic and prevent unnecessary delays and annoyance. Such signs shall be kept in place, and lighted at night, as long as the street is closed.

Article 6. ACCOMMODATION OF DRAINAGE

1. Gutters and drains shall be kept open at all times for surface drainage. No damming or ponding of water in gutters or other waterways will be permitted, except to a limited extent where the County shall consider the same necessary and allowable.

Article 7. ROCK EXCAVATION (CLASSIFIED EXCAVATION)

1. Rock Excavation

   a. Any material shall be considered rock, which, in the judgment of the County, cannot be excavated except by drilling and blasting, or drilling and wedging. All foundations of concrete or of brick or stone, laid in cement mortar, will be classified as rock, if the volume requiring removal at any single location is more than one-half (1/2) cubic yard. This classification is not intended and shall not be extended to include materials which can be removed by means other than drilling and blasting, or drilling and wedging, but which, for reasons of economy in excavation, the excavator prefers to remove by drilling and blasting.

   b. Soft or disintegrated rock, which can be removed by pick and shovel; or boulders; or existing foundation less than one-half (1/2) cubic yard in volume; or previously blasted rock; or rock outside of the maximum limit of measurement, which may have been loosened in previous excavation, which by reason of loosening, may fall into the trench, will not be measured, or allowed for as rock excavation.

   c. Rock shall be stripped for measurement as directed by the County before excavating, and no rock excavated or loosened before measurement will be allowed or paid for as rock.

   d. Unless otherwise directed, rock shall be fully taken out at least twenty-five (25) feet in advance of the laying of pipe, and in accordance with Standard Details. Only rock actually removed shall be paid for, and in no case will allowance be made for rock removed outside the Standard Details measurements, unless such rock shall have been taken out by written directions of the County. Rock shall be removed sufficiently at

joints so that they may be properly made. The space below the bottom of the pipe shall be filled with selected clean earth, free from rock or stones, and thoroughly tamped, as shown on Standard Details, or with granular material if ordered by the County.

2. Earth Excavation

   a. All excavation not considered as rock, as defined above, will be considered as earth excavation. Existing paving will be considered as earth excavation.

3. Blasting

   a. Prepare a detailed Blasting Plan for approval by the County.

   b. Only small amounts of explosives shall be kept at any one place, and they shall be kept under lock, the key to be only in the hands of a trustworthy person. Great care shall be taken in handling dynamite and similar explosives during freezing weather. Caps and exploders shall not be kept in the same place as explosives. Blasting shall be done only by qualified blasters and all blasts shall be properly and securely covered.

   c. The excavator shall be solely responsible for injury to persons or property that may result from the use of explosives, and the exercise of, or failure to exercise, control on the part of the County, shall in no way relieve the excavator of responsibility for injury or damage resulting from their use. The excavator shall obtain any and all permits necessary for the use of explosives, and he shall comply with all laws and ordinances governing the same at no expense to the County.

Article 8. EXCAVATION

1. Excavation Below Subgrade

   a. Wherever the character of the material at the bottom of an excavation is such as to require excavation to an additional depth for any purpose except for the construction of a timber foundation or the laying of an underdrain, or wherever a trench has been excavated by machinery, to the grade directed by the County, and they deem it necessary, either on account of a change in plan or because they had previously given the wrong grade, to excavate deeper, such additional depth shall be known as "Excavation Below Subgrade"; provided, however, that no such excavation that may be taken out by default or negligence on the part of the excavator shall be so classed, and that no allowance will be made for earth excavation and refill below subgrade in rock cuts.

   b. Except as modified above, subgrade shall be termed the underside of the pipe or foundation bedding material as stipulated in the approved drawings.

2. Preparation of Foundation

   a. Complete excavations in earth as nearly as practicable to the neat lines of the structures to be built therein. All irregularities and cavities, either in earth or rock excavation, and the bottom of trenches or tunnels, shall be filled up to the required level with screened gravel fill or other approved material, firmly compacted, before pipelines are laid therein, and without extra compensation, unless said cavities have been formed by the direction of the County and their excavation classed as "Excavation Below Subgrade".

b. The excavator shall be responsible for the condition of all excavations made by them. All slides and caves shall be removed without extra compensation, at whatever time and under whatever circumstances they may occur.

c. No pipe shall be laid upon a foundation into which frost has penetrated nor at any time when the County shall deem that there is danger of the formation of ice of the penetration of frost at the bottom of the excavation unless all required precautions as to a minimum length of open trench and promptness of refilling are observed.

3. Bracing and Sheeting

a. Support the sides and ends of all excavation wherever necessary, or directed, with braces, sheeting, shores, or stringers of the quality and character herein specified. All excavation, trenching and related sheeting, bracing, etc., shall comply with the requirements of OSHA excavation safety standards (29 CFR Part 1926 Subpart P) and MOSHA requirements. Where conflict between OSHA and MDSHA regulations exists, the more stringent requirements shall apply.

b. Where sheeting and bracing is required to support the sides of trenches, engage a professional engineer, registered in the State of Maryland, to design the sheeting and bracing.

c. When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support the sides of the trench, care shall be taken in placing and moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and the screened gravel backfill.

d. Ladders, extending from floor of trench excavation to not less than three (3) feet above the top ground surface, shall be placed in trench excavation at intervals of fifty (50) feet, to be used as a means of entrance and exit therefrom.

e. All timbering in excavations shall be withdrawn as the refilling is being done, except where and to such extent as the County shall order in writing that said shoring be left in place or where County permits the same to be left in place at the excavator's request and expense.

4. Miscellaneous Excavation and Test Pit

a. Complete such miscellaneous excavation work as may be necessary or directed. This may include the digging of test pits, extra width of trench made necessary by change in its location, or excavation for any special structure, outside the trench, that may not be shown on the approved drawings or described in the specifications, where such excavation is done at the direction of the County. Such excavation shall be subject to the same conditions and requirements as specified for trench excavations.

b. Test pits shall be dug wherever directed. Their depth and size shall be such as shall be required by the County. Test pits may be dug without being directed to do so along the lines of excavation as shown on the approved drawings in advance of the excavation to verify the location of underground obstructions. Test pits dug without written order of the County will not be paid for by the County.

5. Dewatering Excavations

a. All excavations must be kept free of water below the subgrade of work while work is in progress. This can be accomplished by ordinary pumping methods, use of underdrains, or by well points, whichever is necessary to keep the excavation in-the-dry. The method used to accomplish this dewatering must be approved by the County.

6. Change of Excavation Location

a. In case the County shall direct that the location of a trench be changed to a reasonable extent from the proposed on the approved drawing, on account of the presence of an obstruction, or from other cause, or if a changed location shall be authorized upon request; the excavator shall not be entitled to extra compensation or to a claim for damage, provided that the change is made before the excavation is begun. If, however, such change, made at the direction of the County, involves the abandonment of excavation already made, such abandoned excavation, together with the necessary refill, will be classed as miscellaneous excavation and refill. In case the full width of excavation has not been abandoned, but the full width of the trench has been abandoned, the excavation and refill shall be classed as excavation and refill for trenches of the size and depth excavated. In the event that the opening is abandoned in favor of a new location at the excavator's request, the abandoned excavation and refill shall be at the excavator's expense.

b. If an obstruction shall lie within the opening in such a manner that it has to be excavated to extra width, such extra width shall be classed as miscellaneous excavation and refill.

7. Maintenance of Backfilled Excavations

a. Maintain all refilled excavations regardless of location for a period of 1 year following the date of the construction completion. All depressions appearing in the backfilled excavations shall be properly backfilled. If the excavator shall fail to do so within 24 hours after the receipt of written notice from the County, the County shall backfill said depressions and the cost thereof shall be deducted from any monies due or to become due the excavator or charge the expense thereof to the excavator. In case of emergency, the County shall refill any dangerous depression without giving previous notice to the excavator, and the cost of so doing shall be expensed to the excavator.

b. The excavator shall be responsible for any injury or damage that may result from improper maintenance of any backfilled excavations, at any time to the end of the maintenance period. The excavator shall be directly responsible for continuous maintenance of all backfilled excavations made along roads or streets accommodating traffic. These trenches shall be thoroughly compacted to within 8 inches of the finished grade. The final 8 inches of backfill shall be Crusher Run Stone or compacted Bank Run Gravel, as directed by the County.

Article 9. BACKFILL

1. Select Backfill

a. Select backfill may be utilized for easement areas only, or as directed by the County, and after 12 inches of AASHTO No. 57 stone pipe bedding has been laid.

b. Select backfill shall be made normally with the earth removed from the trench or excavation, provided that, in the opinion of the County, the excavated material is suitable for backfilling. Suitable material for select backfill shall be construed as material of a

classification that will pass a 2-inch sieve one hundred 100 percent and compact readily when the usual methods of tamping are used. Unsuitable material shall be construed as clay, material that will not crumple under light hand pressure, frozen materials, ashes, cinders, and putrescible or other refuse.

c. Should the excavated material be considered unsuitable material, remove and dispose of the material from the site at no expense to the County. Suitable select backfill material excavated elsewhere in the same project may be utilized at the discretion of the County. If additional select backfill material is required, procure and substitute locally available material as necessary to complete the work at no expense to the County.

d. All backfill materials, including select backfill used, shall contain a sufficient amount of moisture for proper compaction. These materials shall be compacted to not less than the specified density indicated in paragraph EXCAVATION BACKFILL. Upon completion of the backfilling of the trenches included in any area of the project, the County may make tests to determine the degree of compaction of the backfill material. If the results of any tests show that the backfills are not compacted sufficiently as specified, the conditions shall be remedied, or material replaced in such portions of the trenches as are represented by the unsatisfactory tests.

e. After completion of backfilling, all material not used therein shall be removed and disposed of in such a manner and at such point(s) as approved by the County. All roads, sidewalks, and other places on the line of the work shall be kept clean and free of excess material. If the excavator fails to perform faithfully within reasonable time after receipt of notice, it will be performed by the County, and the cost thereof shall be charged to the excavator.

2. Excavation Backfill

a. Backfill all trench and structure excavations immediately upon completion of laying the pipelines, building the structure, or immediately after the excavations have served their purpose. Any unauthorized excavations made shall be immediately backfilled at no expense to the County. No backfilling operations shall commence until approved by the County.

b. In general, the quality of backfilling materials shall be the same materials as previously excavated and as approved by the County. No ashes, putrescible matter, refuse, large stones, or rock and/or other unsuitable materials as determined by the County, for backfilling trenches or structure excavations shall be employed for this operation. It is expressly prohibited to use the excavation as a dumping ground or disposal area.

c. The jetting or puddling of backfill for trench or structure backfill is prohibited. In the event backfill materials do not possess the optimum moisture content, and are excessively dry as determined by the County, clean water shall be added at an approved rate and quantity, and thoroughly blended with the soil to achieve the proper moisture content for compaction.

d. Any materials encountered during the excavation work which, in the opinion of the County, cannot be compacted to an approved density and optimum moisture content, after being placed or replaced in the excavation and backfilled as specified herein, shall be completely removed from the work sites, and replaced with acceptable materials as approved by the County.

e. Backfilling operations over pipelines, connections branches, specials of any character, or any

part of the structure or work which requires field location for record purposes, shall not commence until the required pay measurement or record location has been made by the County. Any such backfilling operation made without authorization shall be carefully removed at no expense to the County.

f. If damage to the constructed pipeline or structure occurs during either authorized or unauthorized backfilling operations, all required corrections and/or replacements shall be at no expense to the County. No backfilling operations shall commence until the joint has been made and approved, or in the case of structures, all waterproofing or damp-proofing has been inspected and approved.

g. All excavations shall be refilled to the original ground surface or specified elevations or grades as the Plans, Details, Standard Specifications and Details, or County may direct.

h. In backfilling all trenches and irrespective of the pipe material, the approved backfill material shall be carefully placed under and around the pipe in 8 inches (±2 inches) measured loose-layered lifts to a line 2 feet above the top of the pipe and carefully placed by hand methods. After placement of each layer, compaction and ramming shall be accomplished with mechanical vibrators and rollers, rammers, tampers, or other approved special tools manufactured for this express purpose. This backfill shall be compacted to not less than 95 percent of standard density as determined by the AASHO Methods, Compaction and Density of Soils, T-180, unless otherwise specified (modified proctor). The County may perform compaction tests on the initial or subsequent backfill layers to be assured of adequate compaction. In the event the specified density and moisture content is not achieved, carefully remove the backfilled material, and repeat the operations until the specified compaction, density, and moisture content are approved.

(1) All costs related to removal of unacceptable and unapproved backfill and repeating compaction operations shall be the full responsibility of the excavator. If replacement and re-compaction is required, it shall be completed at no expense to the County.

(2) The backfill from 2 feet above the top of the pipe to the indicated upper limit as shown on the Standard Details or as specified in the Special Conditions and Permits shall be placed by hand or machinery methods in the measured loose lifts, spread evenly for the full length and compacted as specified below:

(3) In state roads paving, shoulders and for the full width of the excavated right-of way, the compaction shall be full height trench compaction to the specified and required elevation. Such refill shall be placed in 8 inches (±2 inches) measured loose lifts, and each lift compacted to not less than 95 percent of standard density as determined by the AASHO Methods, Compaction and Density of Soils, T-180 (modified proctor), unless otherwise specified in the Special Provisions. Testing for compliance shall be as previously specified.

(4) All backfill shall be compacted to not less than 95 percent of AASHO designation T-180 maximum density (modified proctor), in layers not exceeding 6 inches loose depth with mechanical tampers. Puddling will not be permitted. Backfill shall be well tamped under the haunches of the pipe and shall be compacted evenly on each side of the pipe. After completion of backfilling, clean-up and dispose of all excess materials, and repair any damage caused by operations.

(5) In existing or acquired utility rights-of-way and/or easements, select backfill may be used. The remaining backfill shall be placed in successive horizontal layers not exceeding 8 inches in depth (loose measurement) and shall be compacted with suitable rollers to not less 95 percent of maximum density value as determined with the latest AASHO Method, Compaction and Density of Soils, T-180 (modified proctor). When the embankment is constructed over swampy ground, the first layer of the fill may be made by depositing material in a layer no thicker than that required to support the equipment. Subsequent layers to be constructed as described above.

3. Fill and Backfill Around Structures

a. Special consideration shall be given to fill and backfill around structures above the foundation inside a 2-foot strip adjacent to the structures as specified hereinafter in this paragraph.

b. Fill and backfill around all structures shall be placed in compacted layers not exceeding 6 inches in thickness and each layer shall be compacted by mechanical tampers or light vibratory compactors to the applicable required densities specified hereinbefore. Compaction by rollers or heavy equipment is prohibited within this 2-foot strip adjacent to the structures.

4. Flowable Backfill

a. Flowable Backfill meeting the requirements of MDSHA *Standard Specifications for Construction and Materials Section 314 – Flowable Backfill for Utility Cuts* may be used as an alternative to backfilling with stone. Material consists of a mixture of cement and water which shall have a 28-day unconfined minimum compressive strength of 100 psi based on the manufacturer's certification and shall be placed in accordance with the manufacturer's recommendations.

Article 10. CONCRETE ENCASEMENT

a. Pipes to be encased in concrete shall have a minimum of 6 inches of concrete above and below the pipe and the concrete shall extend for the full width of the natural trench. No formwork to limit the concrete width shall be used. Flexible pipe joints shall be provided in the pipe at a distance of three times the pipe diameter from the ends of the concrete encasement, to provide pipe articulation. Pipes shall be protected against flotation during placement of concrete encasement. This may require two stage concrete placements combined with anchor straps.

Article 11. REPAVING, REPAIRING ROADS AND STREETS

1. Complete final resurfacing or repaving of streets and roads over the excavations made. Excavator shall also be responsible for and bear the cost of resurfacing or repaving over any unauthorized excavations that are made, or of repairing or relaying paving, surfacing, or roadbeds, outside of authorized excavations, that have failed or been damaged, at any time before the end of the project, on account of work done by excavator; and shall likewise bear the expense of resurfacing or repaving over any tunnel excavation that shall settle enough to break the surface.

2. After pipelines have been constructed and backfill material has been thoroughly consolidated, replace road surface to such extent as the directed by the County. The replacement of all roadway material shall be in accordance with the standards and methods prescribed in the permit issued by

the State Highway Administration and/or County Roads Department which permits are made a part of the project.

Article 12. SODDING

1. Sod in areas shown on the approved drawings, as directed by the County, or as specified hereinafter. Sod shall be supplied in strips not less than 1-foot wide. Sod shall be taken only from fields not less than 3 years old and have been previously mowed with a lawn mower. Sod shall be of sufficient thickness to prevent excessive breakage and shall be stripped in the largest practical widths and lengths.

2. After construction operations are complete and the trench consolidated to the satisfaction of the County, approved topsoil shall be placed over the disturbed area, trimmed, and raked to lines of the previous grade, with a minimum depth of 3 inches. All roots, boulders, or other debris shall be removed, and a finely pulverized bed shall be formed. Commercial fertilizers known as 5-10-5, the above figures refer to the available percentages of nitrogen, phosphoric acid, and potash, delivered in bags or other containers with name of material, weight, and analysis on each bag or container, shall be spread at a rate of 30 pounds per 1,000 square feet and raked or harrowed into the top 2 inches of the topsoil.

3. Sod shall then be placed and rolled or tamped, properly leveled and immediately well sprinkled. All sod not in good condition after in place shall be removed and resodded.

4. On banks or slopes over 2:1 slope, sod shall be staked or pegged in place.

5. Maintain all areas until final acceptance. Any re-grading, re- fertilizing, or re-sodding, which may be required due to erosion, gullies, washouts, or other causes, shall be done at no expense to the County. Any areas which fail to show a "catch" or uniform stand for any reason whatsoever, shall be re-sodded at no expense to the County.

6. Any damage done to the area outside the width specified shall be repaired without any claim for additional compensation.

7. Sod all residential type lawns disturbed by construction operations in accordance with the preceding paragraphs.

Article 13. SEEDING AND MULCHING

1. After topsoil has been placed as specified hereinafter under paragraph STRIPPING AND STORING TOPSOIL, seed those disturbed areas outside of paved roads and shoulders which prior to construction were grassed areas, or where directed by the County.

2. All other disturbed areas shall be seeded and mulched as follows:

    a. Trench shall be seeded and mulched after each 1,000 linear feet of pipe installation.

    b. If the excavator shall cease operations for a period of 5 or more working days, seed and mulch all disturbed areas prior to the shut-down.

    c. Seeding and mulching shall conform to "2011 Maryland Standards and Specifications for

Soil Erosion and Sediment Control" and the erosion and sediment control plan approved by the Carroll Soil Conservation District.

d. Residential lawns shall be reseeded with a seed mixture consistent with the existing lawn.

Article 14. PROTECTION OF PROPERTY AND STRUCTURES

1. The excavator shall, at their own expense, sustain in their place and protect from direct or indirect injury, all pipes, poles, tracks, walls, buildings, and other structures or property in the vicinity of the work, whether above or below the ground, or that may appear in the trench. The excavator shall take all risks attending the presence and proximity of pipes, poles, tracks, walls, buildings, and other structures and property, of every kind and description in or over the trenches or in the vicinity of the work, whether above or below the surface of the ground; and shall be responsible for all damage and assume all expense for direct or indirect injury, caused by the work to any of them, or any person or property by reason of injury to them, whether such structures are or are not shown on the approved drawings.

2. Preserve and protect trees and other vegetation designated on the approved drawings or directed by the County to remain. No cutting of large roots or tap roots will be permitted.

Article 15. USE OF CALCIUM CHLORIDE FOR DUST CONTROL

1. Calcium Chloride shall be spread at the rate of approximately 2 pounds to the square yard of trench surface. Spreading can be done either by hand or machine method.

2. Calcium Chloride shall only be used in public rights-of-way if, and as, required, and shall be done with the written approval of the County.

Article 16. STRIPPING AND RESTORING TOPSOIL

1. Topsoil shall be defined as the top 6 inches of existing earth. Where topsoil exists and in areas where the pipe is to be laid, it shall be stripped, stored, and restored to such area after excavation and backfilling of pipe trenches are completed. All finished grades of the disturbed area shall match the finished or undisturbed grades of the adjoining area.

Article 17. MAINTENANCE OF TOP SURFACES

1. The excavator is specifically reminded of the detailed requirements of paragraph MAINTENANCE OF BACKFILLED EXCAVATIONS and the Standard Details with respect to installation, and maintenance of crusher run stone surfacing.

2. Each morning during the life of the project, ascertain from the Weather Bureau whether precipitation in the form of rain or snow is imminent in the next 24 hours. If such precipitation is imminent, the following procedures shall be strictly adhered to:

   a. An inspection of the previously filled trench surfaces shall be made daily at the beginning and close of each working day.

   b. Should there be any settlement or erosion of the crusher run stone topping due to precipitation, immediately furnish and install such additional mechanically compacted material as may be required to restore the surface to its required and specified line, grade, and cross section.

c. Such inspections and additionally installed materials shall be repeated daily as necessary and as directed until acceptance of the work in writing by the County has been made.

d. The same provisions as enumerated above shall govern and be employed in the event there is trench and/or topping settlement for any other cause that modifies the previous restoration of line grade and cross section of the trench surface.

3. The same provisions shall also apply in utility easements when the trench top surfacing is topsoiled, sodded, seeded, and mulched. Additional topsoil and vegetative cover shall be furnished as required.

Article 18. CRUSHER RUN STONE

1. Furnish and place crusher run stone CR-6 as specified to the thickness shown on the approved drawings and where directed by the County. In general, crusher run stone shall be placed over trenches in road shoulders and over trenches in State and County roads. No stone shall be placed in lawn areas or areas to be topsoiled and seeded.

2. Crusher run stone will be measured and paid for as specified under other sections of these specifications.

Article 19. DRIVEWAYS

1. Unless otherwise specified, all driveways shall be restored to a condition equal to that existing prior to start of construction. All driveways shall be temporarily repaired by placing a topping of crusher run stone to a minimum thickness of 4 inches, which shall be maintained for a minimum of 15 days before any necessary permanent repaving is placed. In the case of stone driveways, no further repair other than that provided for temporary repair will be required provided the temporary repair is at least equal to that existing prior to construction.

Article 20. REPAVING

1. Existing paving, disturbed by the excavator's operations, shall be replaced in accordance with the Standard Details attached to the Specifications and the road permits attached thereto.

2. Materials to be utilized in connection with trench repaving for streets other than State Roads shall conform to those noted under the appropriate paving type in the Maryland State Highway Administration Specifications and in accordance with the attached Utility Permit of the County Commissioners of Carroll County.

a. As soon as the utility installation and refill have been completed in or adjacent to public or private roads, place crusher run stone to a depth of 12 inches for improved roadways and 4 inches in all other locations such as dirt roads, earth shoulders, and sidewalks. Normally, this crusher run surface shall be allowed to settle for a period of approximately 30 days before any permanent repaving is undertaken. The County may direct that repaving be accomplished prior to or later than the 30 days noted above. This election will not, however, relieve any guarantee requirements connected with this work.

b. Prior to the installation of permanent repaving, any temporary paving shall be removed. If settlement results in depths more than permanent paving thickness, it will be the excavator’s responsibility to add crusher run stone at their own expense to bring the ditch to the proper cross section for the installation of paving. After this has been done, permanent paving of the type specified shall be installed. Generally, bituminous concrete

repaving shall be utilized in bituminous concrete streets.

c. There will be no additional compensation for crusher run stone or other materials used to repair failures in the work. All paving quantities shall be based on the trench widths shown for repaving in the Standard Details. Any damaged or undercut areas resulting in trenches wider than specified or shown in the Standard Details shall be replaced by the excavator at their own expense for the quantity more than the standard trench width.

END OF SECTION

SECTION 2.2

TABLE OF CONTENTS

WATER MAINS

SECTION 2.2 - WATER MAINS

This section provides specifications pertaining to construction of water mains and appurtenances thereto.

Article 1. GENERAL INFORMATION

1. The installer shall furnish all materials for and shall construct the pipelines, and all required appurtenances at the points and to the lines and elevations shown on the approved drawings, required in the Standard Specifications and Details, or designated by the County. All pipe and fittings shall be laid true to the lines, slopes and elevations set and the direction given from time to time as the work proceeds.

2. The County shall furnish all meters.

3. The size of the water mains shall be as shown on the approved drawings. Water mains, unless otherwise noted on the approved drawings, shall be cement lined ductile iron (DI) pipe.

4. Municipal castings shall be made in Accordance with the Maryland Steel Products Procurement Act. All Manufacturers must be listed and or approved by the Maryland State Highway Administration and Carroll County Maryland. All must meet or exceed the latest published version of AASHTO M306 standard specifications for Drainage, Sewer, Utility and Related Castings.

5. All water mains and appurtenances must carry approval of ANSI/NSF Standard 61.

6. All pipes, fittings, valves, and appurtenances shall be lead-free.

Article 2. MATERIALS AND EQUIPMENT

1. Ductile Iron Push-on Joint Pipe

    a. Ductile iron pipe shall be in accordance with the Standard Specification as set forth in the ASTM A746 and in accordance with the standard specification as set forth in ANSI Specification A21.50 or AWWA Standard C151. Thickness design shall be per AWWA C150, except provide thickness Class 52 unless the Designer determines that an alternative special thickness class is required due to a special application.

    Alternates must be calculated in accordance with the method provided in AWWA Standard C150/ANSI A.21.50. The thickness of the selected class shall be equal to or greater than Class 52, as the calculations require. Pipe thickness, in combination with pipe bedding, must be sufficient to resist excess deflection and bending stress, compensate for negative manufacturing tolerances and withstand internal operating and surge pressures. Calculations shall be performed conservatively, based on using a Type 1 Laying Condition. Where field conditions are expected to be moderate, the unit weight of soil shall be 120 pounds per cubic foot and the truck load shall be a single AASHTO H-20 truck on an unpaved road or flexible pavement with a 1.5 impact factor. An appropriate trench bedding detail shall be provided on the plans. Consideration should be taken into account for the following applications not covered by the Standard Specifications.

        (1) Shallow cover, less than 3 ½ feet.

        (2) Vehicular or equipment loading greater than AASHTO H-20 or HS-20 load

configurations.

(3) Excessive surge pressures.

b. All pipe of the same material and size shall be furnished by the same manufacturer. Each pipe length and fitting shall be clearly marked with the manufacturer's name and trademark.

c. If potentially corrosive materials are encountered, polyethylene encasement shall be installed to protect ductile iron pipe in accordance with ANSI/AWWA C105/A21.5.

d. Ductile iron pipe shall be by U.S. Pipe and Foundry Company, American Ductile Iron Pipe Company, Griffin Pipe Products Company, or approved equal.

2. Ductile Iron Joints and Fittings

a. Joints shall be of the push-on type or mechanical joint type in full accordance with ANSI A21.11 or AWWA C111 Specifications.

b. Mechanical joint retainer glands shall be selected for restraining the mechanical joint of ductile iron pipe for field closures. Retainer glands, when used for restraint, shall be ductile iron with twist-off nuts to ensure proper actuating of the restraining devices and coated with a minimum two coats of epoxy coating. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to ANSI/AWWA A21.11 and ANSI/AWWA C153/A21.53 of latest revision. Retainer glands shall be manufactured by EBAA Iron Inc., Ford Meter Box Company, Inc., SIGMA Corporation, Star Pipe Products, Tyler Union, or approved equal. The minimum number of restrained joints required for resisting forces at fittings and changes in direction of pipe shall be determined from the length of restrained pipe on each side of fittings and changes in direction necessary to develop adequate resisting friction with the soil. Required lengths may be shown on the approved drawings.

c. The employment of properly designed concrete thrust blocks and anchors at fittings is of great importance. Details of thrust blocks and anchors are included in the Standard Details and are to be used in all cases compatible with design conditions. Where field conditions do not permit the use of thrust blocks and anchors, restrained joints using tie rods or harnessing may be employed.

d. Sleeve type couplings shall be ductile iron mechanical joint solid sleeves.

e. Ductile iron fittings shall have a minimum pressure rating of 250 psi and shall conform to ANSI A21.10 (AWWA C110) and shall be cement mortar lined as specified below.

f. Fittings used with ductile iron pipe shall be furnished with mechanical joint ends conforming to ANSI A21.11. Mechanical joint fittings shall be furnished complete with ductile iron glands, carbon steel bolts and nuts as per ASTM A307, and plain rubber gaskets.

g. Flanged fittings, for exposed piping and/or when specified, shall conform to ANSI A21.10 or ANSI B16.1. All flanges shall be faced and drilled in accordance with ANSI B16.1. Machine bolts and nuts for flanged fittings shall be steel, conforming to ASTM Designation A307, Grade B. Dimensions of bolts and nuts shall conform to ANSI B18.2. Threads of bolts and nuts shall conform to ANSI B1.1, Coarse-Thread Series, Class 2A fit

on bolts, and Class 2B fit on nuts. Gasket for flanged connections shall be red sheet rubber or 1/16" thick cloth insertion rubber full face type and shall be the flat ring type. Dimensions of gaskets shall conform to ANSI B16.21.

h. All fittings shall be cement-mortar lined, paint seal coated inside, and bituminous coated outside, conforming to AWWA C104. Fittings shall be manufactured by American Cast Iron Pipe Company, Griffin Pipe Products Company, SIGMA Corporation, Star Pipe Products, Tyler Union, US Pipe & Foundry, or approved equal.

i. Wall and/or floor pipe penetrations shall be made by means of a sleeve capable of being bolted directly to the formwork to prevent misalignment. Seal of the annular space between the carrier pipe and the sleeve shall be by means of a confined rubber gasket and capable of withstanding 350 psi. Sleeve shall be manufactured from ductile iron with an integrally cast water stop of ½ inch minimum thickness and 2½ inch minimum height. Wall sleeves shall be Omni Sleeve or approved equal.

3. Linings and Coatings for Ductile Iron Pipe and Fittings

a. Cement mortar linings shall be in accordance with ANSI Specification A21.4 or AWWA C104, except the thickness of the linings shall not be less than the following:

Pipe Diameter	Thickness
3 inches through 12 inches	1/8 inches
14 inches through 24 inches	3/16 inches

b. Buried pipe shall be installed with a bituminous coating in accordance with AWWA C151 and C110 respectively.

c. Buried pipe in corrosive or hydric soils, as determined by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) soil survey or site-specific geologic survey, shall be installed with polyethylene encasement conforming to AWWA C105, where indicated on the approved drawings or as directed by the County. The polyethylene sheet shall be 8 mils thick minimum and shall be manufactured by American Cast Iron Pipe Company, US Pipe & Foundry, or approved equal.

4. PVC Pipe

a. PVC pipe shall be in accordance with the ANSI/AWWA Standard C900. Pipe shall conform to AWWA C900 pressure class DR 18 or 235 psi.

b. PVC C900 pipe shall be by JM Eagle, North American Pipe Company, National Pipe & Plastic, Diamond Plastics, or approved equal.

c. PVC gaskets shall meet ASTM F477, and joints shall be in compliance with ASTMD3139.

d. Detectable warning tape shall be polyethylene film encasing a metallic core, minimum 6 inches wide and 4 mils thick, color-coded blue for water, bearing in black letters, the continuous legend “CAUTION – WATER LINE BURIED BELOW”.

e. For locating PVC water mains, continuity test stations shall be located adjacent to each fire hydrant within the public easement, and tracer wire shall be installed continuously along all PVC water mains. See Standard Details. All tracer wire shall be taped to the top of the pipe with minimum 2-inch-wide x ½ pipe circumference long PVC tape every four feet

along the pipe. The copper wire shall be continuous for the full length of the pipeline including all hydrant leads and shall terminate at continuity test stations. Copper tracer wire shall be manufactured by Kris Tech Wire Company, Pro-Line Safety Products, Copperhead Industries, or approved equal. Where required splicing shall be done with direct bury splice kit listed and labelled for direct bury, installed as recommended by manufacturer and taped to the pipe. After backfilling test the tracer wire to demonstrate electrical continuity throughout the length of the PVC line installed. Tracer test boxes shall be manufactured by Bingham & Taylor, Copperhead Industries, or approved equal. All tests shall be performed in the presence of the County or a designated representative. Any discontinuity shall be located, repaired, and retested at no expense to the County until full continuity is achieved.

f. PVC high deflection couplings shall be rated for a minimum 200 psi meeting the requirements of AWWA C900, shall have a minimum lay length of 9-inches and shall have center stops. PVC high deflection couplings shall be CertainTeed PVC High Deflection (HD) Stop Couplings or approved equal.

g. 5-degree sweeps shall be bell by spigot, rated for a minimum 225 psi, DR 18 meeting the requirements of AWWA C900 and shall be Multi Fittings (Ipex) Blue Brute DR 18 or approved equal.

h. PVC bell stop shall be manufactured of ductile iron and incorporate an expansion retention spring to allow for pipe expansion and contraction. The bell stops shall be Series 5000 Mega-Stop, as manufactured by EBAA Iron, Inc. or approved equal.

i. Restraint for PVC pipe bell (AWWA C900) shall consist of the following:

(1) The restraint shall be manufactured of ductile iron conforming to ASTM A536 and coated with a minimum two coats of epoxy (MEGA-BOND by EBAA Iron, Inc., or approved equal).

(2) A split serrated ring shall be used behind the pipe bell. A split serrated ring shall also be used to grip the pipe, and a sufficient number of bolts shall be used to connect the bell ring and the gripping ring as recommended by the manufacturer. The restraint will be subject to the same pressure requirements (working and test) of the water main. The restraint shall be the Series 1500, as manufactured by EBAA Iron, Inc., or approved equal.

5. HDPE Pipe

a. HDPE pipe shall be high density, extra high molecular weight (EHMW) polyethylene with a standard thermoplastic material code of PE3608 and have a cell classification of 45464C per ASTM D3350. The pipe shall be manufactured in accordance with ASTM F714 and/or ASTM D3035. The pipe shall meet the Utility Location and Coordination Council, "Uniform Color Code," per APWA/ULCC Standards Committee. The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects. Black pipe with colored striping shall be acceptable for water mains or force mains.

b. The material shall be listed by the Plastics Pipe Institute (PPI), a division of The Society of the Plastics Industry in PPI TR-4. The pipe material shall have a Hydrostatic Design Basis of 1600 psi at 730F and 800 psi at 1400F. The PPI listing shall be in the name of the pipe manufacturer and testing and validation of samples of the pipe manufacturer's production

pipe shall be based upon ASTM D2837 and PPI TR-3.

c. The manufacturer's certification shall state that all pipe used on this project was manufactured from one specific resin in compliance with these specifications. The certificate shall state the specific resin used and its source.

d. Pipe and fittings shall be manufactured from material meeting the requirements of this section. Pipe supplied under this specification shall have a nominal IPS (Iron Pipe Size) outside diameter unless otherwise specified. The Dimension Ratio (DR) and pressure rating of the pipe at 73° shall match the following unless noted otherwise on the drawings:

DR 7.3 - 250 psi	DR 13.5 - 130 psi	DR 21 - 80 psi
DR 9 - 200 psi	DR 15.5 - 110 psi	DR 26 - 65 psi
DR 11 - 160 psi	DR 17 - 100 psi	DR 32.5 - 50 psi

e. The pipe and fittings shall have product traceability. The manufacturer shall include a printline on the pipe. This shall notate the manufacturer's name, date of manufacture, the lot and supplier of raw material, plant location, and production shift. The ASTM standard shall also appear as ASTM F714 with the material designation as PE3608. The printline color shall be contrasting to the overall pipe color.

f. Fittings shall be manufactured according to ASTM D 3261. Both pipe and fittings shall carry the same pressure rating. All fittings shall be pressure rated to match the system piping to which they are joined. At the point of fusion, the outside diameter and minimum wall thickness of the fitting shall match the outside diameter and minimum wall thickness specifications of ASTM F714 for the same size pipe. Fittings shall be manufactured by the manufacturer of the pipe. For force mains /reclaimed water mains or pressure rated fittings, all fittings shall be de-rated according to the manufacturer's written specifications, and clearly labeled on the fitting as such. For gravity or sanitary sewer, either direct bury or insertion lining fittings will be fully pressure rated. All fittings will have a quality control label as approved by the manufacturer. The fitting shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects.

g. Flanged and Mechanical Joint Adapters:

(1) Flanged and Mechanical Joint Adapters shall be PE 3608 HDPE, Cell Classification of 345464C as determined by ASTM D 3350 and be the same base resin as the pipe. Flanged and mechanical joint adapters shall have a manufacturing standard of ASTM D 3261. All adapters shall be pressure rated to provide a working pressure rating no less than that of the pipe.

h. Mechanical Restraint:

(1) Mechanical restraint for HDPE may be provided by mechanical means separate from the mechanical joint gasket sealing gland. The restrainer shall provide wide, supportive contact around the full circumference of the pipe and be equal to the listed widths. Means of restraint shall be machined serrations on the inside surface of the restrainer equal to or greater than the listed serrations per inch and width. Loading of the restrainer shall be by a ductile iron follower that provides even circumferential loading over the entire restrainer. Design shall be such that restraint shall be increased with increases in line pressure.

(2) Serrated restrainer shall be ductile iron ASTM A 536 with a ductile iron follower;

bolts and nuts shall be corrosive resistant, high strength alloy steel. The restrainer shall have a pressure rating of, or equal to that of the pipe on which it is used or 150 PSI whichever is lesser. Restrainers shall be JCM Industries, Sur-Gripor pre-approved equal.

(3) Pipe stiffeners shall be used in conjunction with restrainers. The pipe stiffeners shall be designed to support the interior wall of the HDPE. The stiffeners shall support the pipe's end and control the "necking down" reaction to the pressure applied during normal installation. The pipe stiffeners shall be formed of 304 or 316 stainless steel to the HDPE manufacturers published average inside diameter of the specific size and DR of the HDPE. Stiffeners shall be by JCM Industries or pre-approved equal.

6. Gate Valves

a. Isolating valves shall be gate valves unless specified otherwise.

b. Gate valves shall be iron body, bronze mounted, resilient seated, wedge type and shall conform to AWWA C509. Valves 12 inches and smaller designed for 200 psi working pressure, shall pass 400 psi test. Valves 16 inches and larger designed for 150 psi working pressure, shall pass 300 psi test.

c. Valves shall be vertical, inside screw, non-rising stem with 2-inch operating nut. Valves shall open counterclockwise and shall be fitted with double O-ring stem seals and be suitable for buried applications. Valves shall have mechanical joint ends and shall have fusion-bonded epoxy coating inside and outside.

d. Position and by-pass and gearing requirements on 16 inches and larger, may be specified according to individual job requirements.

e. Acceptable manufacturers: Mueller Company, M&H, Kennedy Valve, or approved equal.

f. Where valves are placed on the end of a pipeline, a length of pipe shall be laid on the closed end and carefully plugged and blocked.

g. All internal ferrous components and surfaces of the valves, except for stainless steel and finished or bearing surfaces, shall be shop painted with two coats (10 mils min. dry film thickness) of the manufacturer's premium fusion bonded epoxy for corrosion resistance. Epoxy shall be NSF 61 compliant for potable water service valves. Damaged surfaces shall be repaired in accordance with the manufacturer's recommendations.

7. Butterfly Valves

a. Isolating valves 16 inches and larger, or valves used for throttling shall be butterfly valves.

b. Butterfly valve body and disc shall be cast iron (ASTM A126) or ductile iron (ASTM A536) and conform to AWWA C504. Valves 16 inches and larger designed for 150 psi working pressure, shall pass 300 psi test.

c. Valve shaft shall be one or two-piece, mechanically secured to disc, capable for mechanical separation from disc without damage to shaft or disc. Bearings shall be self-lubricating. Shaft seals/packing shall be self-compensating V-type primary means,

with multiple O-rings for up to 24 inches and pull-down seals using a square braid of graphite fiber for over 24 inches.

d. Valve shall be retained by bolted retainer plate or gland (clips are not acceptable) for up to 24 inch and retained by stuffing box with follower gland for over 24 inches. Replacement must be possible without removal of valve from line, and adjustment must be possible without disturbing actuator assembly for over 24 inches. Retaining rings shall be ASTM A276 Type 316 stainless steel.

e. Seats shall be EPDM, Buna-N, or neoprene elastomer. Seats must be resilient type, field adjustable and replaceable. For body mounted seats, supply machined metal seating edges on disc. Seats must be mechanically retained and adjustable with common tools for valves larger than 24-inch. For disc mounted seats, fasten with a segmented or one-piece machined metal retaining ring installed in the valve body, with self-locking bolts or set screws, fully adjustable with common tools.

f. Gear actuators for manual valves must comply with AWWA C504.

g. Acceptable manufacturers: Crispin, Keystone Valve, M&H, Mueller Company, or approved equal.

h. All internal ferrous components and surfaces of the valves, except for stainless steel and finished or bearing surfaces, shall be shop painted with two coats (10 mils min. dry film thickness) of the manufacturer's premium fusion bonded epoxy for corrosion resistance. Epoxy shall be NSF 61 compliant for potable water service valves. Damaged surfaces shall be repaired in accordance with the manufacturer's recommendations.

8. Air Release Valves

a. Air release valves shall conform to AWWA C512 specifications (latest edition) and shall be combination type.

b. Valves shall be sized as follows:

(1) 1-inch on mains 12 inches or less

(2) 2-inch on mains greater than 12 inches

c. Connecting the air release valve, air vacuum valve or combination air release and vacuum valve to the main pipeline shall be as follows:

(1) For a valve with a 2-inch inlet or smaller use a tapped corporation stop.

(2) For a valve with a 3-inch inlet or larger or on water mains 24 inches and larger in diameter use a tapping sleeve and valve.

(3) The air release valve, vacuum valve or combination air release and vacuum valve shall be centered on a 20-foot length of pipe with both ends of the pipe section having the same elevation.

d. Air release valve manhole and valve construction details is shown in the Standard Details. The following information shall be shown on the plans for air valves: size of the valve and orifice size. The following shall be shown on the plans for combination air release and air vacuum valves:

(1) Size of both valves.
(2) Orifice size of the air release valve.
(3) Model number(s).
(4) Piping layout.
(5) Pressure rating of the gate valve which shall be provided between the air vacuum valve and the air release valve.

e. Acceptable manufacturers: Apco/DeZurik, Crispin, Val-Matic, or approved equal.

9. Valve Boxes

a. Underground valves shall have extension-type, roadway-type valve boxes. Valve boxes shall be cast iron and shall be two-piece telescoping screw-type construction. Valve boxes shall have 5-1/4-inch shafts, shall have covers marked "WATER", and shall be coated inside and out with a tar or asphalt compound. Valve boxes shall be manufactured by Bingham & Taylor, East Jordan Iron Works, Tyler Pipe, or approved equal.

b. All valves having a depth greater than 8 feet from the top of operating nut will have an extension installed to 4 feet.

10. Tapping Sleeves and Valves

a. Tapping sleeves shall be ductile iron construction meeting ASTM A536 Grade 65-45-12, designated for working pressure not less than 200 psi. Armored end gaskets shall be provided for the full area of the sleeve flanges. Sleeves shall be as manufactured by Romac, Smith Blair, Tyler Pipe, JCM Industries, Mueller, American Flow Control, or approved equal. Nuts and bolts shall be Type 304 stainless steel.

b. Tapping valves shall conform to the requirements specified above for gate valves except that one end shall be flanged and one mechanical. Tapping valves shall be provided with an oversized opening to permit the use of full-size cutters.

11. Fire Hydrants

a. All fire hydrants shall comply with AWWA Specifications C502 and the following design specifications:

(1) Fire hydrants shall be of the compression type, closing with the line pressure with a 5 ¼-inch opening.

(2) The depth of bury shall be the same as that specified for the pipe.

(3) Hydrants shall be furnished with a seal or an oil/grease reservoir located in the bonnet so that all threaded and bearing surfaces are lubricated when hydrant is operated.

(4) All hydrants shall be furnished with an epoxy coated shoe. Size and type of shoe shall be determined by the size and type of pipe used or approved equal.

(5) Hydrants shall have at least two drain outlets.

(6) Hydrants shall be furnished with a breakable feature that will break cleanly upon

impact. This shall consist of a two-part breakable safety flange or breakable lugs with a breakable stem coupling. Breakable bolts are not allowed.

(7) The inlet connection shall be a 6-inch, Class 250, mechanical joint bell.

(8) Hydrants shall be three way and match existing threads and component parts presently employed.

(9) Flow loss of approved hydrants shall not exceed 500 gpm, 1.35 psi through two simultaneous 2 ½-inch hose nozzles, and 4.45 psi through a 4 ½-inch pumper nozzle at 1,000 gpm.

(10) All hydrants shall have a barrel I.D. of no less than 7 inches and shall have a barrel or standpipe wall thickness of 9/16 inches below grade.

(11) Exposed hydrants exterior shall be painted with corrosion-resistant epoxy gloss coating, color OSHA Red. Primer coat shall be Duron Dura Clad Terminator 2, White #7121811, or approved equal. Finish coat shall be Duron Dura Clad DTM Acrylic Coating, High Gloss Red or Sherwin-Williams Red Gloss Finish Industrial Enamel Paint, or approved equal.

(12) Fire hydrants shall be Kennedy Valve Co. (Model K-81), Mueller Co. LLC (Model A423), or approved equal.

12. Sampling Station

a. Sampling stations are to be provided where indicated by the County.

b. Sampling stations shall have 3/4-inch FIP inlet and a 3/4-inch hose or unthreaded nozzle.

c. All stations shall be enclosed in a lockable, nonremovable, aluminum-cast housing.

d. When opened, the station shall require no key for operation, and the water will flow in an all-brass waterway.

e. All working parts will also be of brass and be removable from above ground without digging. Exterior piping shall be brass or galvanized.

f. A copper vent tube will enable each station to be pumped free of standing water to prevent freezing and to minimize bacteria growth.

g. Sampling station shall be manufactured by Kupferle Foundry, Model Eclipse No. 88, or approved equal.

13. Pressure Reducing Valves

a. System PRVs are comprised of two PRVs, one to handle peak fire flows and the other to handle low flows. Usually, the smaller PRV is adjusted for a discharge pressure setting of 5 psi above the setting of the larger PRV so that the smaller PRV will handle

the low flow requirements. The large PRV opens only when demands exceed the capacity of the smaller PRV and the pressure drops to the pressure setting of the large PRV.

b. The PRV shall automatically throttle to reduce a higher incoming pressure and maintain an accurate and constant lower downstream pressure regardless of changing flow rate and/or inlet pressure. If downstream pressure increases above the pilot spring setting, the valve shall close. When the outlet pressure is greater than the inlet pressure, the valve shall permit return flow.

c. 3-inch and larger PRVs shall have flanged ends and the pressure rating shall be designed similar to gate valves, class 125 ANSI valves. PRVs, smaller than 3-inches, shall have threaded ends (National Pipe Threads). The setting information for the PRVs shall be noted on the plans.

d. The valve shall be hydraulically operated, single diaphragm actuated, globe pattern. The valve shall consist of three major components; the body with seat installed, the cover with bearing installed and the diaphragm assembly. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating the operating pressure from line pressure. Packing glands, stuffing boxes and/or rolling diaphragm technology will not be permitted and there shall be no pistons operating the main valve or pilot controls. No fabrication or welding shall be used in the manufacturing process. Y-pattern valves shall not be permitted. Main valve shall comply with NSF/ANSI Standard 61 and certified lead free to NSF/ANSI 372 as a safe drinking water system component.

e. The pressure reducing pilot control shall be a direct-acting, adjustable, spring-loaded, normally open, diaphragm valve designed to permit flow when controlled pressure is less than the spring setting. The pilot control is held open by the force of the compression on the spring above the diaphragm and it closes when the delivery pressure acting on the underside of the diaphragm exceeds the spring setting. The pilot control system shall include a strainer and a fixed orifice closing speed. No variable orifices shall be permitted. The pilot system shall include an opening speed control on all valves sizes 3” and smaller as standard equipment. The pilot control shall have a second downstream sensing port which can be utilized to install a pressure gauge. A full range of spring settings shall be available in ranges of 0 to 400 psi. Pilot shall comply with NSF/ANSI 61 and certified lead free to NSF/ANSI 372 as a safe drinking water system component.

f. The pilot control system shall include a strainer and a fixed orifice closing speed. No variable orifices shall be permitted. The pilot system shall include an opening speed control on all valves sizes 3” and smaller as standard equipment. A full range of spring settings shall be available in ranges of 0 to 400 psi. Pilot to be manufactured by control valve manufacturer.

g. A vault shall be designed to house the system PRV and appurtenances. An equipment access opening of sufficient size shall be designed directly over the center of the PRV. Where two PRVs are required, the hatch shall be placed over the larger of the two PRVs. A personnel access hatch shall be provided with a 30-inch by 30-inch opening. Hatches shall be designed as watertight and capable of sustaining an H-20 load.

h. Gate valves shall be provided on each side of the PRV for maintenance or removal of

the PRV. Typically, the PRV shall be located on a branch line off the primary water main between to connections. The branch from the first tee extends through the PRV vault and back to the second tee connection at the primary main. A divisional gate valve, normally closed, is installed between the two tee connections on the primary main which acts as a bypass line to the PRV and vault.

i. Material Specification for the Pressure Reducing Control Valves Main Valve as follows:

Component	Material
Body & Cover	Ductile Iron-ASTM A536
Main Valve Trim	Stainless Steel
Seat	Stainless Steel
Stem, Nut and Spring	Stainless Steel
Seal Disc	Buna-N® Rubber
Diaphragm	Nylon Reinforced Buna-N® Rubber
Internal Trim Parts	Stainless Steel: Bronze; Brass
End Detail	Threaded NPT (<3"); Flanged (3" – 36")
Pressure Rating	Class 150 lb. (250psi Max.)
Temperature Range	Water to 180°F
Any other wetted metallic parts	Stainless Steel; Bronze; Brass
Coating	Fusion Bonded Epoxy Coating (Interior and Exterior); ANSI / NSF 61 Approved / AWWA coating specifications C116-03.
Accessories	Position Indicator, Opening Speed Controls, Isolation Valves, Gauges.

j. Material Specification for Pilot Control:

Component	Material
Body & Cover	Bronze, UNS C87850
Pilot Trim	Brass & Stainless Steel 303
Rubber	Buna-N®
Connections	FNPT
Pressure Rating	400 psi Max.
Temperature Range	Water to 180°F Max.
Control Tubing	Stainless Steel
Control Fittings	Stainless Steel

k. Pressure reducing valve shall be manufactured by Cla-Val, Series 90; Golden-Anderson, 5450 Series; Zurn, ZW209 Series; or approved equal.

14. Blow-Off Hydrant & Vault

a. Blow-off hydrant shall have 2-inch vertical FIP inlet and 2-inch NPT outlet. Hydrant shall fit in 5 ¼-inch valve box and shall be non-freezing and self-draining.

b. Hydrant shall be operated by turning a top-mounted 9/16-inch square operating nut counterclockwise to open, clockwise to close. Hydrant must seal the drain outlet in all positions from ¼ open to fully open.

c. All internal working parts, the inlet, and the outlet shall be brass. All working parts shall be serviceable from above with no digging required. Disassembly must be accomplished with no turning forces applied to the hydrant barrel.

d. All wear parts (O-rings and valve seat) shall be of commonly available dimensions and material, and none may be of vendor unique design.

e. Hydrant shall be model TF500 as manufactured by Kupferle Foundry Co., or approved equal.

15. Steel Casing Pipe

a. The steel casing pipe shall have a minimum yield strength of 35,000 psi, have a thickness as required but not less than 0.375 inches, be equipped with grout holes and conform to AWWA C200 and ASTM A53. A corrosion allowance of one gauge shall be used in design calculations. Casing interior and exterior shall be painted with two coats bitumastic enamel coating in accordance with AWWA C203. Pipe cradles or isolators shall be as shown on the approved detail drawings, APS casing spacers, Model SSI, or approved equal.

Article 3. INSTALLATION

1. Connections to Existing System and Interruptions of Service

a. The County shall be notified at least 10 working days before installing connections to the existing system or shutting off a portion of the system. Under no circumstances shall the valves on the existing system be operated by anyone other than the Carroll County Bureau of Utilities staff.

b. The County reserves the right to designate the day and time when water mains may be shut off and may require that this work be done at night or on a weekend. In addition, the County reserves the right to require that, where service to customers is interrupted, work is carried out continuously and expeditiously until water service is restored. The installation schedule and procedure shall be approved by the County before the work is started, and all necessary materials, tools and equipment shall be on hand before work is started. Where required, the new water mains shall be tested, disinfected, and flushed prior to the installation of the connections. Written notification of service disruption shall beprovided to the County and all affected residents and businesses a minimum of 48 hours in advance of the disruption.

c. Test pits to determine the exact location, elevation, diameter, and type of the existing pipe shall be excavated under the supervision of the County.

2. Excavation and Backfill

a. Refer to requirements set forth in SECTION 3.1 – EXCAVATION, BACKFILL, AND PROTECTION

3. Pipeline Installation

a. General

(1) This Section covers the installation of the water mains, complete with all fittings,

valves, reaction backings and/or harnessing, connections and appurtenances. Installation shall be performed as specified in AWWA Standard for Installation of Ductile Iron Water Mains (C600), AWWA Standard for Installation of PVC Water Mains (C605), or where otherwise specified herein.

(2) All pipe and fittings shall be inspected and approved by the County prior to placement.

(3) Pipe, fitting, valve, and hydrant interiors shall be kept free of soil, and other foreign matter at all times. Watertight plugs shall be used in pipes when pipe is not in the process of being placed, as applicable. Fire hydrants and valves shall be drained and stored so that they are protected from damage by freezing.

(4) Gaskets for use with mechanical joints, push-on joints, and flanged joints shall be stored in a cool location out of direct sunlight, as shall rubber/resilient seats for valves and hydrants. Gaskets and seats must not come into contact with petroleum products, ozone sources, engine exhaust, sanitary waste, or cleaning solvents. Gaskets shall be used on a first in first out basis.

(5) During construction, pipe, fittings, valves, and hydrants shall be placed as near as practical to the joint where it will be laid. Sufficient support shall be provided so that neither end touches the ground and so that movement is prevented.

(6) Any damage to existing utilities caused by installation of mains shall be immediately repaired to the satisfaction of the County at no expense to the County.

b. Responsibility for Material

(1) The County shall not be responsible for materials, and materials found defective in manufacture or damaged in handling, as determined by the County, and shall be replaced at no expense to the County. Any materials found defective shall be promptly removed from the site. Defective pipe shall be classified as follows:

(a) Damage to interior or exterior paint seal coats.

(b) Damage to interior cement-mortar lining.

(c) Insufficient cement-mortar lining thickness.

(d) Poor quality interior paint seal coat causing a partial obstruction in the pipe round.

(e) Pipe out of round.

(f) Damaged pipe barrel area causing a reduction in effective pipe thickness.

(g) Any material that is dropped during handling, regardless of its apparent condition.

c. Handling of Material

(1) Pipe shall be so handled that the coating and lining is not damaged. If any part of the coating or lining is damaged, the repair shall be made to the satisfaction of the

County. Valves and hydrants shall be stored and kept dry before installation. Any material that is dropped during handling is subject to rejection regardless of its apparent condition.

d. Alignment and Grade

(1) Where the proposed pipeline route is on a curve, the pipe may be deflected at the joints to published manufacturer's tolerances. Where underground conditions require a change of alignment or grade, such change shall be made only with the written consent of the County. When a change in grade is indicated which will result in the pipe having more cover than originally anticipated, the class of pipe installed at the location shall withstand the new loadings.

(2) Except at predesignated points, no high points shall be established where air can accumulate. If field conditions necessitate a change in the pipe profile and, in the opinion of the County, the change requires the installation of an air release valve and manhole, installation of the same shall be ordered at no expense to the County.

e. Cleaning Pipe and Fittings

(1) Pipe shall be cleaned of any foreign matter prior to installation. Additionally, all lumps, blisters, and excess coating shall be removed from the end of each piece of pipe and fitting. The outside of the spigot, the inside of the bell, and the gasket shall be thoroughly wiped clean and dry before the pipe is installed. All damaged coatings shall be repaired in accordance with the manufacturer's recommendations

f. Laying Pipe

(1) No pipe shall be laid when, in the opinion of the County, trench or weather conditions are unsuitable. No wedging or blocking will be permitted unless permission is obtained from the County. When pipelaying is not in progress, the open ends of installed pipe shall be closed by approved means to prevent entrance of trench water and foreign material into the line. Enough backfill shall be placed in the center sections of the pipe to prevent floating. Any pipe that has floated shall be removed from the trench and re-laid.

(2) No pipe shall be laid upon a foundation into which frost has penetrated, nor at any time when the County shall deem that there is danger of the formation of ice or the penetration of frost at the bottom of the excavation, unless all required precautions as to the minimum length of open trench and promptness of refilling are observed.

(3) Pipe cuts shall be made by machine and shall be at right angles to the axis of the pipe. If cut ends are to be used with a matching bell end, cut ends shall be beveled to conform to the manufactured spigot end. When applicable cement lining shall be undamaged.

(4) The County shall direct placement of additional fittings in addition to those shown on the approved drawings as required to avoid existing utilities or obstructions encountered when opening the trench.

(5) Pipe Clearance in Rock

(a) Ledge rock, boulders and large stones shall be removed to provide a clearance of at least 6 inches below and on each side of all pipe and fittings for pipes 24 inches in diameter or smaller, and 9 inches for pipes larger than 24 inches in diameter.

(b) The specified minimum clearances are the minimum clear distances which will be permitted between any part of the pipe and/or fitting being laid and any part, projection or point of rock, boulder, or stone.

(6) Joints

(a) All joints shall be made in accordance with the pipe supplier's specifications and in accordance with the following instructions:

(b) Push-on Type Joints

i. Cleaning and assembly of push-on joints shall be in accordance with AWWA C600 and C605, and as specified herein.

ii. File or grind the spigot on field cut pipe lengths to resemble the pipe as manufactured so that the spigot end will slip into the socket intact without hindrance or gasket damage. Place an identifying mark on pipe that is not furnished with a depth mark on the spigot to show the depth of the socket.

iii. Assemble joints in accordance with AWWA C600 and C605. Clean with soapy water the inside of the socket and outside of the spigot and the pipes to be jointed to obtain clean, smooth surfaces free of foreign materials. Apply a thin film of gasket lubricant furnished by the joint manufacturer to the inside surface of the gasket and to the outside surface of the spigot. Enter the spigot into the socket up to the depth mark, using equipment designed for the purpose.

(c) Mechanical Joints

i. The cleaning, assembly, and bolting of the mechanical joint shall conform to AWWA C600 and C605. Bolts on mechanical joints shall be inserted and made hand tight and then tightened alternatively to bring the gland into position evenly. Excessive tightening of the bolts shall be avoided. All nuts shall be pulled up using a torque wrench which will not permit unequal stresses in the bolts. Torque shall not exceed the recommendations of the manufacturer of the pipe and bolts for the various sizes. Care shall be taken to make sure the pipe remains fully "home" while the joint is being made.

ii. Assemble joints in accordance with AWWA C111, C600, C605 and as specified herein. Clean with soapy water and lubricate contact surfaces with vegetable oil soap. Slip the gasket over the spigot end in the bell. Complete the joint by alternate tightening of proper number, size, and length bolts 180 degrees apart with a torque wrench set to the range listed below, so that the gland and face of the flange present parallel faces during the procedure. The first bolt to be tightened shall be at the bottom of the joint. Second shall be at the top of the joint and so on.

iii. Where satisfactory sealing of the joint is not attained at the maximum permissible torque, disassemble, reclean, and reassemble the joint with a new gasket.

(d) Flanged Joints

1. Flanged joints shall not be used for buried service except at a tapping sleeve/valve joint.

2. Flanges shall be wiped clean with a solvent-soaked rag prior to installation. The gasket shall also be wiped clean.

3. The pipe, fittings and valves shall be properly supported during installation.

4. All flanges shall be properly aligned and checked with a spirit level, both horizontally along the pipe and vertically across the flange faces.

5. With flanges secured in position, half the bolts shall be inserted at the bottom of the flange, the gasket inserted between the flanges, and the remaining bolts inserted.

6. The threads of the bolts shall be given a light coating of thread lubricant, and the nuts shall be installed on the bolts and turned up by hand. The nut shall be tightened with a wrench by the crossover method to load the bolts evenly until the joints are tight.

(7) HDPE Joints

(a) Butt Fusion: Sections of polyethylene pipe should be joined into continuous lengths on the jobsite above ground. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements of 400-450 degrees Fahrenheit, alignment, and an interfacial fusion pressure of 75 PSI. The butt fusion joining will produce a joint weld strength equal to or greater than the tensile strength of the pipe itself. All field welds shall be made with fusion equipment equipped with a McElroy Data Logger, or equal. Temperature, fusion pressure, and a graphic representation of the fusion cycle shall be part of the quality control records.

(b) Sidewall Fusion: Sidewall fusions for connections to outlet piping shall be performed in accordance with HDPE pipe and fitting manufacturer's specifications. The heating irons used for sidewall fusion shall have an inside diameter equal to the outside diameter of the HDPE pipe being fused. The size of the heating iron shall be ¼ inch larger than the size of the outlet branch being fused.

(c) Mechanical: Bolted joining may be used where the butt fusion method cannot be used. Flange joining will be accomplished by using a HDPE flange adapter

with a ductile iron back-up ring. Mechanical joint joining will be accomplished using either a molded mechanical joint adapter or the combination of a Sur-Grip Restrainer and Pipe Stiffener as manufactured by JCM Industries, Inc., or approved equal. Either mechanical joint joining method will have a ductile iron mechanical joint gland. Mechanical couplings shall be installed in accordance with the mechanical coupling manufacturer's recommended procedures.

(d) Other: Socket fusion, hot gas fusion, threading, solvents, and epoxies may not be used to join HDPE pipe.

g. PVC Specific Pipe Laying

(1) Proper assembly of gasketed PVC pipe joints:

(a) The manufacturer's insertion line of gasketed PVC pipe joints indicates the maximum depth of insertion of the spigot into the bell. After assembly of the joint, the insertion line shall remain visible. Dual insertion lines on gasketed PVC pipe indicate the maximum and minimum depth of insertion of the spigot into the bell. The installer shall not over insert or over home the spigot into the bell of the PVC pipe.

(b) All changes in horizontal or vertical direction of PVC water pipe shall be made with standard bends, 5-degree sweeps or high deflection (HD) couplings. No bending of the pipe for deflecting of PVC pipe joints is permitted. Where high deflection couplings or 5-degree sweeps are permitted, the installer shall provide one full pipe length on either side of the high deflection coupling or 5-degree sweep. Use a vibratory plate compactor or other approved means to thoroughly compact the backfill on both sides of the high deflection coupling or 5-degree sweep, taking care not to use compaction equipment directly over the fitting.

(c) PVC high deflection couplings shall be limited to a total deflection of 3-degrees (1 ½-degree on either end of the coupling).

(d) When PVC high deflection couplings or PVC 5-degree sweeps are used to facilitate changes in horizontal or vertical alignments of AWWA C900 PVC pipelines, install devices for the prevention of over-insertion of the PVC pipe spigots or plain ends into the push on bell joint on both sides of the high deflection couplings and 5-degree sweeps. Bell stops shall be placed at the proper insertion line for the fitting.

4. Setting Valves and Valve Boxes

a. All valves shall be set vertical and shall be provided with a valve box. The boxes shall be fitted together securely, and the tops of boxes shall be set 1/4-inch below finished grade, unless directed otherwise by the County. Valve and fitting installation shall be in accordance with AWWA C600 and C605.

b. Install valves in accordance with the Standard Details for Construction and at the locations shown on the approved drawings or as directed by the County.

c. All valves shall be properly supported so that the adjacent pipe is not required to support

the weight of the valve. All adjacent pipes shall be properly supported so that no loading is transferred to the valve.

d. All valves shall be furnished and installed with stainless steel hardware.

e. All valve boxes shall be placed so as not to transmit shock or stress to the valve and shall be centered plumb over the operating nut of the valve. The ground in the trench upon which the valve boxes rest shall be thoroughly compacted to prevent settlement.

f. After installation, but prior to pressurization of the valve, use a calibrated torque wrench, adjusted to the manufacturer's recommendations, to inspect all pressure-containing bolting (bonnet, seal plate, packing gland, and end connections).

5. Setting of Hydrants

a. Fire hydrants shall be installed as specified in AWWA C600 and C605 at a minimum burial depth of 4 feet, and placement shall comply with the International Fire Code. Where there is curbing, the hydrant shall be a minimum of 2 feet from the edge of curb. Where there is no sidewalk or curb, the hydrant shall be not less than 6 feet from the edge of paved road surface. In no case will hydrants be located closer than 25 feet to a building except where building walls are blank fire walls. Hydrants shall not be located closer than 3 feet to any obstruction, or in front of entrance ways. All hydrants shall stand plumb, with the pumper nozzle facing the curb, and the hose nozzles parallel to the curb as shown on the approved detail drawings. The vertical variance between the manufacturer's recommended bury grade line and finish grade shall not exceed 4 inches. The hydrants shall be firmly set on a bed of screened gravel, which shall extend down 1-foot below the bottom of the hydrant and be filled around it. The total amount of gravel used shall be not less than ¼ cubic yard. The hydrant shall be firmly braced at the back, opposite the inlet pipe.

b. Where hydrants are to be relocated, determine whether or not the hydrant valve has been restrained before removing the hydrant to be relocated. If necessary, the lead shall be capped and blocked so that service can be restored to the parent main pending the removal of or plugging of the mainline tee.

6. Installation of Tapping Sleeves

a. Maintain a minimum separation of 24 inches from the near end of sleeve to adjacent joints or fittings. For PVC pipe 14 inches and larger, maintain a minimum separation of 36 inches from near end of sleeve to adjacent joints or fittings.

b. Clean any dirt, corrosion, or foreign material from pipe.

c. Lubricate gasket and install sleeve.

d. Tighten sleeve bolts in accordance with manufacturer's recommendation using a torque wrench that has been properly calibrated.

e. Install tapping gate valve to sleeve using the appropriate gasket, nuts, and bolts. Apply blocking to support the valves suspended weight.

f. Test the valve and sleeve assembly using the tapping sleeve test port. Using potable water as the test medium, bring the pressure up to the test pressure and hold for 5 minutes. No

leakage shall be permitted during the test period.

g. After attaching the sleeve to the existing main, but prior to making the tap, disinfect all surfaces to be in contact with potable water by swabbing with a 50-ppm chlorine solution.

h. Attach the drilling machine to the tapping valve and provide proper mating and alignment between the valve and the machine by using blocks and shims secured in place.

i. Perform the tap. Stresses induced during tapping may relax bolt torque; recheck tapping sleeve bolt torque and recheck torque on bolts connecting sleeve and valve. Tapping equipment shall be supported so that the sleeve does not support the weight of the equipment.

j. Provide concrete thrust block in accordance with standard details.

k. Make connection between new main and tapping valve. To prevent undue stress on the tapping sleeve and valve assembly, the new main shall be installed such that it rests on a well compacted bed with its centerline axis matching the centerline axis of the tapping valve.

l. Where required by the County, provide valve vault in accordance with the appropriate standard details.

7. Anchorage

a. All plugs, caps, tees, and bends (both horizontal and vertical) shall be provided with concrete reaction backings or approved restrained joint system. Where the water mains must be tested before connections to existing mains can be installed, temporary reaction backings or restrained type plugs shall be installed.

b. The County's approval shall be obtained for the anchorage of the pipe and fittings at each connection, or at any other locations designated by the County. The County reserves the right to require mechanical joint retainer glands in addition to concrete reaction backings.

c. Hydrant bases shall be braced against undisturbed earth with reaction backings, or shall be restrained with restrained joints, in a manner approved by the County. Tie rods or clamps are also acceptable.

8. Backfilling

a. Installed pipe shall always have sufficient cover to protect it from the equipment that will cross it. The installer shall replace pipe that, in the opinion of the County, has been subjected to excessive loading. This shall be done at no expense to the County.

b. Compacted clay dikes shall be installed along the water main alignment at an interval not to exceed 300 feet, at the downstream side of stream crossings and at the upstream and downstream limits of wetlands crossings. Dikes shall extend the full width of the trench and shall be a minimum length of 5 feet. Dikes shall extend vertically from undisturbed ground at the bottom of the trench to 2 feet below final grade. Clay shall contain no more than 15 percent stone by volume.

c. Refer to additional requirements set forth in SECTION 2.1 – EXCAVATION, BACKFILL AND PROTECTION.

9. Surface Restoration

   a. The installer is responsible for the cost of replacing paving surfaces of roadbeds that have failed or have been damaged by the installer at any time during the work completed by the installer. Resurface or repave over any trench or tunnel excavation that settles.

   b. In state highways surface restoration shall be in accordance with MDSHA requirements, or as specified in the MDSHA permit issued for the subject project.

   c. In County roads, paved areas or other traffic areas surface restoration shall be in accordance with County requirements.

10. Bored Crossings

   a. Tolerances for installation of the casing pipes shall be as follows:

      (1) Elevation: to grade or a maximum of 9 inches below grade.

      (2) Plan Location: plus or minus 1-foot.

   b. The carrier pipes shall be supported within the casing pipes so that the pipe bells do not rest directly on the casing. The load of the carrier pipes shall be distributed along the casing by the method of support shown on the approved detail drawings.

   c. All work shall be performed in conformance with the requirements of MDSHA or other regulatory agencies involved.

Article 4. TESTING, DISINFECTION, AND INSPECTION

1. General

   a. This Section covers the testing and disinfection of the water mains. A schedule and procedure for the testing and disinfection of the different parts of the work shall be prepared and submitted to the County for approval two weeks before beginning the testing and disinfection. Testing and disinfection shall be performed promptly and efficiently without interference to the system operation. A minimum 24-hour notice shall be given before testing any main.

   b. Testing and disinfection of the various sections of water mains shall begin promptly upon the completion of a section of work unless the County approves otherwise. County inspection shall be done prior to backfilling the work. The County reserves the right to limit the amount of water main to be tested.

   c. The County reserves the right to change waterline testing as necessary to meet governing regulations.

2. Pressure Test

   a. General

      (1) After the pipe has been laid and backfilled as specified, all newly laid pipe or any test section thereof shall be subjected to a hydrostatic pressure of 150 pounds per

square inch, or 150% of the normal working pressure, whichever is greater in accordance with AWWA C600 and C605. The duration of each pressure test shall be 2 hours.

(2) Where any section of a water main is provided with concrete reaction backing, the hydrostatic pressure test shall not be made until at least five days have elapsed after the concrete reaction backing was installed.

(3) Air release valves shall be installed but isolated during testing of the pipeline.

b. Procedure

(1) Each section of pipe shall be slowly filled with water and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the County. The pump, pipe connections, and all necessary apparatus, including gauges, shall be furnished by the installer and are subject to approval by the County. Make all taps into the pipe and furnish all necessary assistance for conducting the tests. Valves shall not be operated in either the opening or closing direction at differential pressures above the rated pressure. The system shall be stabilized at the test pressure before conducting the leakage test.

(2) Expelling Air Before Test

(a) Before applying the specified test pressure, all air shall be expelled from the pipe. If permanent air vents are not located at all high points, the necessary taps shall be made at such points before the test. After the test has been completed, remove and plug the taps or leave them in place at the direction of the County.

(3) Examination Under Pressure

(a) Any cracks or defective pipes, fittings, or valves discovered in consequence of this pressure test, shall be removed, and replaced at no expense to the County, and the test shall be repeated.

(4) Testing Allowance

(a) Testing allowance shall be defined as the quantity of makeup water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 psi of the testing pressure. The maximum volume of makeup water shall be calculated by the following formula:

$$L = \frac{SD\sqrt{P}}{133{,}200}$$

Where:
L = volume of allowable makeup water [gph]
S = length of pipe tested [ft]
D = nominal diameter of the pipe [in]
P = test pressure [psig]

During the 2-hour test period, the test shall be deemed successful if the required volume of makeup water does not exceed the allowable volume as calculated above.

3. Disinfection

a. General

(1) Before being placed in service, all pipe installed shall be disinfected in accordance with AWWA C651.

b. Form of Chlorine for Disinfection

(1) Either liquid chlorine, sodium hypochlorite solution or calcium hypochlorite granules or tablets shall be used for disinfection in accordance with AWWA C651, Section 2.

c. Application of Chlorine

(1) One of the three methods of chlorination (continuous-feed method, tablet method and slug method) specified in AWWA C651 Section 5 shall be used for disinfection. The method most suitable for the given situation shall be used and shall be reviewed with the County's representative before application. The continuous-feed method is suitable for general application. The tablet method is suitable for use in pipes smaller than 24 inches in diameter and only if the pipe is kept clean and dry. The slug method is suitable for use in large diameter pipes where the volume of water involved makes the continuous-feed method impractical.

d. Point of Application

(1) The chlorine solution shall be applied at the high end of the pipeline section through a corporation stop inserted in the top of the new pipe. If the water for the chlorine solution is supplied from the existing pipeline, there shall be a physical break between the injector supply and the injector or pump.

e. Rate of Application

(1) The chlorine solution shall be pumped slowly into the new pipeline until the entire main is filled with the chlorine solution. If required by the County, the chlorine residual shall be measured at several points along the main.

f. Point of Discharge

(1) The sterilizing solution shall be dechlorinated prior to discharge through available outlets, or through taps in the main. Chlorinated water is extremely toxic, and the property and fish life shall be protected from any damage that would result from contact with the discharge. Where necessary, federal, state, and local regulatory agencies shall be contacted to determine special provisions for the disposal of the water.

(2) One available option is to discharge the dechlorinated water to the sanitary sewer, subject to County approval. Prior to discharge, check the downstream chlorine residual to determine if there is any chlorine present using a pocket colorimeter.

g. Flushing Water

(1) The County will provide flushing water. Water used for flushing must either be metered, or the usage must be calculated and reported to the County. No existing water system valves shall be operated without the presence of the County's representative.

h. Water for Testing

(1) The County will furnish water for one hydrostatic test and disinfection procedures per line installed. If pipelines must be retested and disinfected, additional water will be provided at current County rates.

(a) Disinfection of Water Main Connections

i. If it is not possible to disinfect the pipe, valves, and fittings in the manner specified above, with the County's approval, the following procedure will be used:

The interior of all pipe, fittings, and valves shall be swabbed with a 5% hypochlorite solution which can be obtained by mixing 3 pounds of granulated calcium hypochlorite with 5 gallons of water. After the pipe, fittings, and valves have been swabbed, they shall be thoroughly flushed with water.

i. Bacteriological Tests

(1) After final flushing is completed and before the water main is put into service the replacement water shall be tested for bacteriological quality.

(2) Bacteriological sampling and analysis shall be performed in accordance with AWWA C651 by an MDE certified laboratory.

(3) The county shall supply all meters.

(4) The size of the water mains shall be as shown on the approved drawings. Water mains, unless otherwise noted on the approved drawings, shall be ductile iron (DI) pipe.

END OF SECTION

SECTION 2.4

TABLE OF CONTENTS

SANITARY SEWERS

SECTION 2.4 – SANITARY SEWERS

Article 1. GENERAL INFORMATION

1. The installer shall furnish all material and shall construct the pipelines and all required appurtenances at the points and to the lines, slopes and elevations shown on the approved drawings, required in the Standard Specifications and Details, or designated by the County. All pipe and fittings shall be laid true to the lines, slopes and elevations set and the direction given from time to time as the work proceeds.

2. The type, size, and class of pipe for sewers shall be as shown on the approved drawings and in accordance with the requirements herein specified.

Article 2. MATERIALS AND EQUIPMENT

1. Polyvinyl Chloride Sewer Pipe and Fittings

   a. General

      (1) All pipe between structures shall be of the same size and material and shall be furnished by the same manufacturer. Each pipe length and all fittings shall be clearly marked with the manufacturer's name or trademark and pipe type or strength. Pipe not marked as indicated herein may be rejected.

      (2) Any damage to existing utilities caused by the installation shall be immediately repaired to the satisfaction of the County at no expense to the County.

   b. Materials

      (1) Polyvinyl chloride (PVC) sewer pipe and fittings for installation depths up to 16 feet shall be PVC SDR 26 with full diameter dimensions and shall conform to ASTM D3034 for sizes 6 (for sanitary sewer laterals) through 15 inches, PVC sewer pipe and fittings 18 through 60 inches shall have a minimum Pipe Stiffness (PS) 115 psi and shall conform to ASTM F679. SDR 26 pipe shall be manufactured by Diamond Plastics Corp., JM Eagle Sewer, National Pipe and Plastic, North American Pipe Corporation, or approved equal.

      (2) Pipe and fittings to be installed at depths greater than 16 feet shall be C900 DR18 or equivalent with joints in compliance with ASTM D3139 and rubber gaskets in compliance with ASTM F-477. DR18 pipe shall be manufactured by Diamond Plastics Corp., JM Eagle Sewer, National Pipe and Plastic, North American Pipe Corporation, or approved equal.

      (3) Pipe and fittings to be installed at depths greater than 25 feet shall require evaluation of material type to be approved by the Bureau of Utilities.

      (4) Pipe with blisters, bubbles, cuts, or scrapes on inside or outside surfaces which appreciably damage the wall thickness, or other imperfections which may impair either the performance or life of the pipe shall be rejected.

c. Joints

(1) PVC pipe and fittings shall have bell and spigot push-on joints. The bell shall consist of an integral wall section with a solid cross-section elastomeric gasket securely locked in place to prevent displacement during assembly. Installation of elastomeric gasketed joints and performance of the joint shall conform to ASTM F477, ASTM D3139 or ASTM D3212.

d. Fittings

(1) PVC SDR 26 fittings shall be by Harco, Multi Fittings, GPK Products, JM Eagle, or approved equal.

(2) PVC C900 DR18 fittings shall be by Harco, Multi Fittings, JM Eagle, or approved equal.

(3) PVC pipe saddles shall be by Fernco, Geneco, Romac, or approved equal.

(4) Sewer plugs shall be Hand-Tite by R.C. Graham; Wing Nut Test Plugs by Circle Gas Manufacturing; or approved equal.

(5) Elastomeric gravity sewer couplings shall be by Fernco, Mission Rubber, Trelleborg, or approved equal.

(6) Electrofusion service saddles shall be by Isco Industries; Performance Pipe Company; or approved equal.

2. Ductile Iron (DI) Pipe and Fittings

a. Ductile Iron Pipe

(1) Ductile iron pipe shall conform to AWWA C151 and ASTM A746. Pipe shall be supplied in standard lengths and shall be by U.S. Pipe and Foundry Company; American Ductile Iron Pipe Company; Griffin Pipe Products Company; or approved equal.

(2) Ductile iron fittings shall be in accordance with SECTION 3.2 – WATER MAINS.

b. Joints

(1) Joints shall be rubber-gasket push-on type or rubber-gasket mechanical joint type conforming to AWWA C111. Gasket shall be of SBR material and by U.S. Pipe or approved equal.

c. Linings

(1) Ductile iron pipe and fittings for sewer use shall be epoxy lined with Protecto 401 ceramic-filled amine cured epoxy by Induron Protective Coatings or approved equal.

d. Minimum Thickness

(1) Thickness design shall be per AWWA C150, except provide minimum pressure Class 350.

3. Alternative Gravity Sewer Pipe Materials

a. Alternative gravity sewer pipe materials may be considered and will be subject to approval by the County on a case-by-case basis. Full details of alternatives must be submitted.

4. Steel Casing Pipe

a. The steel casing pipe shall have a minimum yield strength of 35,000 psi, have a thickness as required but not less than 0.375 inches, be equipped with grout holes and conform to AWWA C200 and ASTM A53. A corrosion allowance of 1 gauge shall be used in design calculations.

b. Casing pipe shall be by American Cast Iron Pipe Company; Northwest Pipe Company; or approved equal.

c. Casing interior and exterior shall be painted with two coats bitumastic enamel coating in accordance with AWWA C203.

d. Pipe cradles or isolators shall be as shown on the approved detail drawings. Pipe casing spacers shall be by Advance Products & Systems, CCI Pipeline Systems, RACI North America Inc., or approved equal. Casing end seals shall be by Advance Products & Systems, CCI Pipeline Systems, Maloney Technical Products, Pipeline Seal and Insulator, Inc., or approved equal.

5. Detectable Warning Tape (Tracer Tape)

a. Detectable warning tape shall be polyethylene film encasing a metallic core, minimum 6 inches wide and 4 mils thick, color-coded green for sewer, bearing in black letter – CAUTION: SEWER LINE BELOW.

Article 3. INSTALLATION

1. General

a. This Section covers the installation of the sewer mains, complete with all fittings, structures, harnessing, connections, and appurtenances. Installation shall be performed as specified in SECTION 3.1 – EXCAVATION, BACKFILL, AND PROTECTION except where otherwise specified herein.

b. Existing Utilities

(1) The County may provide existing utility information from available records by request. The installer shall verify all information to its own satisfaction and shall notify the County of any impact to the to the work. Test pit existing utilities that impact construction, at no additional expense to the County. The County reserves the right to designate the utilities that are to be test pitted by non-destructive methods in pavement and destructive methods in unpaved areas.

2. Responsibility of Material

    (1) The County shall not be responsible for materials, and materials found defective in manufacture or damaged in handling, as determined by the County, shall be replaced at no expense to the County. Any materials found defective shall be promptly removed from the site. Defective pipe shall be classified as follows:

3. Receiving and Handling

    a. All PVC pipe and fittings will be inspected upon delivery and shall be subject to reasonable tests as to strength and other characteristics as described in ASTM Designation D3034. Any materials failing to meet the requirements of this specification shall be replaced with pipe and fittings which meet said requirements, and labor provided as necessary to inspect the pipe, at no expense to the County.

    b. Each length of pipe and fitting shall be clearly marked in accordance with the requirements of ASTM D3034.

    c. PVC pipe shall be stored on flat surfaces to support the barrel evenly with bell ends overhanging. Individual lengths of pipe shall be store in piles no higher than five (5) feet.

    d. All PVC pipe and fittings subject to prolonged exposure to sunlight, shall be covered with canvas or some other opaque material, and provisions made for adequate ventilation. Failure to do so may result in pipe discoloration which indicates a significant reduction in pipe impact strength. Such a condition shall result in rejection of the pipe.

    e. Similar applicable receiving and handling requirements shall be enforced for alternative sewer pipe materials, including ductile iron pipe.

    f. Pipe shall be so handled that the lining if present is not damaged. If any part of the lining is damaged, the repair shall be made to the satisfaction of the County.

4. Laying Pipe

    a. Ductile iron pipe and fittings shall be installed in accordance with requirements of AWWA C600. PVC pipe and fittings shall be installed in accordance with the requirements of the manufacturer and ASTM D2321. All pipes shall be laid to a uniform line and grade, bell ends upgrade, with a firm and even bearing along the barrel of the pipe. The spigot end of the pipe is to be centered in, shoved tight and secured against the bell of the previously laid pipe. The interior of each pipe shall be cleaned of all foreign material before the next pipe is laid. Pipe laying shall commence at the lowest point and proceed upgrade. No wedging or blocking will be permitted in laying any pipe without written or permission of the County. No pipe shall be brought into position until the preceding length is properly embedded and secured in place. Bell holes shall be dug sufficiently large to ensure the making of proper joints and to ensure that the pipe is firmly bedded for the full length of the barrel. At the close of each day's work, and at such other times when pipe is not being laid, the open end of the pipe shall be closed by a watertight plug or other approved means.

    b. Cutting

(1) When a pipe needs cutting to fit into the line or bring it to the required location, perform the cutting in a satisfactory manner to leave a smooth end, without extra compensation. All cut ends and damage to lining of ductile iron pipe shall be repaired in strict accordance with the manufacturer's instructions.

c. Grade and Alignment Control

(1) At the request of the County, a grade sheet for each manhole run shall be furnished. Grade and alignment control shall be established by laser (direct reading).

d. Pipe Clearance in Rocks

(1) Ledge rock, boulders and large stones shall be removed to provide a clearance of at least 6 inches below and on each side of all pipe and fittings for pipes 24 inches in diameter or smaller, and 9 inches for pipes larger than 24 inches in diameter.

(2) The specified minimum clearances are the minimum clear distances which will be permitted between any part of the pipe and/or fitting being laid and any part, projection or point of such rock, boulder, or stone.

e. Pipes at Manholes or Other Rigid Structures

(1) Pipes directly connected to or supported by rigid structures shall not have a length beyond the rigid support in excess of that shown in the approved manhole detail drawings.

f. Water in Trenches

(1) Trenches shall be dewatered prior to laying pipes such that installation occurs in-the-dry. Joints shall not be made under water or water allowed to rise in the excavation until joint material receives its set. Ground and surface water in trenches shall not be permitted to enter the sewerage system.

5. Surface Restoration

a. In state highways surface restoration shall be in accordance with MDSHA requirements, or as specified in the MDSHA permit issued for the subject project.

b. In non-state roads, paved areas or other traffic areas, surface restoration shall be in accordance with the requirements of the local municipality in which the street is located.

c. All street, road or highway surfaces which are disturbed or damaged during installation of the sewers shall be properly repaired at no expense to the County.

d. Subsequent settlement of the street, road or highway surface resulting from improper compaction of the sewer line trench or failure to protect the sewer line trench shall be promptly repaired at no expense to the County.

6. Bored Crossings

a. The carrier pipe shall be installed to the exact line and grade required within the casing pipe using a leveling grout course, adjustable pipe supports, or other methods as approved by the County.

b. The carrier pipes shall be supported within the casing pipes so that the pipe bells do not rest directly on the casing. The load of the carrier pipes shall be distributed along the casing by the method of support shown on the approved detail drawings.

c. All work shall be performed in conformance with the requirements of MDSHA or other regulatory agencies involved.

Article 4. TESTING AND INSPECTION

1. General

a. Upon installation of sewers and house connections and after placement of the compacted backfill to the original ground line or paving subgrade, the sewers shall be tested for acceptability. The tests shall be comprised of a visual inspection, an elevation check and mandrel test for verifying alignment and grade, and the low-pressure air test to determine leakage. These tests prescribed herein shall be performed between each manhole, including house connection laterals, or at shorter intervals as directed by the County. No tests shall be conducted until the interior of the pipelines have successfully been cleaned of all internal construction, debris, dirt, or stones. All safety precautions and applicable governing regulations of the Occupational Health and Safety Act of 1970 shall be strictly adhered to.

b. All expenses related to the performance of tests on the sewers shall be included by the installer. If any test fails to meet the herein specified performance requirements, the County will direct the extent of corrective measures to be employed. This may include total or partial replacement as determined by the County. Corrective steps or procedures are to be followed until a satisfactory test is obtained and written acceptance can be made.

c. In subdivisions when streets, driveways, courts, etc. are completed and all lots are improved, a power flushing should be done to assure all lines are cleaned of construction materials.

2. Visual Inspection

a. All sanitary sewers, including manholes, shall be inspected prior to air testing. Any water leakage into the system sufficient to constitute any noticeable trickle or seepage into sewer pipes or manhole structures shall be corrected and eliminated prior to undertaking the low-pressure air test. No infiltration will be allowed.

3. Televising Test

a. New sewer mains are to be televised in accordance with SECTION 3.8 – TV INSPECTION OF SEWER PIPELINES. Coordinate so that the televising may occur in the presence of the County and final videos may be transferred to the County.

4. Elevation and Alignment Check (Survey)

a. All sanitary sewer structures shall be surveyed after construction to verify grades as installed. Surveyed information shall be transferred to the record drawings and delivered to the County.

5. Low Pressure Air Test

a. Testing to be conducted in accordance with ASTM F1417-11a: Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air. Testing guidance and tables herein are provided for reference only.

b. Sewers shall be tested for leakage only after all sewers and sewer laterals, including stoppers, are installed. Each sewer section between manholes including all laterals will be tested with low pressure air. The installer may perform preliminary tests at their own discretion, without the presence of the County at no expense to the County. The final acceptance test shall be made in the presence of, and to the complete satisfaction of the County. All material, equipment and labor required shall be provided at no expense to the County.

c. Sewer sections to be tested shall be cleaned by flushing or other means prior to conducting the low-pressure air test.

d. The equipment shall be specifically designed and manufactured for testing pipelines with low-pressure air and shall be provided with an air regulator valve or air safety valve set to prevent the air pressure in the pipeline from exceeding 9 psig. All plugs shall be braced to prevent blowout. Care must be taken so that the pressures generated by the air testing equipment do not exceed the pipe manufacturer's recommendations.

e. The above ground air control equipment shall include a shut-off valve, pressure regulating valve, pressure relief valve, input pressure gauge and a continuous monitoring pressure gauge having a range from 0 to 10 or 15 psi.

f. Low pressure air shall be slowly introduced into the sealed line until the internal pressure reaches the test pressure. As a safety precaution no personnel shall be allowed to remain in the manhole after the air pressure is increased in the sewer line. If there is any indication of leakage in the test plug, pressure shall be relieved before taking steps to eliminate the leak. The pipe shall remain under pressure for not less than 2 minutes before the test begins, to allow equilibrium of the air temperature with the pipe wall.

g. When the pressure has stabilized, the air hose from the control panel to the air supply shall be disconnected.

h. Testing shall be conducted following either a 1 psig pressure drop method, or 0.5 psig pressure drop method may be used for larger diameter pipes, longer test sections, or both. Minimum time calculations and tables are within ASTM F1417-11a and are within **Appendix D** of the Standard Specifications for reference.

i. Pipe which falls to maintain the stipulated pressure for the specified holding time shall be deemed to have failed to pass the low-pressure air test and is unsatisfactory for acceptance by the County. Any sewer main or lateral that fails to pass the air test shall be repaired at no expense to the County. All materials and methods used to repair the sewer

shall meet the approval of the County. Following corrections, the sanitary sewer shall be tested again in accordance with the above procedure.

6. Cleaning

   a. At the conclusion of the work, thoroughly clean all pipelines by flushing with water or other means to remove all dirt, stones, pieces of wood, or other material which may have entered the pipes during the construction period. Debris cleaned from the lines shall be removed from the low end of the pipe. If after this cleaning, obstructions remain, they shall be removed. After the pipelines are cleaned and if the groundwater level is above the pipe or following a heavy rain, the County will examine the pipes for leaks. If any defective pipes or joints are discovered, they shall be repaired or replaced as directed by the County.

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SECTION 2.5

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SANITARY SEWER LATERALS

SECTION 2.5 - SANITARY SEWER LATERALS

Article 1. GENERAL INFORMATION

1. A sanitary sewer lateral is that section of a sanitary sewer that extends from the sewer main to a point 12 inches beyond the right of way, curb, or sidewalk in front of the property which it serves.

2. Each improved property shall have its own sanitary sewer lateral. Each side of a duplex, or each townhouse unit shall have its own sewer lateral.

3. Disconnection of Sewer Laterals

    a. Disconnection of a sewer lateral shall be done at the sewer main. The 45° bend and the lateral pipe shall be removed, and a cap installed on the sanitary tee on the main line. After the cap has been installed, concrete shall be poured over the sanitary tee and cap to prevent future connections at that point. If it is not possible to remove the lateral pipe, and at the discretion of the Engineer, the pipe may be filled with AASHTO No. 8 stone, sand or flowable fill to prevent future use.

Article 2. MATERIALS AND EQUIPMENT

1. Gravity Sewer Laterals

    a. Polyvinyl Chloride Sewer Pipe and Fittings

        (1) Refer to SECTION 3.4 – SANITARY SEWERS for these requirements.

    b. Ductile Iron Pipe and Fittings

        (2) Refer to SECTION 3.4 – SANITARY SEWERS for these requirements.

    c. Alternative Gravity Sewer Pipe Materials

        (1) Alternative gravity sewer pipe materials may be considered and will be subject to approval by the County on a case-by-case basis. Full details of alternatives must be submitted.

2. Sanitary Tees for Connection to Main Line

    a. Sanitary tees shall conform to the pipe materials specifications above.

3. Lateral Connections to Existing Sanitary Sewer Lines

    a. Saddles used to connect laterals to existing PVC sanitary sewer lines shall be molded tees, gasket branch and gasket skirt and shall have two stainless steel straps.

    b. Saddle tees installed on PVC pipe shall be solvent-weld type saddles by GPK Products, Inc. or approved equal.

    c. PVC pipe saddles shall be by Fernco, Geneco, Romac, or approved equal.

d. Lateral connections to existing terra cotta or asbestos cement (transite) pipe shall be made by cutting out a small section of the main and installing a PVC tee. Connection of the tee to the main shall be made with Fernco style transition couplings or approved equal.

e. Lateral connections to existing ductile iron gravity sewer main shall be made by cutting out a small section of the main and installing a ductile iron tee. The tee shall be secured to the main by attaching the bell ends of the tee to the main line on one side and a short section of pipe on the other side. The short section of pipe shall be secured to the main using a Dresser style repair coupling or approved equal.

4. Detectable Warning Tape

a. Detectable warning tape shall be polyethylene film encasing a metallic core, minimum 6" wide and 4 mils thick, color-coded green for sewer, bearing in black letter – CAUTION: SEWER LINE BELOW.

Article 3. INSTALLATION

1. General

a. Where no sanitary tee is present in an existing sewer line, lateral connections shall be made with a saddle type connection. The hole for this saddle must be carefully cut into the existing line, making sure that the cut-out piece is not dropped into the pipe. All saddles shall be securely fastened to the existing line with two stainless steel straps, one on each side of the opening in the pipe. In addition, saddles installed on PVC pipe shall be glued per the manufacturer's recommendations. A bead of silicone caulk shall be used to seal the saddle at the interface with the existing sewer main. Under no circumstances should any inserted pipe protrude into the sewer main.

2. Excavation

a. Trench excavation, in any material, shall extend 4 feet beyond the end of the lateral for the full depth of the lateral. If the lateral is intended to be used at a later date, then prior to backfilling, a minimum 2-inch x 4-inch treated lumber locator marker shall be placed against the end of the lateral and shall extend a minimum of 18 inches above finished grade.

b. Refer to SECTION 3.1 – EXCAVATION, BACKFILL, AND PROTECTION for additional requirements.

3. Bedding

a. Refer to SECTION 3.4 – SANITARY SEWERS for these requirements.

4. Laying Pipe

a. Refer to SECTION 3.4 – SANITARY SEWERS for these requirements.

5. Backfilling

a. Refer to SECTION 3.1 – EXCAVATION, BACKFILL, AND PROTECTION for these requirements.

6. Surface Restoration

a. Refer to SECTION 3.4 – SANITARY SEWERS for these requirements.

Article 4. TESTING AND INSPECTION

1. Lateral connections to existing sanitary sewer lines shall be visually inspected prior to backfilling. Laterals shall be inspected for alignment, depth, slope, and for fittings and pipe material used.

2. Lateral connections which are constructed as part of new sanitary sewer installations shall be tested and inspected as described in SECTION 3.4 – SANITARY SEWERS.

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SECTION 2.3

WATER LATERALS

SECTION 2.3 – WATER LATERALS

Article 1. GENERAL INFORMATION

1. A water lateral is that section of a water line that extends from the water main to the property line, curb line or right-of-way line of the property which it serves. County responsibility ends, and property owner responsibility begins, at the first coupling after the meter vault. This is approximately the property line.

2. All water laterals constructed within the service area of the County shall meet the requirements of this specification.

3. Water lateral pipe and fittings shall be furnished and installed in strict accordance with these specifications, and any and all practices and precautions required for the water mains specified in SECTION 3.2 – WATER MAINS of these specifications are equally applicable to the water laterals.

4. Each Improved Property shall have its own individual lateral and meter vault. The water lateral shall normally consist of a corporation stop, pipe, curb stop with box, and meter vault.

5. Twin meter settings are discouraged but will be allowed at the County's discretion.

6. Supervision and Inspection

    a. The construction of laterals shall at all times be subject to the supervision and inspection by the County or its duly authorized representative and shall conform to the County's specifications. No owner shall permit water laterals to be covered or backfilled until authorized by the County to do so.

7. All pipes, fittings, valves, and appurtenances shall be lead-free.

Article 2. MATERIALS AND EQUIPMENT

1. Pipes

    a. Copper Tube and Fittings

        (1) Copper tube shall conform to the requirements of ASTM B88, with Type K for underground installations and Type L in exposed locations.

        (2) No Type K soft copper larger than 2 inches shall be allowed. Pipe larger than 2 inches shall be ductile iron pipe, thickness Class 52.

        (3) The water lateral copper tubing must be one continuous piece with no fittings or splices.

    b. Fittings for Copper Tubing

        (1) Fittings for copper tubing shall be the compression type conforming to AWWA C800 with a pressure class of 150 psi. All lateral fittings shall be compression connection manufactured by Mueller Company or Quick Joint manufactured by Ford, "Q" compression by A.Y. McDonald, or approved equal.

c. Ductile Iron Pipe and Fittings

(1) Refer to SECTION 3.2 – WATER MAINS for these requirements.

2. Corporation Stops

a. Corporation stops shall be compliant with AWWA C800, and shall be brass with Mueller- type threads, not less than 1-in in diameter and shall be installed where shown, specified, or required.

b. Corporation stops shall be compression style ball type corporation stops rated for 300 psig maximum working pressure, threaded x compression, as manufactured by the following:

(1) The Figure B-25008N by Mueller Company of Decatur, Illinois; Model FB1000-Q-NL by Ford Meter Box Company Inc. of Wabash, Indiana; Model 74701BQ by A.Y. McDonald Manufacturing Company of Dubuque, Iowa; or equal.

3. Service Saddles

a. For water lateral connections up to 2 inches, service saddles may be used. Service saddles shall have 304L stainless steel straps with ductile iron coated (epoxy or nylon) body. Service saddles shall be by Ford Meter Box Company, Inc., A.Y. McDonald, JCM Industries, Mueller, PowerSeal Pipeline, Romac, Smith-Blair, or approved equal.

4. Tapping Sleeves

a. For water lateral connections that are 3 inches or larger, tapping sleeves shall be used. Tapping sleeves shall be of ductile iron construction with a ductile iron mechanical joint outlet. Tapping sleeves shall be by American Flow Control, Mueller, Romac, Smith-Blair, Tyler Pipe, JCM Industries, or approved equal.

5. Curb Stops and Curb Boxes

a. Curb stops shall be compliant with AWWA C800, and shall be 300 psig maximum working pressure, compression ball type and shall be Figure B25209N by Mueller Company of Decatur, Illinois; Model B44-444-Q-NL by Ford Meter Box Company Inc. of Wabash, Indiana; Model 76110Q by A.Y. McDonald; or approved equal; and shall be bronze with copper fittings and shall be of the inverted key type with base cap and stops.

b. Curb stops shall be furnished with curb boxes of the extension type with stationary rod, arch pattern base, and provided with the word “WATER” cast on the lid. Curb boxes shall be Mueller's Figure H-10306; Ford's Model EA1; A. Y. McDonald's Model 5601; Tyler/Union’s Series 6500; or approved equal and shall be provided with lid, foot piece and one operating key. Manufacturer shall be ISO 9000 certified or domestic.

c. For service lines 3-inches and larger the curb stop valve shall be a gate valve with box meeting the requirements of SECTION 3.2 – WATER MAINS.

6. Clamping Devices

   a. Socket clamps, anchor, straps, and tie rods, used to anchor pipe fittings, shall be as manufactured by the Grinnell Company, Inc., Stellar Corporation or approved equal.

Article 3. INSTALLATION

1. Refer to the applicable parts of SECTION 3.2 – WATER MAINS for installation requirements.

2. All services shall be laid to the grade and lines in accordance with the approved drawings or as directed by the County.

3. Special care shall be taken to ensure that the service lines are well bedded on a solid foundation. Care shall be taken during installation to ensure that copper tubing is not crimped, gouged, or otherwise damaged. Copper tubing shall not be installed near sharp stones or stone ledges that could cause damage to the tubing.

4. Copper tubing shall be installed without sharp turns or bends. Smooth vertical and horizontal bends are required for installation as shown in the Standard Details. The installer shall have available and shall utilize a pipe bending mandrel to bend copper tubing at no additional expense to the County, if directed by the County.

5. Only proper tube cutters shall be used to cut copper tubing. Hacksaws and other similar equipment that may result in rough edges are strictly prohibited. Only smooth jawed wrenches are permitted to tighten fittings and connections.

6. When installing corporation stops, the main shall be tapped at a 45-degree angle with the horizontal. Service tubing shall be installed as a continuous length of pipe and shall have a minimum cover of 3 feet – 6 inches. Curb stops shall be vertical, with the top of the curb box at finished grade. Curb boxes shall not be in roadways or driveways. The curb box shall be set on a precast concrete block firmly embedded in virgin soil at a minimum depth of 4 feet but shall not exceed a maximum depth of 5 feet. The curb box shall be positioned so that it is centered over the curb stop valve. Align to provide unobstructed access to the valve.

7. Copper tubing laterals shall be bedded in screened topsoil. A minimum of 6 inches of bedding material shall be provided around the pipe in all directions.

8. Laterals crossing any roadway must either be installed by the open cut method or must be installed within a protective steel casing which is auger bored or jacked beneath the roadway. Laterals crossing state highways are subject to state approval and must be installed in accordance with MDSHA requirements and specifications. Laterals crossing County roads are subject to County approval and shall be installed in accordance with County requirements.

9. Meters & Meter Vaults

   a. Meter settings shall be installed level and with the long axis of the meter installed perpendicular to the curb and gutter or edge of pavement (existing or proposed). When the meter setting is remote from the roadway, the long axis of the meter shall be aligned with the centerline of the water service.

   b. Meter vaults shall be installed outside, within meter pits, in non-traffic areas only. Vaults should not be located within a driveway unless otherwise noted on the

approved drawings or directed bythe County.

c. All meter vaults shall be bedded on firm undisturbed earth in combination bricks or pre-cast vault bottom sections. Meter vaults shall be installed level. For circularmeter vaults, vaults shall be centered over meter valves and fittings such that there is a uniform gap between meter valves and fittings and the inside surface of the vault.

10. Special Conditions and Requirements

a. Trench excavation, in any material, shall extend for 4 feet beyond the end of the lateral for the full depth of the lateral. If the lateral is intended to be used at a later date, then prior to backfilling, a minimum 2-inch x 4 inch treated lumber locator marker shall be placed against the end of each lateral and shall extend a minimum of 18 inches above the ground.

Article 4. TESTING AND INSPECTION

1. Before backfilling the trench or covering any work, an inspection by the County from the water main to the curb valve must be performed.

2. Lateral connections which are constructed as part of new water main installations shall be inspected and tested as part of the water main extension as described in SECTION 3.2 – WATER MAINS.

3. Lateral connections to existing water mains shall be pressure tested from the curb valve to the corporation stop.

a. Pressure Test

(1) Each lateral shall be subjected to a pressure test prior to approval by the County. The test shall be witnessed by an agent of the County and the service line shall not be deemed acceptable until said lateral has satisfactorily passed the test described below. All expense of testing and any subsequent test(s), including equipment, material or labor required shall be the responsibility of the installer.

(2) Laterals 2-inches and Smaller

b. All newly laid pipe shall be subjected to a test pressure of 150 pounds per square inch, or 150% of the normal working pressure, whichever is greater in accordance with AWWA C600. There shall be no drop in pressure for a period of 15 minutes.

(1) Service Lines Larger than 2-inches

(2) Refer to SECTION 3.2 – WATER MAINS for the testing requirements.

Article 5. DISINFECTION

1. Laterals shall be part of the testing and disinfection program specified in SECTION 3.2 – WATER MAINS per AWWA standards. The chlorine from the laterals shall be flushed and drained. If necessary, request service customers to run spigots in the dwelling to remove chlorine from the lines. The County shall not be responsible for any damage to customer service lines.

END OF SECTION

SECTION 2.6

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MANHOLES

SECTION 2.6 – MANHOLES

Article 1. GENERAL INFORMATION

1. Manholes between gravity sewers shall be placed at all pipe intersections and at intervals not greater than 400 feet. Manholes shall be placed at all changes in grade, pipe size and alignment.

2. Manholes shall be constructed at the location and to the elevations shown on the approved plans or directed by the County and be in accordance with the Standard Details.

Article 2. MATERIALS AND EQUIPMENT

1. Precast Reinforced Concrete Manhole Riser and Tops

    a. Unless otherwise specified, the installer shall set and backfill all precast manholes. Precast reinforced concrete manhole risers and tops shall conform to ASTM Specification C-478 Latest Edition and shall be of watertight construction.

    b. Precast concrete manholes shall be furnished with water stops, sleeves and openings as noted on the approved drawings. Box out for wall pipes shall conform accurately to the sizes and elevations of the adjoining pipes.

    c. The minimum wall thickness shall be 5 inches.

    d. The date and time of manufacturer shall be marked inside each precast section.

    e. No more than two lift holes may be cast or drilled in each section.

    f. Precast concrete manholes shall be manufactured by Advanced Drainage Structures, Atlantic Concrete, Concrete Pipe and Precast, Concrete Pipe & Products, Contractor Precast, Gillespie Precast LLC, Hamilton Kent, Hanson Products, Horne Concrete Construction LLC, Maryland Concrete, Monarch Products Company, Oldcastle Infrastructure, Terre Hill, York Concrete, or approved equal.

    g. Joints between manhole sections shall be provided with preformed plastic joint sealing material conforming to ASTM C990 and shall be manufactured by Concrete Sealants Inc., Henry, Press Seal Corporation, Royston Laboratories Division, or approved equal. The preformed joint sealer shall be protected by a removable two-piece wrapper and shall be applied in strict accordance with the manufacturer's recommendations. The chemical composition of the sealer shall meet the following requirements: the latest revision of: Bitumen-ASTM D-477, Inert Ash Mineral AASHTO T-11-42, Volatile Matter ASTM D-667.

    h. Manhole bases may be cast-in-place concrete and shall have a compressive strength of not less than 4,000 psi after 28 days (tests to be in accordance with ASTM Specification C-39, Latest Revision).

    i. Precast manhole bases shall have flexible watertight joints at the point of entry of any sewer pipe into the manhole. The rubber materials shall conform to ASTM C443. The gaskets shall be cast into the manhole base to become an integral part of the concrete. The gaskets shall be manufactured by A-Lok Products, Inc., Press Seal Corporation,

Trelleborg Pipe Seals, GPT, or approved equal. All connectors shall be designed to allow adequate deflection for all pipe slopes entering and existing manhole structures.

j. Manhole bases with precast outside drop shall conform to ASTM C478, Latest Revision and shall provide a 90-degree elbow cast in monolithically with the base. The riser pipe shall be supported by concrete U-shaped collars. The collars shall be a minimum vertical height of 12 inches and shall be connected by tongue-and-groove joints.

k. Precast concrete grade rings with a minimum thickness of 2 inches used for leveling and adjusting to grade shall be of compressive strength as specified above. Precast rings shall be a single piece (no semi-circular pieces). Rubber grade adjustment rings are acceptable with a minimum thickness of 0.5 inches for tapered arrangements and shall be “Infra-Riser” as manufactured by East Jordan Iron Works or approved equal. The use of poured concrete grade rings shall be allowed only with prior approval from the County. Design of the grade rings must provide for full bearing of manhole frame and must have a maximum thickness of 6 inches. Joints between grade rings must be sealed using an approved preformed plastic joint sealing material specified in this section. Cement mortar will not be permitted in any joints. No more than two (2) rubber grade rings with a combined total thickness of 4” may be used per manhole structure. Concrete grade rings shall be manufactured by A.C. Miller, Atlantic Concrete, Concrete Pipe and Precast, Contractor’s Precast, Gillespie Precast LLC, Oldcastle Infrastructure, Smith-Midland, or approved equal.

l. Adjustable manhole riser rings shall only be allowed with prior Bureau of Utilities approval. Adjustable manhole riser rings shall be of tongue and groove construction with rubber or neoprene "O" ring gaskets, and be manufactured by American Highway Products, East Jordan Iron Works, J. Thomas Ltd., or approved equal.

2. Manhole Frame and Cover

a. Manhole frames and covers shall be as follows:

(1) Manhole frames and covers in easements shall be manufactured by East Jordan Iron Works; US Foundry; or approved equal.

(2) Manhole frames and covers in pavement shall be manufactured by East Jordan Iron Works (Model 1545 A); US Foundry (Model 288 or 424): or approved equal.

(3) Manholes where top of frame and cover elevation exceeds adjacent finished grade by 2 feet of more shall use REVO24 series frame and covers as manufactured by East Jordan Iron Works or approved equal.

(4) Cover shall have letters "SANITARY SEWER" cast approximately in the center of the cover

b. Manhole frames shall be connected to the concrete cone (through grade adjustment rings as necessary) by the installation of 5/8-in stainless steel anchor bolts and nuts.

(1) The mating surface between manhole frame and concrete shall be a polyurethane gasket/grade ring. The product shall be Infra-Riser as manufactured by East Jordan Iron Works or approved equal.

3. Watertight Manhole Frame and Cover

   a. Watertight manhole covers shall be 24-inch diameter of cast iron similar in design to Model #6530-WT as manufactured by the Bridgestate Foundry Corp., Berlin, NJ; US Foundry Models 755 or 288; or approved equal, and having the letters "SANITARY SEWER" cast approximately in the center of the cover. Watertight covers shall have an inner lid and locking bar to prevent inflow into manholes.

   b. Watertight frames shall be securely attached to the manhole by use of anchor bolts. The joint between the frame and the precast manhole section shall be provided with preformed plastic joint sealing similar to ConSeal as manufactured by Concrete Sealants Inc. or approved equal. All joints shall be watertight. Manhole covers shall be bolted to the frames using four 4 ½ inch stainless steel bolts.

4. Drop Connections

   a. Drop connections shall be used when the invert of the inflow sewer is greater than 2 feet above the manhole invert. Drop connections with outside or inside drop in accordance with the Standard Details shall be built where shown on the approved drawings or where directed by the County. Cost or complication of shoring will not be considered as a reason allowance of an inside drop connection. In no case will more than one inside drop connection per manhole be allowable.

5. Manhole Steps

   a. Manhole steps shall be composed of a ½ inch Grade 60, ASTM A615 steel reinforcing bar completely encapsulated in Grade 49108, ASTM D2146 polypropylene copolymer compound, as manufactured by M.A. Industries Inc., Peachtree City, GA or approved equal. The County reserves the right to have steps tested according to the latest revision of ASTM Specification C-478 at no expense to the County.

   b. Manhole steps shall be positioned to form a continuous ladder with 12-inch intermediate spacing in the manhole in such a manner to permit easy access to the manhole and not conflict with either influent or effluent lines. The first step shall be no further than 24 inches from the top of the manhole, and the bottom step shall be no higher than 16 inches from the bench.

6. Connections into existing System

   a. All connections into existing manholes shall be field cored and a flexible connector installed. The interior manhole channel of the existing manhole must be reconstructed to accept the new connection.

7. Protective Coatings and Linings

   a. Exterior Coating

      (1) All exterior surfaces shall be coated with dampproofing. Dampproofing shall be coal tar waterproofing pitch and be BASF MasterSeal 610, 614, or 615 by BASF Corporation; or Karnak 220 Asphalt Emulsion by Karnak Corporation; or approved equal.

b. Interior Coating (hydrogen sulfide corrosion protection)

(1) New manholes with an internal drop of less than 2 feet shall have a white epoxy coating (Epoxy 2228 by ProGuard Coatings, Semstone 870 by Sentry Polymers Inc., or approved equal) applied to all interior surfaces at the manhole manufacturer's facility before delivery to the site. Surface preparation and application shall be as recommended by coating manufacturer.

(2) New manholes with a drop of 2 feet or greater or force main terminal manholes shall have one of the following liners:

(a) A High-Density Polyethylene (HDPE) liner to provide an impermeable lining on the interior concrete surfaces shall be AGRU Sure Grip HDPE of polypropylene random copolymer as furnished and installed by Terre Hill Concrete Products, or approved equal. The Sure Grip liner shall have a minimum thickness of 2 mm. The minimum anchor stud density shall be 39 studs per square foot. The anchoring studs shall not be welded or mechanically attached to the liner. All joints shall be sealed by thermal welding performed by AGRU certified welders. The interior surfaces to be protected shall include the wall, ceiling, pipe entries and structure chimney.

(b) A Polyvinyl Chloride (PVC) resin liner to provide an impermeable lining on the interior concrete surfaces shall be Dura Plate 100 as manufactured by A-Lok Products, Inc., T-Lock PVC sheet Liner by Ameron, or approved equal. The liner shall have a minimum thickness of 1.65 mm. The PVC liner, channel joints, H-joints and corner joints shall be manufactured from PVC and shall be white in color. A combination of standing ribs and dovetails shall be used to secure the liner panels to the wall of the structure and shall be spaced a maximum of 6 inches apart. Liner panels for 48" through 60" diameter manholes shall be a minimum of 0.50 inches high and shall be 0.75 inches high for 72" and larger diameter manholes. Liner panels shall be formed to the correct radius and have a PVC return into the joint of 0.50 inch. The fabricated liner panels shall be joined together by a slotted strip of EPDM rubber meeting the manufacturer's specifications. Sections of lined concrete structure shall be joined together by an approved butyl rubber strip as manufactured by A-Lok Products, Inc. (or approved equal), designed to produce sufficient squeeze-out between PVC returns. Manhole steps, if required, shall be polypropylene drive-in step. Pipe penetrations through the wall shall be afforded protection by applying 0.125-inch cementitious corrosion resistant material, Forsroc Epoxy Liner (or approved equal), to the unlined exposed areas within the openings and shall overlap the liner wall a minimum of 1.50 inches. The manhole chimney shall be protected by installing a telescoping PVC connector, Water-Lok, as manufactured by A-Lok, or approved equal. The interior surfaces to be protected shall include the wall, ceiling, pipe entries and structure chimney.

(c) Manholes to receive a PVC or HDPE liner shall also have a fiberglass reinforced plastic (FRP)-lined base. The FRP base liner shall be by GU International, Predl Systems, or approved equal. The liner shall be of one-piece construction of unlayered, homogenous composite. Minimum thickness shall be 0.12" – 0.20" (3 mm – 5 mm) and shall be in lengths and

nominal inside diameters corresponding to the precast concrete base section. The prefabricated FRP base liner shall include full flow channels with side walls to the crown of the pipe; inner surface of the bench shall have an anti-skid pattern; watertight gasketed pipe bell connections of FRP/PVC boot hole sleeves to suit specific pipe types, grade, and alignment, shall be monolithically attached to prefabricated FRP base liners to extend to the outside profile of the precast concrete structure. The outer surface of the liner shall be aggregate-coated and shall have steel spirals/lattice bonded to the FRP to ensure adequate anchoring to concrete base sections to pass vacuum test with 10" of Mercury negative pressure.

(3) Existing manholes receiving a new drop connection of 2 feet or greater or a new force main connection shall have a spray-applied polyurethane coating such as SprayWall by Sprayroq (or approved equal), provided that the condition of the manhole is suitable. The polyurethane interior coating shall be installed by a Sprayroq certified technician. All liners shall be applied so that they result in a monolithic liner covering the invert, walls and corbelled top up to the cast iron manhole frame.

(4) If the County determines that an existing manhole requiring an interior coating is in poor condition, a new manhole will be required, and the interior shall be as described in paragraph B.5.b.(2) above.

Article 3. INSTALLATION

1. General

   a. The relevant parts of SECTION 3.4 – SANITARY SEWERS shall apply regarding earthwork.

2. Precast Concrete Bases

   a. Bedding

      (1) Install bases on a 12-inch-deep compacted layer of aggregate meeting requirements of pipe bedding as specified previously in SECTION 3.4 – SANITARY SEWERS.

   b. When using prefabricated pipe opening seals (i.e., Press Wedge II, Dura-Seal, etc.) for connecting pipes into manholes, and such seals create an annular space on interior and exterior of manhole wall pipe openings after pipe connection is made, fill such annular spaces with non-shrink grout. Following sealing compound installation, trowel compound surface smooth and flush with interior face of manhole.

   c. Non-shrink grout to be protected with the same epoxy coating as manhole interior.

3. Concrete Channel Fill

   a. The following criteria shall apply to both field and factory formed bases:

      (1) Form inverts directly in concrete channel fill. Concrete fill shall be a minimum depth of 3 inches.

(2) Accurately shape invert to a semi-circular bottom conforming to inside of connecting pipes, and steel trowel finish to a smooth dense surface.

(3) Make changes in size and grade gradually.

(4) Make changes in direction of entering sewer and branches to a true curve of as large a radius as manhole size will permit.

(5) Make slopes gradual outside the invert channels. Provide a minimum slope of 1 inch/foot and a maximum slope of 2 inches/foot.

b. Use 3,000 psi concrete unless otherwise approved by the County.

c. Channels shall be full pipe height; PVC channels may be used for invert section.

4. Manhole Wall Erection

a. Precast Components

(1) Provide precast reinforced concrete straight riser, tapered riser, and top sections necessary to construct complete manholes. Fit the different manhole components together to permit watertight jointing and true vertical alignment of manhole steps.

b. Install two rings of preformed plastic sealing compound between sections in accordance with manufacturer's recommendations and as shown on the Standard Details and join sections in accordance with written instructions of manhole component manufacturer.

(1) Prime joint surfaces if required by preformed sealing compound manufacturer.

(2) If sealing compound is installed in advance of section joining, leave exposed half of two-piece protective wrapper in place until just prior to section joining.

(3) Use preformed sealing compound as the sole element used in sealing section joints from internal and external hydrostatic pressure.

(4) Following manhole section installation, trim any excess sealing compound to provide a smooth surface that is flush with interior face of manhole.

(5) Make pipe connections into manhole walls as specified previously for pipes connecting into manhole bases.

5. Frame and Cover Installation

a. Adjust frames using grade rings. Set grade rings in preformed plastic joint sealing material specified in this section.

b. Bolt manhole frames in place on manhole top section, or on grade rings, if required, after installing ½-inch thick preformed plastic sealing compound on bearing surface of manhole frame and between grade rings. Remove excess sealing compound squeeze-out after manhole frame is bolted in place.

c. Use bolts of sufficient length to properly pass-through concrete grade rings, if any; engage full depth of manhole top section inserts and allowing enough threaded end to pass through manhole frame to properly tighten nut and washer.

6. Drop Manholes

a. Construct as depicted on the Standard Details, or as approved by the County.

Article 4. TESTING AND INSPECTION

1. All manholes shall be tested for water infiltration. Furnish all labor, materials, water, tools, equipment, and accessories necessary to perform the required tests. All tests shall be made in the presence of and to the complete satisfaction of the County.

2. The manhole shall be thoroughly cleaned, and all openings sealed to the satisfaction of the County. All pipe openings in the base and the walls shall be plugged with plugs properly designed to provide a watertight and airtight seal. All excess joint sealing material protruding into the manhole shall be removed.

3. There shall be no groundwater around the outside of the manhole during the vacuum test. If there is groundwater around the manhole during the vacuum test and any water is found in the manhole at the conclusion of the test, it shall be deemed to have failed the test.

4. The manhole shall be tested using the vacuum testing method (ASTM C1244).

a. An inflatable circular rubberized seal shall be placed in the manhole cover frame, and a vacuum of 10 inches (mercury) shall be applied to the manhole. The time lapse shall be measured for the vacuum to drop from 10 inches to 9 inches. The vacuum drop shall be measured by a vacuum gauge graduated between 0 and 20 inches (mercury).

b. If the time lapse is greater than 60 seconds, the manhole is considered to have passed the test.

c. If any manhole fails to meet the testing requirements, determine the source or sources of leakage. Repair or replace all defective material and/or workmanship and conduct such additional tests as required to demonstrate that the manhole meets the requirements. All materials and methods used to repair the manholes shall be as approved by the County and at no expense to the County.

END OF SECTION

SECTION 2.7

TABLE OF CONTENTS

CURED-IN-PLACE PIPE LINING

SECTION 2.7 - CURED-IN-PLACE PIPE LINING

Article 1. GENERAL INFORMATION

1. Furnish all labor, materials, equipment, and incidentals required to install and test the cured-in-place pipe (CIPP) lining and appurtenances complete as shown on the approved drawings and as specified herein, including, but not limited to services necessary for traffic control, bypass pumping and/or diversion of sewage flows, cleaning and television inspection of sewers to be lined, liner installation, reinstatement of service connections, quality control, providing samples for performance of required material tests, final television inspection, testing of lined pipe system and warranty work, all as specified herein.

2. Sewer cleaning, pre-rehabilitation, and post-rehabilitation CCTV inspection of all pipes to be rehabilitated by CIPP lining methods are required per applicable Specifications.

3. Remove obstructions and protruding service connections as required to complete the CIPP rehabilitation. Removal of all pipeline obstructions and protruding service connections required for sewer rehabilitation using cured-in-place pipe lining shall be completed prior to the pre-rehabilitation CCTV inspection.

4. Neither the CIPP system, nor its installation, shall cause adverse effects to any of the County's processes or facilities. The use of the product shall not result in the formation or production of any detrimental compounds or by-products in the system or at the wastewater treatment plant. Notify the County and identify any by-products produced as a result of the installation operations, test and monitor the levels, and comply with any and all local waste discharge requirements. Cleanup and restore existing surface conditions and structures, and repair any of the CIPP system determined to be defective. Conduct installation operations and schedule cleanup in a manner to cause the least possible obstruction and inconvenience to traffic, pedestrians, businesses, and property Owners or tenants.

5. The installer performing the work shall not change any material, design values or procedural matters stated or approved herein, without informing the County and receiving written approval of the change. Such changes constitute a breach of contract and shall result in rejection and removal of work performed with the unapproved materials or processes at no expense to the County.

6. Maintenance and Protection of Traffic, confined space entry, and work site protection shall be the responsibility of the installer and costs of these items are included in the cost of the work. Notify Police, Fire, Ambulance agencies, and residents/businesses in advance of any and all road closures. Comply with applicable OSHA trench safety rules, confined space, and sewer system entry.

7. Submit to the County shop drawings, product data, materials of construction, design calculations, and details of installation including all information described in items 9 to 25 below. Provide this information without delay or claim to any confidentiality and shall include all information described in items 9 to 25 below.

8. Detailed information on the CIPP installation procedures (wet-out, heating, curing, and cool down, if applicable) and all tools and equipment required for a complete installation identifying which tools and equipment will be redundant on job site in the event of equipment breakdown. Equipment to be furnished for the work, including proposed back-up equipment, shall be clearly described. Outline the mitigation procedure to be implemented in the event of key equipment failure during the installation process.

9. CIPP lining schedules including field-verified lengths and diameters of all CIPP lining and appurtenances required shall be provided. Plans should include map(s) that show insertion point manholes for all CIPP installations. Insertion points that are not manholes shall be brought to the specific attention of the County for review prior to plan approval.

10. Shop drawings and product data to demonstrate compliance with these specifications and identify materials of construction (including resins, catalysts, felt, etc.), felt manufacturer, location of the felt manufacturing facility, location of the wet-out facility, etc., flexible membrane (coating) material (including recommended repair/patching procedure, if applicable) shall be provided.

11. Manufacturers' shipping, storage, and handling recommendations for all components of the CIPP System.

12. MSDS sheets for all proposed products and materials to be furnished for the work.

13. Detailed sample collection, laboratory testing and quality control procedures, including schedule and shipping and storage requirements.

14. A written description and/or plan for odor control that will ensure that project specific odors such as styrene will be minimized at the work site and surrounding area.

15. Provide the end seal material(s) and description of their installation such that a hydraulic seal is present between the CIPP liner and host pipe at the manholes.

16. Detailed written plan of the method of flow maintenance (Bypass Pumping plan) and noise prevention measures shall be provided.

17. A detailed description of the installer's proposed procedures for removal of any existing blockages in the pipeline that may be encountered during the cleaning process.

18. A detailed written traffic-control plan that details every street that will be impacted and how impacts will be mitigated.

19. Data on the maximum allowable stresses and elongation of the tube during installation and the means in which monitoring stress and elongation shall be provided (i.e., ideal inversion head and maximum cold head, minimum inversion head, maximum hot head).

20. A detailed public notification plan shall be prepared and submitted including detailed staged notification to residences affected by the CIPP installation.

21. A complete description of the proposed wet-out procedure for the proposed technology.

22. A Safety Plan identifying all competent persons, a description of a daily safety program for the job site and all emergency procedures to be implemented in the event of a safety incident. All work shall be conducted in accordance with the submitted Safety Plan.

23. A detailed quality control plan (QCP) that fully represents and conforms to the requirements of these specifications. At a minimum the QCP shall include the following:

    a. A detailed discussion of the proposed quality controls to be performed by the installer.

    b. Defined responsibilities of the installer's personnel for assuring that all quality

requirements for this work are met. These shall be assigned by the installer, to specific personnel.

c. Proposed procedures for quality control including those pertaining to fit and finish, and product sampling and testing shall be defined and submitted as part of the plan.

d. Proposed methods for product performance controls, including method of and frequency of product sampling and testing both in raw material form and cured product form.

e. A schedule for performance and product test result reviews with the County at regularly scheduled job meetings.

f. Inspection forms and guidelines for quality control inspections shall be prepared in accordance with the standards specified in these specifications and submitted with the QCP.

24. Design data and specification data sheets listing all parameters used in the CIPP liner design and thickness calculations based on ASTM F 1216 for fully deteriorated "deteriorated gravity pipe conditions." Thickness of liners for oval and egg-shaped pipe shall be calculated in accordance with the "Sewerage Rehabilitation Manual" published by the Water Research Center (WRC). All calculations shall be prepared under the supervision of and stamped by a professional engineer registered in the State of Maryland.

25. Before, during and after CIPP installation work shall include the following:

a. Prior to each shipment of CIPP lining, submit certified test reports that the CIPP lining was manufactured and tested in accordance with all ASTM Standards specified and referenced herein.

b. CIPP lining schedules including field-verified lengths and diameters of all CIPP lining and appurtenances required to show that every pipe to be rehabilitated has been physically measured. Plans should include map(s) that show insertion points for all CIPP installations.

c. Detailed installation procedures and manufacturer's recommended cure method for each diameter and thickness of CIPP liner to be installed, including CIPP lining production schedule, acceptable inversion heads and pressures, inversion or winching procedures, curing and cool-down procedures detailing the curing rate of temperature increases and cool down and the method of application, and times for each stage of the process.

d. Wet-out forms/reports for each CIPP segment with detailed information including but not limited to: date and time of wet-out, wet-out facility address, volumes and/or weights of resin, length and diameter of CIPP liner (both wet-tube and dry-tube), roller gap settings, start times, finish times, resin used (product name and batch/shipment number) and quantity, gel times, resin injection locations, thickness of CIPP liner (dry and wet), catalyst(s) name and quantity used, and any other pertinent data documenting the wet-out for each section of CIPP liner manufactured. The wet-out forms shall be submitted prior to CIPP liner installation and shall be provided without delay or claim to any confidentiality. Wet out forms shall be submitted to the County field representative on the day of delivery.

e. CIPP liner field curing reports documenting the liner installation for all sewer segments. The CIPP liner reports shall document all details of liner installation, including manhole

numbers, street names/sewer location, project number, date, time, ambient temperature, heads used during the inversion process, pressures and/or heads (minimum inversion pressure, ideal head, maximum hot head, and maximum cold head) used during curing (including cool down if applicable), curing temperature, curing time, rate of cool down, CIPP liner thickness, etc. A sample report shall be submitted to the County for approval prior to the installation of any CIPP lining. The reports shall be submitted without delay or claim to any confidentiality.

f. For UV cured liners, record the curing and light train speed (feet per minute), light source (number of lamps, intensity, and wattage), inner air pressure (psi), exothermic (curing) temperatures per unit time over the length of the liner, and temperature of the internal liner surface. Include liner manufacturer recommended citations in the submittal.

g. Complete certified copies of the report(s) output(s) of the continuous temperature monitoring systems used in the control of the curing, printed and in electronic format. The reports shall be submitted without delay or claim to any confidentiality. Also provide the County with access to the website where the secure reports can be obtained.

h. Pre-rehabilitation and post-rehabilitation closed-circuit television (CCTV) inspection data as further defined herein. Post-rehabilitation CCTV inspection data shall be submitted within one week after the CIPP segment is installed and conform to requirements set forth in SECTION 3.8 – TV INSPECTION OF SEWER PIPELINES.

i. Samples of installed liner(s) for testing to be performed by an ASTM-certified independent testing laboratory, as described further herein.

j. Information on any grouts, epoxy, or cements proposed for sealing annular space between CIPP liner and host pipe at manholes, or for other uses.

k. Submit daily production reports to the County's Superintendent and/or field representative at the end of each workday.

l. A list of all service laterals (with distances and clock position) that were abandoned or reconnected as part of the work as further defined herein.

m. Some installations may result in the need to repair or replace a defective CIPP. Submit in writing, for review by the County, specific repair or replacement procedures for potential defects that may occur in the installed CIPP. Repair/replacement procedures shall be as recommended by the CIPP system manufacturer and shall be submitted to also include the following:

(1) Defects in the installed CIPP that will not affect the operation and long-term life of the product shall be identified and defined.

(2) Repairable defects that may occur in the installed CIPP shall be specifically defined by the installer based on manufacturer's recommendations, including a detailed step-by-step repair procedure, resulting in a finished product meeting the requirements of these specifications. Repairable defects may include but are not limited to blisters, wrinkles, fins, pinholes, over- or under-cut lateral connections, and any voids found between liner and the host pipe.

(3) Un-repairable defects that may occur to the CIPP shall be clearly defined by the installer based on the manufacturer's recommendations, including a

recommended procedure for the removal and replacement of the CIPP. Un-repairable defects may include but are not limited to thickness below required minimum thickness, structural strength below required limits, lifts, shrinkage, folds, bulges, and delamination.

n. A list of all repair or replacement of CIPP defects that were executed during the work including identification of segment, location of the repair, and type of repair.

Article 2. MATERIALS AND EQUIPMENT

1. CIPP Liner

a. CIPP liner shall be Inliner by Layne Inliner, Inc., Insituform by Insituform Technologies, Inc., National Liner by National EnviroTech Group LLC, SAK Liner by SAK Construction LLC, CIPP Corp., Sancon CIPP by Sancon Engineering Inc., Improved Technologies Group, or County approved equal.

b. CIPP liner shall be composed of tubing material consisting of one or more layers of a flexible non-woven polyester felt with or without additives such as woven fiberglass or other fibers and meet the requirements of ASTM F 1216, ASTM F 1743 - Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP), and ASTM D 5813 "Standard Specification for Cured-in-Place Thermosetting Resin Sewer Piping Systems". Determine the felt content of CIPP liner; however, it shall not exceed 15 percent of the total impregnated liner volume. Fabric tube shall be capable of absorbing and carrying resins, constructed to withstand installation pressures, and curing temperatures and stretch to fit irregular pipe sections. Submit certified information from felt manufacturer on normal void volume in the felt fabric that will be filled with resin.

c. CIPP liner tube may be made of single or multiple layer construction, with any layer not less than 1.5 mm thick, unless the tube is made of fiberglass material. Wet-out fabric tube shall have a uniform thickness and void space for resin distribution that when compressed at installation pressures will produce a predictable finished thickness that meets or exceeds the design thickness after cure.

d. No material shall be included in fabric tube that may cause de-lamination in cured CIPP. No dry or unsaturated layers shall be acceptable upon visual inspection as evident by color contrast between felt fabric and activated resin containing a colorant.

e. Wall color of interior pipe surface of CIPP after installation shall be a light reflective color so that a clear detailed examination with closed circuit television inspection equipment may be made. Hue of the color shall be dark enough to distinguish a contrast between fully resin saturated felt fabric and dry or resin lean areas.

f. Seams in the fabric tube, if applicable, shall meet the requirements of ASTM D5813.

g. The outside layer of the tube shall be coated with an impermeable material compatible with the resin and fabric.

h. Prior to inversion, if applicable, outside and/or inside layer of tube (before inversion/pull-in as applicable) shall be coated with an impermeable, flexible membrane that will contain the resin and facilitate, if applicable, vacuum impregnation and monitoring of resin saturation during the resin impregnation (wet out) procedure.

i. Exterior of manufactured tube shall have distance markings along its length at regular intervals not to exceed 5 feet. Use these marks as a gauge to measure elongation during insertion. Should overall elongation of a reach exceed 5 percent, liner tube shall be rejected and replaced.

j. Identify the wet-out facility where all CIPP liner under this specification will be manufactured. All CIPP liner shall be manufactured from this designated wet-out facility throughout the entire project unless specifically approved otherwise by County in writing. Multiple wet-out facilities shall not be allowed.

k. County and/or an agent of County may inspect CIPP liner during manufacturing and wet-out. County shall be given an opportunity to witness manufacturing of all CIPP liner for this project. County is responsible for costs associated with witnessing the manufacturing of CIPP liner.

l. If County decides to inspect the manufacturing of CIPP liner, provide full access to witness wet-out process and shall provide any and all information related to the manufacturing as requested by County or County's agent without delay and without claims of confidentiality or product privacy.

m. Application of resin to felt tubing (wet-out) shall be conducted under factory conditions using vacuum impregnation and materials shall be fully protected against UV light, excessive heat, and contamination at all times. If on-site wet out is required, maintain ambient conditions similar to those encountered during factory wet outs.

n. Liners that are impregnated at the factory and transported to the project site in refrigerated trucks shall be installed as soon as possible and no more than two (2) weeks after the date of impregnation at the factory.

o. Shall form a continuous, tight-fitting, hard, impermeable liner that is chemically resistant to any chemicals normally found in domestic sewage per Table 2.1 in ASTM F 1216. CIPP liner shall be chemically resistant to trace amounts of gasoline and other oil products commonly found in municipal sewerage and soils adjacent to sewer pipe to be lined.

p. CIPP liner tube shall be manufactured or fabricated to a size that will tightly fit internal circumference of sewer being rehabilitated after being installed and cured. CIPP liner shall be capable of fitting into irregularly shaped pipe sections and through bends and dips within the pipeline. Allowance for longitudinal and circumferential expansion shall be considered when sizing and installing CIPP liner. Tube shall be properly sized to diameter of existing pipe and length to be rehabilitated and be able to stretch to fit irregular pipe sections and negotiate bends. Determine minimum tube length necessary to effectively span designated run between manholes. Verify lengths in field prior to ordering and prior to impregnation of tube with resin, to ensure that tube will have sufficient length to extend entire length of the run, which is defined as the length of the existing host pipe measured from the interior walls of the manholes, and/or from the ends of the pipe when/if the pipe extends into the manholes. Measure inside diameter and circumference of existing pipelines at face of each manhole in field prior to ordering liner so that liner can be installed in a tight-fitted condition with little or no wrinkling.

q. Length of CIPP liner shall be as deemed necessary to effectively carry out insertion of CIPP liner and sealing of CIPP liner at outlet and inlet manholes. Required diameter and

length of each pipe segment shall be measured in advance of wet-out and a list of these measurements shall be submitted to County at least one week prior to installation of each CIPP liner.

r. Installer shall be responsible for ensuring that correct liner is installed in each sewer reach being rehabilitated.

s. All pipes of diameter 8-in and greater shall have a minimum finished thickness of 6mm or as designed, whichever is greater.

t. Verify proposed CIPP liner thicknesses and submit associated calculations. Actual cured liner thickness shall be -5/+10 percent of approved design thickness and shall not include thickness of any non-structural membrane (inner/pre- liner). CIPP liner shall be designed in accordance with applicable provisions of ASTM F 1216 for "fully deteriorated gravity pipe conditions", unless County agrees in writing, prior to installation that "partially deteriorated gravity pipe conditions" shall apply based upon review of CCTV video. CIPP liner shall meet following design conditions, unless County agrees in writing of their change:

(1) AASHTO H 20 Live Load.

(2) Constrained soil modulus of native soil in the pipe zone of 1,000 psi.

(3) Soil weight of 120 pounds per cubic foot and a coefficient of friction of Ku'=0.130r shall be used for the installed depths.

(4) Long-term flexural modulus used in design calculations shall be estimated by multiplying lowest short-term flexural modulus used in design calculations by a retention factor of 0.50 (i.e., long-term retention of mechanical properties equal to 50 percent.)

(5) Design safety factor of 2.0.

(6) Typical groundwater levels shall be estimated at one half (1/2) the distance between crown of pipe and ground surface. If actual groundwater depth information is available from USGS or other sources, it shall be utilized in calculations. Groundwater depth used in calculations shall be from estimated maximum groundwater level from surface to invert of interior pipe or at elevation specified for in these Standard Specifications.

(7) Service temperature range shall be 40 to 100 degrees F.

(8) Minimum ovality of host pipe of 2 percent.

(9) Long-term retention of mechanical properties equal to 50 percent.

(10) Thickness to be used for CIPP liner shall be largest thickness as determined by calculations for deflection, bending, buckling and minimum stiffness.

(11) CIPP liner thickness for non-round pipes or circular pipes with greater than 10 percent ovality shall be designed on accordance with WRC Sewerage Rehabilitation Manual, Type II Design, Section 5.3.2.iii.

(12) Minimum liner thickness after installation and curing for all pipes 8 inches in diameter and larger shall be 6 mm or as designed, whichever is greater. Thicknesses following installation and curing shall be based on design calculations provided by the installer.

(13) CIPP liner shall provide a minimum service life of 50 years and, for design purposes, shall have the following minimum initial and long-term properties:

Property	Test Method	Initial (psi)	Long Term (psi)
Flexural Strength	ASTM D 790	4,500	2,250
Flexural Modulus of Elasticity	ASTM D 790	350,000	175,000

(14) The CIPP shall be designed to withstand all imposed loads, including dead and live loads and, if applicable, hydrostatic pressure. The liner shall have sufficient wall thickness to withstand all anticipated external pressures and loads that may be imposed after installation.

2. Resin

a. Resin shall be a corrosion resistant polyester or vinyl ester resin and catalyst system or epoxy and hardener system manufactured specifically for sewer rehabilitation, that, and when properly cured within the tube composite, meets the requirements of ASTM F 1216, ASTM F 1743 or ASTM F 2019 (Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Thermosetting Resin Pipe (CIPP)), the physical properties herein, and those, which are to be utilized in the design of CIPP for this project. Resin shall produce CIPP that will comply with or exceed structural and chemical resistance requirements of this specification. Liner material and resin shall be completely compatible. Generally, resin shall not contain fillers, except those required for viscosity control or fire retardance or increase strength, and with applications for which inert fillers would facilitate better heat transfer and retention during installation. Liner installer may add up to 5 percent by mass, a thixotropic agent for viscosity control, which will not interfere with visual inspection.

b. Resins may contain pigments, dyes, or colorants, which shall not interfere with visual inspection of cured liner. Quantity of resin used for tube impregnation shall be sufficient to fill volume of air voids in tube with additional allowances for polymerization shrinkage and loss of resin through cracks and irregularities in original pipe wall. Use serial vacuum impregnation or pressure impregnation process (or approved equal) to provide maximum resin impregnation throughout the tube.

3. Styrene Reducing Agent

a. The styrene reducing agent shall be a gelatin, water soluble, biodegradable, non-toxic, FDA approved powder and/or capsule. The styrene reducing agent shall be added in a calculated amount according to manufacturer’s recommendations into the down-tube for water curing or directly into the water holding tank for steam curing.

b. The styrene reducing agent shall be StyRedux by Integrated Chemical & Equipment Corporation or approved equal.

4. End Seals

c. End seals shall be composed of hydrophilic rubber and molded as a one-piece, three-inch wide cylinder which when installed will form a 360-degree seal between the host pipe and the newly installed liner. Use of caulking, rope or band type of an end seal shall not be allowed. Acceptable end seals are Insignia™ End Seals by LMK Enterprises or approved equal.

d. Where manhole rehabilitation is necessary and required, install epoxy at the end of each lined pipe to cover any piece of existing pipe that are exposed at the manhole wall. Acceptable epoxy resins are Sikadur 31 or approved equal. Where rehabilitation of the manholes is not necessary or feasible, the hydrophilic seals shall provide adequate protection against infiltration.

5. Service Lateral Seals

a. Service lateral connections shall be sealed. If the sewer is not under the phreatic surface, seal service lateral connection by injecting a chemical hydrophilic grout into the space between the connection and the main line using a remote packer system. If the sewer is under the phreatic surface, seal the service lateral connection by installing a hydrophilic rubber connection seal.

b. Chemical hydrophilic grout shall be AV-202 Multigrout by Avanti International or approved equal.

c. Rubber connection seals shall be composed of a hat made of hydrophilic polymeric neoprene rubber designed with a specified wall thickness to provide a compression seal at connection of a lateral and a mainline pipe. Use of caulking, rope or band type of an end seal shall not be allowed.

d. Acceptable hydrophilic rubber seals are Insignia™ Hydrophilic Connection Hat by LMK Enterprises or approved equal.

6. CIPP Spot Repairs

a. Install a sectional CIPP spot repair for areas where longitudinal shrinkage of the installed CIPP liner near the manholes is three (3) inches or more, at no cost to the County.

b. For any other longitudinal shrinkage observed within a pipe segment, install a sectional CIPP spot repair.

c. CIPP spot repair shall be accomplished using a liner tube of a particular length and a thermo-set resin with physical and chemical properties appropriate for the application. The tube positioned within a translucent inversion bladder is vacuum impregnated with the resin, then placed inside a protective launching device and winched through the sewer pipe. The tube shall consist of one or more layers of flexible non-woven needled felt or a reinforced non-woven felt. The tube shall be continuous in length exhibiting a uniform minimum wall thickness based upon design calculations found in ASTM F1216 - Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube, appendix XI. No overlapping sections shall be allowed in the circumference or the length of the liner. The tube shall include compressible material at each end forming a smooth transition to the host pipe. The liner shall be capable of conforming to offset joints, bells, and disfigured pipe sections. The resin shall be polyester, vinyl-ester or epoxy with proper catalysts as designed for the specific application. The cured-in-place pipe shall provide a smooth bore interior. Each

installation shall have a design report documenting the design criteria for a fully deteriorated pipe section, or a partially deteriorated pipe in cases where the pipe has previously been lined. The installation procedure shall conform to ASTM F2599-11 "Standard Practice for Sectional Repair of Damaged Pipe by Means of an Inverted Cured-In-Place Liner". The cured-in-place pipe shall meet or exceed the minimum test standards specified by the American Society for Testing Methods as described in the most current ASTM F1216 standard, most current edition. Acceptable CIPP spot repairs are LMK Performance Liner or approved equal.

d. CIPP spot repairs shall be ambient cure and shall have a fiberglass mat consisting of two or more layers of 0/90 degrees bias woven fiberglass with a Trevara felt coating on one side and capable of carrying a two component, 100 percent solid epoxy or silicate base resin. Acceptable fiberglass CIPP spot repairs are Prime Line sectional lining spot repair or approved equal.

Article 3. INSTALLATION

1. Delivery, Storage, and Handling

   a. Care shall be taken in shipping, handling, and laying to avoid damaging the CIPP liner. CIPP liner damaged beyond repair in shipment shall be replaced as directed by County.

   b. Any CIPP liner showing a visible split, tear, or defect, shall be repaired per manufacturer's recommendations and to the satisfaction of the County or, if not possible, shall be removed at once from the project site.

   c. While stored, CIPP shall be adequately supported and protected in a manner as recommended by manufacturer.

   d. CIPP liner shall be maintained at a proper temperature in refrigerated facilities to prevent premature curing at all times prior to installation. CIPP liner shall be protected from UV light. CIPP liner showing evidence of premature curing will be rejected for use and shall be immediately removed from the site.

2. If available, examine County's CCTV video of each pipe segment before starting work.

3. Notify all property owners or businesses that discharge sewage directly to sewer being lined and whose service lateral will be affected by lining work, that their service will be temporarily discontinued during installation of CIPP liner. Deliver written notification to each such resident or business at least 72 hours in advance, giving the date, start time and estimated completion time for the work being conducted, and any restrictions on use of sewage system facilities including exact days and hours when sewer system cannot be used. Method of notification, and the text included in the notification, shall be approved by County.

4. Clean each length of pipe to be lined and shall dispose of all resulting material offsite as specified in SECTION 3.9 – CLEANING OF SEWERS.

5. Conduct a pre-rehabilitation CCTV inspection of all sewers to be rehabilitated by CIPP lining methods. Inspection shall be for purpose of identifying defects in pipe, to document location of all service lateral connections, and to confirm point repair locations. The project manager and/or superintendent shall review the pre-rehabilitation inspection videos to confirm the quality of the videos, locations of lateral connections, and locations of point repairs to be performed; only after the video quality is adequate for a clear review of pipeline, shall they be submitted to the County.

County will review pre- rehabilitation inspection videos to confirm locations of point repairs to be performed. If the County is on site or immediately available, allow the County to view the pre-installation video to verify the pipe is ready for CIPP installation which includes proper cleaning, trimming protruding taps and mitigating and significant infiltration.

6. If the data is available, County will provide information on location of known active laterals and cleanouts; however, this list may not be interpreted as all-inclusive. Installer shall be responsible for verifying active customer service connection prior to rehabilitation. Compare service connections from CCTV video with the above ground measurements at approximate location of center of each house or building. Any discrepancies between CCTV data and above ground measurements of laterals shall be brought to attention of County for a determination of lateral reinstatements. If an error is discovered or an addition to the list provided, immediately notify County for additional investigation. Upon completion of rehabilitation work, a list of all service laterals abandoned or reconnected as part of the work shall be submitted to County. Compiled list can be in the form of post-inspection installation inspection logs and shall include the following information:

    a. Location of each service lateral based on CCTV inspection logs. Location shall include both accurate distance measured from centerline of starting manhole as well as a notation (by clock-reference) of where on circumference of pipe, the service lateral connects.

    b. Status (Active or Inactive).

    c. Address of each customer and associated active lateral location.

7. During pre-rehabilitation CCTV inspection and prior to installation of CIPP lining, all service lateral connections protruding into main line by 1/2-inch or more shall be internally cut or ground down flush with pipe wall with a robotic cutter specifically designed for this purpose. Internal cutter shall be capable of cutting unreinforced concrete pipe (CP), cast iron pipe, PVC, vitrified clay pipe (VCP), ductile iron pipe, and Orangeburg pipe. All materials / cuttings shall be removed from sewer and properly disposed of.

8. Infiltration runners or gushers as defined by NASSCO PACP that are observed during the pre-rehabilitation CCTV shall be stopped by injecting a chemical hydrophilic grout as required using a remote packer, unless otherwise approved by the County. If the pipe is larger than 36 inches, man-entry with hand-applied fast-setting epoxy can be performed to stop the infiltration.

9. Maximum amount of time any home or business shall be without sanitary sewer service is 10 hours and not between 6:00 PM and 8:00 AM. Any service out longer than 10 hours shall be bypassed to a sanitary sewer at no cost to County.

10. Provide bypass pumping of sewage flows to accommodate the work. Service connection effluent may be plugged only after proper notification to affected residence and may not remain plugged overnight. Installation of liner shall not begin until the required plugs or a sewage by-pass system have been installed and all pumping facilities have been tested under full operating conditions, including bypass of mainline and side sewer flows. Once lining process has begun, existing sewage flows shall be maintained, until resin/felt tube composite is fully cured, cooled down, fully televised and CIPP ends finished.

11. Wastewater flows from existing sewers shall not be allowed to enter the new or rehabilitated facilities until the new or rehabilitated facilities have been cleaned and tested as required in these Standard Specifications.

12. Provide CIPP liner in full length of sewer as shown on work orders. Installation of CIPP liner shall be in complete accordance with applicable provisions of ASTM F 1216 or ASTM F 1743 and manufacturer's recommendations.

13. Install a hydrophilic end seal at face of each manhole at all manhole penetrations prior to inverting or pulling in uncured CIPP liner.

14. If in the opinion of CIPP liner manufacturer and/or the County, rate of infiltration in sewer segment is high enough to risk washout of resin, perform measures, as required, to minimize infiltration prior to installation, including pre-liners, grouting, etc. If during pre-lining CCTV inspection, any infiltration runners, or gushers (per NASSCO PACP®) are observed, submit in writing for approval by County the methods and materials for mitigating any adverse impacts from the infiltration.

15. Pressure gauges for the ends shall be digital pressure/vacuum gauges with a pressure range of 0 to 50 psi and ±0.25% test gauge accuracy.

16. For pipes 18-in diameter and larger, install and use continuous temperature sensor strips. Provide the Owner's representative with access to the longitudinal temperature monitoring system data during the installation via digital data, web-based or other approved methodology and printed reports.

17. CIPP liner shall be installed via inversion using hydrostatic head or air pressure in accordance with ASTM F 1216 or ASTM F 1743 and manufacturer's recommendations or inserted through a manhole by means and methods required by the manufacturer. Hydrostatic head and/or steam pressure used during installation process shall be sufficient to hold liner tight to pipe wall, producing dimples at all service connections, and flared ends at two access manholes. Closely follow the requirements in the submitted liner field curing reports, including the minimum inversion pressure, ideal head, maximum hot head, and maximum cold head for each installation.

18. If CIPP does not fit tightly against original pipe at its termination points, at no additional cost to County, the full circumference of CIPP exiting host pipe shall be filled with a resin mixture compatible with CIPP, approved by CIPP manufacturer and County. There shall be no significant leakage of groundwater between existing pipe and CIPP at manhole connection or service lateral connections. Any leakage shall be removed and/or eliminated at no additional expense to County. Any infiltration found at manhole and/or service connections shall be eliminated by no additional expense to County. Any infiltration runners or gushers as defined by NASSCO PACP shall be stopped with chemical hydrophilic grouting.

19. Fit heat source with monitors to accurately gauge temperature of incoming and outgoing water or steam supply. Place another such gauge between CIPP liner and pipe invert at downstream end to determine temperature during curing process. Temperature in CIPP during curing process shall be as recommended by resin manufacturer. Length of time for allowing curing process to be completed shall be of duration recommended by manufacturer, during which time the installer shall maintain required temperature throughout CIPP. Provide a written temperature data chart/curing log to County's Representative for review to ensure that curing temperatures for resin meet manufacturer's recommendations.

20. The full length from manhole to manhole of the installed resin-impregnated flexible felt tube CIPP liner shall be cured using circulating heated water or steam in accordance with ASTM F 1216 and manufacturer's recommendations or with UV light sources to affect desired cure throughout length of the tube, extending full length from manhole to manhole(s). Resin shall be

cured into a rigid, impermeable pipe with minimum specified thickness, providing a structurally sound, uniformly smooth interior and tight-fitting liner within existing pipe. Cool-down procedures shall be in accordance with ASTM F 1216 and manufacturer's recommendations. The cool-down shall follow manufacturer's guidelines, be measured digitally to allow inspector to inspect or record, be linear, and be gradual; no super cooled air shall be allowed to be injected. UV cured CIPP shall not be permitted without written approval from County and after documentation has been reviewed that liner is compatible with all specifications and other related work including any lateral lining systems.

21. For pull-in-place liners cured by UV light (ASTM F2019)

    a. Fiberglass liner shall be cured with UV light sources at a constant inner pressure sufficient to maintain the liner tight against the existing wall of the pipe.

    b. The time, the rate of travel of the ultraviolet light assembly, light sources and the internal pressures shall all be recorded and as specified by the liner manufacturer. This segment curing data shall be submitted to the County, along with the manufacturer's curing standards

22. CIPP lining may be installed in multiple sewer segments at one time where possible. When installing CIPP lining in multiple sewer segments at one time, the top one-half of CIPP liner in intermediate manhole shall be neatly removed, leaving the invert in place, and void between CIPP liner and existing channel shall be filled with non-shrink grout. Manhole bench shall be reconstructed as required to provide a smooth transition to new CIPP liner.

23. All cutting and sealing of CIPP liner at manhole connections shall provide watertight pipe and manhole seals. All cut edges of cured liner shall be thoroughly sealed with same resin as was used in liner. Catalyst or hardener used shall be compatible with resin/catalyst used in liner previously but shall not require an external heat source to begin exothermic reaction (curing). There shall be no leakage of groundwater into manhole between CIPP liner and existing sewer pipe and between existing sewer pipe and manhole wall.

24. Continuous temperature monitoring systems are required for all 18 inches or larger sewer or any sized sewer in locations with significant known groundwater infiltration or if pipe is within 50 feet of stream, river or lake for liners being cured by heated water or steam. This system shall be installed at the invert of pipe and be installed per manufacturers recommended procedures. Temperature sensors shall be placed at upstream and downstream ends of reach being lined to monitor pressurized fluid's (air or water) temperature during curing process. To monitor temperatures inside tube, wall and to verify proper curing, temperature sensors shall be placed between host pipe and liner in bottom of host pipe (invert) throughout the reach to record the heating and cooling that takes place on the outside of liner during processing. As a minimum, sensors shall be spaced apart at intervals no greater than 20 feet for pipe sizes up to 15 inches in diameter; and no greater than 10 feet for pipe sizes 18 inches and larger. Additionally, sensors shall be strategically placed at points where a significant heat sink is likely to be anticipated. Monitoring of these sensors shall be by a computer that can record temperatures at this interface throughout processing of CIPP utilizing a tamper-proof database. Temperature monitoring systems shall be Zia Systems or Vericure by Pipeline Renewal Technologies.

25. Pipes smaller than 18 inches may be monitored with thermocouples at the upstream and downstream manholes.

26. Prior to installing liner in host pipe, temperature monitoring system's proper functioning shall be confirmed by hooking it up to computer and seeing that sensors are reporting their ambient

temperatures. No more than two sensors in sequence can be found faulty during this test. If three or more sensors in sequence are discovered faulty, a new sensor array shall be provided and installed at no extra cost to the County; and the new array shall be again tested for its proper functioning.

27. Curing of resin system shall be as per recommendations of CIPP system manufacturer of CIPP product. Temperatures achieved and duration of holding the liner at those temperatures shall be per System Manufacturer's established procedures. If any sensor or sensors along reach indicates that there is a localized issue with respect to achieving proper curing per written installation procedure, the installer shall address the issue prior to acceptance of the liner. Sensor array's database required in above paragraphs shall have an output report that identifies each sensor by its station in reach and shows maximum temperature achieved during processing of CIPP and time sustained at or above Manufacturer's required curing temperature at each sensor. The temperature of the liner shall be recorded until the liner has completed the cool-down process.

28. If cool-down is to be accomplished by introduction of cool water into an inversion standpipe to replace water being drained from a small hole made in downstream end, the hardened liner shall be cooled down to a temperature below 100 degrees F (38 degrees C), or ambient temperature, whichever is smaller, before relieving static head in inversion standpipe. Take measures to ensure that, in release of static head, a vacuum will not be produced that could damage the newly installed CIPP liner.

29. Incorporate mitigation measures to control styrene odors during installation and curing of the liner. If any styrene odor complaints occur on the jobsite, means and methods shall be provided to immediately mitigate the issue at no additional expense to the County.

30. Vent and/or exhaust noxious fumes or odors generated during and remaining after curing process is completed. This process shall remain in place at all manholes, laterals, etc., until noxious odors have dissipated to an acceptable level in accordance with OSHA requirements for materials used and there is no more air pollution or potential health hazard left to general public or construction workers.

31. Identify points to which curing water can be discharged. At no point shall curing water be discharged to a storm sewer system.

32. Provide piping, pumps, valves, and other equipment to discharge curing water.

33. After the installation of the first 1,000 linear feet of CIPP lining, no additional CIPP lining shall be installed until acceptance testing demonstrates that the product meets all thickness and strength properties specified herein. Once the County has reviewed and approved the test results, the remainder of the lining installation may resume.

34. Reinstatement of Services

    a. After new CIPP has been cured and completely cooled down, if applicable, reconnect existing service laterals as designated by pre-installation television inspection report. This shall be done without excavation but from interior of pipeline by means of a television camera and a remote cutting device that reestablishes service connection to not less than 95 percent or better of original diameter and to a maximum of 100 percent of original diameter; overcut connections are not acceptable. All openings shall be clean and neatly cut and the cut shall be buffed with a wire brush to remove rough edges and

provide a smooth finish. Bottom of openings shall be flush with bottom of lateral pipe and shall have smooth edges with no protruding material capable of hindering flow or catching debris. All service lateral connections shall be sealed per the requirements of this specification.

b. Coupons shall be removed from laterals by any means possible including flushing water into yard cleanouts and, with approval of the homeowner, entering homes to flush the material via access from cleanout or other sewer drainage points.

c. Excess resin that builds up and hardens in and around the lateral connections(s) must be removed and/or ground down prior to acceptance of the re-instatement. Supply an extended lateral cutter bit to reach resin buildup beyond standard length bits.

d. If necessary, because of uncertainty of matching each tap in the sewer with each property, perform a dye test to verify if a service connection is active at the direction of the County.

e. Service laterals that were determined to be inactive during CCTV inspection will be abandoned by not reopening service connection after installation of cured-in-place pipe liner. All lateral connections shall be identified as repaired or abandoned in post rehabilitation CCTV. Provide an image file for all lateral locations along a given pipe segment, even if lateral connection has been abandoned.

f. Do not open abandoned/capped service connections except at County's direction. If an abandoned service connection is opened without County's approval, an internal spot repair shall be performed to close connection, at no additional expense to the County.

g. Provide a fully operational backup device for reinstating service laterals. If for any reason remote cutting device fails during reinstatement of a service lateral, immediately deploy the standby device to complete reinstatement. Backup equipment shall be onsite throughout reinstatement process.

h. For service lateral reconnections and/or renewals to be made by excavation methods, InsertaTees may be used for solid wall pipes having a 0.36-inch or greater wall thickness. InsertaTees shall be "Fatboy" type with hub manufactured of SDR 26 PVC material incorporating a 360-degree integral stop on the hub surface and exceeding ASTM F1336 Section 10.3 Pipe Stop Load Support Test or approved equal. Romac type saddles shall be used for pipes having a wall thickness thinner than 0.36-inches. Saddle connections shall be seated and sealed to new CIPP using grout or resin compatible with the CIPP.

i. All existing break-in and/or hammer-tap (break-in) laterals shall be cut and sealed to provide a watertight connection between the lateral and the lined pipe. The method for cutting and sealing of each lateral shall be submitted to the County for approval.

Article 4. TESTING AND INSPECTION

1. CIPP lining placed shall be guaranteed by the installer and manufacturer for a period of two years from Substantial Completion. During this period, serious defects discovered in CIPP lining, as determined by County and which may materially affect the integrity, strength, function and/or operation of pipe, shall be removed and replaced as recommended by the manufacturer in a satisfactory manner at no expense to County. County may conduct an independent CCTV inspection, at its own expense, of CIPP lining work prior to completion of warranty period. Defects replaced at that time shall be fully warranted by the installer and

manufacturer for a period of two years from date the defect was repaired. Wrinkles in flow stream, blisters that may affect the longevity of CIPP liner, dry spots where liner tube has no resin saturation, or other defects that may affect the integrity or strength of the CIPP or the flow capacity of the pipe, are unacceptable. Installer shall be responsible to remove and repair, at no expense to the County, all such defects in a manner that is satisfactory to County. Defects also include but not limited to the following:

a. Leakage through the liner or between liner and host pipe.

b. Reduction of liner thickness of more than 10 percent of the thickness designed and/or required. Final liner thickness shall be delivered based on installed product physical properties and as specified in these Standard Specifications.

c. Separation of liner from host pipe where an annular space is clearly noticed, shrinkages (longitudinal and/or circumferential), dry spots, delamination of liner, cured lifts, dry spots, bulges due to external loading, reverse curvatures, splits, cracks, lifts, breaks, folds, major wrinkles (as defined further herein), flats, pinholes, crazing and any other defects that in the CIPP lining will compromise the longevity of the installed product.

d. Circumferential defects (wrinkle, fin, bulge, etc.) in the invert of pipe between 4:00 and 8:00 o'clock shall not exceed three percent of the host pipe diameter or 1/2-inch by visual measurement, whichever is smaller, at the discretion of the County.

e. Longitudinal wrinkles or fins shall not exceed maximum allowable height of five percent of equivalent host pipe diameter or 1-inch, whichever is smaller.

f. Structural strength below the required limits

2. CIPP linings shall follow the quality control plan submitted to the County.

3. CIPP linings shall be from a single manufacturer. Suppliers shall be responsible for provisions of all test requirements specified herein as applicable. In addition, CIPP lining to be installed under this specification may be inspected at the plant for compliance with these specifications by an independent testing laboratory provided by County. The installer shall require manufacturer's cooperation with these inspections. Cost of plant inspection of all CIPP lining approved will be the responsibility of County.

4. Inspections of CIPP lining may also be made by the County or other representatives after delivery. CIPP lining shall be subject to rejection at any time on account of failure to meet any of the requirements specified, even though sample CIPP lining may have been accepted as satisfactory at the place of manufacture. CIPP lining rejected after delivery shall be marked for identification and shall be removed from the job site.

5. Field acceptance of CIPP lining shall be based on County's evaluation of installation, including a review of the CIPP liner curing data, review of post-rehabilitation CCTV inspection data, and review of certified test data for installed CIPP liner, including air testing. All CIPP sample testing, and repairs to installed CIPP as applicable, shall be completed before final acceptance, meeting requirements of these specifications and documented in written form.

6. In the event that an installation is rejected based on review of the post-rehabilitation CCTV inspection, the sewer segment shall be repaired to the satisfaction of the County at no additional expense to the County.

7. For every 1,000 linear feet of CIPP liner installed for the first 5,000 linear feet, sampling and testing shall be performed to determine the installed CIPP liner flexural properties and CIPP liner thickness. After the first five test results have been collected and all have passed the minimum standards per the specification, the County may require collecting random samples up to one sample per 5,000 linear feet for testing. Frequency of testing may be reduced as approved by County after sufficient tests are performed to verify CIPP liner design, production, and installation procedures. Likewise, frequency of testing may be increased by County and performed at no additional expense to County when required tests show that installed CIPP liner does not meet specifications. If a test is not passed, the installer shall re- evaluate liner thickness design to determine if installed physical properties meet minimum design requirements; if it does not, liner shall be replaced or relined with approval from County at no additional expense to County.

8. Testing shall be performed by an independent testing laboratory certified by the American Association for Laboratory Accreditation (A2LA). Submit to the County the name and location of independent testing laboratory, a certified statement from laboratory indicating that they are independent from and not associated with the installer in any way, and A2lA certification for independent testing laboratory.

9. All expenses for sampling and testing of installed liner shall be paid for the installation contractor. Cost of all manufacturer's testing to qualify products furnished to project site shall also be the responsibility of the installer.

10. Sampling and testing of the installed CIPP liner shall conform to ASTM F 1216 and the following requirements:

    a. Remove one restrained sample of installed CIPP liner at least 18-inches in length. Sample shall be captured by installing CIPP liner through a section of PVC pipe (same diameter as existing sewer diameter) within the most downstream manhole of installation and at all intermediate manholes if multiple sewer segments are lined at same time. The installer may elect to cut the sample longitudinally and provide 1/2 the sample to County's representative or inspector for direct shipping to laboratory and keep other half of sample for additional testing if necessary.

    b. CIPP liner thickness shall be measured in accordance with ASTM D 5813. Flexural properties shall be determined in accordance with ASTM D 790. Label and date all samples and provide to inspector or County's representative same day of installation for shipping to independent testing laboratory. County shall be copied on all transmittals to independent testing laboratory. Testing results shall be submitted to the County within 30 days after installation of CIPP liner.

    c. Any CIPP lining that does not meet new calculated thickness requirements shall be corrected in a manner approved by the County at no additional expense to County. County's decision on how to correct deficient CIPP liner installations shall be final. Options for correcting deficient CIPP liner installations that will be considered by County include the following: removal of existing CIPP liner and re-lining the sewer, open-cut replacement of sewer from manhole to manhole, re-lining sewer with existing CIPP liner in place, or accept a deduct from the total work value.

11. Along with the physical properties testing and post installation CCTV survey, deliver a certified copy of the curing report output from the temperature monitoring system used in the control of the curing process for pipes; or provide the County with access to the website where the secure report can be obtained.

12. Perform a post-rehabilitation CCTV inspection of all sewers rehabilitated using CIPP lining methods. Post-rehabilitation CCTV inspection shall be performed following installation of CIPP liner and reinstatement of all active service laterals. The installer's project manager and/or superintendent shall review the post-rehabilitation inspection videos to confirm the quality of the videos and of the installed CIPP; only after the video is confirmed to be of good quality, the videos shall be submitted to the County. If it is determined that any repairs are needed at any segment, a new CCTV inspection shall be performed of the entire segment(s) after the repairs have been completed.

13. Liner Installation Inspection - A visual inspection of the liner will be considered acceptable if liner shows no significant, wrinkles, lifts, ridges, splits, cracks, delamination, flats, dry spots, pinholes, shrinkage, foreign inclusions, crazing, reverse curvatures, or other type of defects in the CIPP lining. Significant defects as defined in this section; and/or any defect that may create a maintenance issue in future such as inhibiting CCTV cameras or allowing solids to get caught on defect, and/or any defect that appears to reduce long-term structural strength or stability of pipeline. Longitudinal wrinkles/fins in height up to a maximum of five percent of inside diameter of host pipe or 1-inch, whichever is smaller, may be acceptable and shall be evaluated by the County for acceptance on a case-by-case basis. Defective lining shall be repaired or replaced at no additional expense to County. If during removal process, the pipe is damaged, perform a point repair at no additional expense to the County.

14. Post CCTV Video Inspection: Submit a digital CCTV of post-lined sewer within seven business days for each pipe segment. County shall review these post-lining videos and approve the installation based upon satisfactory completion of a liner that is free of significant defects.

    a. Removal of wrinkles or fins deemed significant at the discretion of the County, shall be removed using a milling head, relined, or replaced as directed by the County at no additional expense to the County. There shall be no evidence of other major defects in the CIPP lining.

    b. Longitudinal shrinkage of the CIPP liner's length, of more than three (3) inches from the face of the manhole shall be repaired with a fiberglass reinforced CIPP spot repair at no cost to the County.

    c. Circular shrinkage shall be measured via man entry to try to insert a 1/16" thick ruler or similar into any gap more than 8 inches past the MH wall. Document these measurements with digital photos that shall be submitted to the County for approval. Circular shrinkage shall be repaired per manufacturer recommendations at no expense to the County.

15. The CIPP liner shall be watertight. Groundwater infiltration through the wall of the liner shall be zero.

16. All service connections shall be opened to a minimum of 95 percent and a maximum of 100 percent of opening so that a new lateral or lateral lining can be installed properly. Any overcuts more than 105 percent shall be repaired with hydrophilic seal hat connection, CIPP liner or other approved method by the County.

17. All coupons and excess resin shall be removed from reinstated service laterals prior to acceptance of CIPP lining.

18. All pipe-to-manhole connections shall be watertight and free of infiltration.

19. When CIPP is installed using pressurized air, perform an air-test per SECTION 3.4 – SANITARY SEWERS in presence of County's representative immediately following cool down and prior to lateral reinstatement. Otherwise, hydrostatic testing (exfiltration test) of completed liner shall be performed after liner curing and cool down in accordance with ASTM F 1216. Hydrostatic testing shall be performed prior to reinstatement of active services.

20. CIPP liners installed with water inversion methods shall be tested for water tightness using an exfiltration test. Maximum allowable leakage shall be 50 gallons per day per diameter inch of pipe per mile in accordance with ASTM F 1216.

21. After all installations are complete, inspected, post-construction CCTV has been reviewed and approved by the County, and all work is satisfactory to County, cut and trim the new liner at each manhole wall with a minimum 4-inch reveal to maintain a mechanical lock of the liner to the manhole. Seal liner to manhole wall with a sealant material.

END OF SECTION

SECTION 2.8

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TV INSPECTION OF SEWER PIPELINES

SECTION 2.8 - TV INSPECTION OF SEWER PIPELINES

Article 1. GENERAL INFORMATION

1. Summary

    a. Section includes:

        (1) Assess the condition of the indicated sanitary gravity sewer pipes.

        (2) Closed-circuit television (CCTV) of selected gravity sewer pipes using the National Association of Sewer Service Companies (NASSCO) industry standard Pipeline Assessment and Certification Program (PACP) forms and coding.

        (3) Creation of a digital submission of sewer inspection data, videos, photos, and reports on portable external hard drives.

        (4) Provide a visual and written record of internal pipeline features including, general information, overall condition, wastewater depth, structural integrity, and significant defects.

2. Quality Assurance

    a. Perform Work according to NASSCO PACP standards, latest version.

Article 2. PRODUCTS

1. External Hard Drives

    a. Description: A portable storage device that can be attached to a computer through a USB connection.

    b. Solid state data storage devices are preferred.

2. CCTV Software

    a. Capable of providing complete survey reports in compliance with the most recent version of NASSCO PACP.

    b. The PACP defect and construction codes shall be pre-programmed in the CCTV software and shall be grouped by PACP Groups.

    c. Software and Databases

        (1) Fully compliant with PACP.

        (2) Capable of customization with the ability to modify or add to the pipeline condition and group them for ease of use.

        (3) Assessment and reporting software program shall be menu-driven and shall have a complete on-screen help file.

        (4) NASSCO PACP mandatory fields and any additional available field requested by the

County shall be setup in the software prior to the assessment, and all these fields shall be populated with information collected during the assessment. Any general and pipe segment information that is already known prior to the assessment shall be entered into the appropriate fields in advance of performing the physical assessment.

(5) Maintain a database of underground pipe and manhole assets. Structure the asset database similar to the one referencing pipe usage (i.e., sanitary, storm, drainage, etc.) sections (i.e., projects, areas, quadrants).

(6) Surveys include a method of pipe segment numbering and a chronological survey set-up numbering system.

(7) Capacity to import and export survey results in the most recent NASSCO PACP exchange format.

d. The footage reading from the camera equipment shall be automatically entered into the survey log and shall directly correspond to the noted observation location throughout the pipe graphical and tabular reports generated.

3. Sewer Assessment Reports

a. File Naming Conventions: Name all files in accordance with the requirements of the County to allow direct linking of files to pipe assets using a common unique identifier.

(1) Each manhole has been given a unique manhole identification (Asset ID) the file name for each pipeline assessed shall be that unique upstream manhole Asset ID followed by an underscore followed by the unique downstream manhole such as 0123S0456_0123S0457.pdf.

(2) If an unnamed manhole is found, the letter "A" shall be added to the end of the upstream manhole's Asset ID to form a new Asset ID. The data/video files shall then be renamed to include the new Asset ID and a new CCTV assessment shall be started from the new Asset ID.

(3) If more than one unnamed manhole is found between two named manholes, subsequent new manhole Asset IDs shall be formed using the letters "B", "C", etc.

(4) If an unnamed manhole is found, provide documentation showing the location of the unnamed manhole to the County depicting the change in connectivity found in the field.

(5) If the contractor performs a reverse setup and televises an individual pipe segment from more than one direction (i.e., the camera is only able to televise a portion of the entire segment heading downstream, and the remaining portion of the pipe segment was televised heading upstream) then two or more separate video files are allowable. The name of the additional database files etc. (i.e., unique manhole Asset ID followed by an underscore followed by the unique downstream Asset ID) followed by "_1", "_2" etc. at the end of the filename so that it is clear there are multiple files and videos for the same pipe segment. If unnamed manhole(s) is (are) found the procedure previously described shall also apply. Examples:

(a) Initial filename: 0015S0001_0015S0002

(b) Additional filenames: 0015S0001_0015S0002_1

(c) Base the name of each digital still photo on the video/data filename of the specific sewer in which the photo was taken. Record the name as the video/data filename followed by the PACP code for the item pictured followed by the footage at which the observation was encountered. Examples:

(d) (Filename)_(PACP Coded)@(footage).jpg

(e) 0015S0001_0015S0002_HSV@37_2.jpg

(f) 0015S0001_0015S0002_1_MCU@113_6.jpg

b. Format all data files to facilitate upload into a NASSCO PACP exchange database.

c. Digital Video: CCTV assessments shall be captured at a minimum video bit rate of 4,500 kbps.

d. Indicate individual survey results in tabular form and provide a sortable list of surveys based on a user-defined description field. Include the starting and ending manhole Asset IDs depths, pipe material, total survey length, and pipe diameter. All reports and and/or submittals shall comply with the most recent version of NASSCO PACP standards.

e. Submit assessment data to the County on a weekly basis, including digital videos, digital photos, and evaluation reports, all in electronic format on portable external hard drive. All hard drives and the information contained within them are the property of the County after submittal.

(1) Fill data on each portable external hard drive to minimize the number of hard drives submitted. The hard drives shall contain separate digital files for each manhole-to-manhole section of pipe assessed.

(2) Sections of a single segment of sewer shall not be recorded to more than one hard drive.

(3) Video footage of recorded segments shall be grouped by area and shall be submitted in sequential order relating to the area mapping designation.

(4) The footage counter reading from the camera shall appear on all videos.

f. Create separate folders for each inspection. Within each inspection folder include the video file, digital photos, evaluation reports, supporting documentation etc.

(1) Label each portable external hard drive clearly to indicate the date range of the assessments included on the hard drive, the name of the project, the County's project number, Contactor's name, and the index number of the hard drive. The index number for each hard drive shall be the sequential number followed by the area number.

(2) Each portable external hard drive submitted shall contain all sewer assessment data obtained to date. The database shall be comprehensive for the entire project and additional data shall be added to the database each week.

(3) On each hard drive, new data collected since the previous hard drive submittal shall be indicated as such to facilitate separation of the new data from the previously submitted data.

(4) A typewritten summary in pdf format shall be provided for each portable external hard drive that lists the files contained on that hard drive.

Article 3. EXECUTION

1. PREPARATION

a. Sewer Flow Control

(1) Evaluate each segment of sewer to be assessed with respect to diameter, flowrate, velocity, upstream/downstream manhole diameter, debris levels, extent of pipe wall corrosion, and accessibility. Select and provide the most appropriate equipment and methods based on the condition of the specific sewer line segment and its access manhole(s) at the time the work commences.

(2) All assessment work shall be attempted during periods of low flow in the sewer segments being assessed.

(3) At all times during the assessment, the flow in the sewer line segment(s) being assessed shall be suitably controlled as needed to perform the assessment.

(4) If the depth of flow in the sewer segments to be assessed is above the maximum allowable for the use of floating inspection equipment, off peak hours should be pursued to perform the assessment. If flow levels are not sufficient during off peak hours, the flow level shall be lowered by either:

(a) using flow through plugs

(b) performing bypass pumping as approved by the County.

(5) When flow in a sewer line is plugged, blocked, or bypassed, take precautions:

(a) to protect the sewer lines from damage that might result from sewer surcharging.

(b) to ensure that sewer flow control operations do not cause flooding or damage to public or private property being served by the sewer involved.

(6) The use of floating inspection equipment is subject to approval by the County only after all other methods included in this section have been ineffective or deemed not practical.

b. The equipment and methods used for each sewer pipe and the setup location shall conform to the submitted and reviewed plan.

(1) Standard CCTV equipment is appropriate for sewer segments that:

(a) Have a depth of flow less than 25 percent of the pipe diameter.

(b) Do not have signs of corrosion.

(c) Do not appear to have significant debris accumulation below the water surface.

(2) Floating HD Image equipment is appropriate for sewer segments that:

(a) Do not meet the previously listed conditions for using standard and CCTV equipment.

(b) Require longer continuous lengths of assessment due to the difficulty of the manhole access or connection to a buried manhole or manholes.

Article 4. APPLICATION

1. CCTV Equipment

a. Provide a mobile vehicle large enough to accommodate at least three people with video monitoring equipment specifically compatible with the camera equipment being used. County shall have unrestricted access to observe the television screen and all other operations.

b. CCTV Camera designed and constructed for such assessment and shall be capable of:

(1) Producing digital still photos of all sewer observations and service connections.

(2) Production an adjustable light source that generates an even distribution of lighting for the camera that results in a clear color picture of the entire periphery of the pipe. A reflector in front of the camera may be required to enhance lighting in black pipe.

(3) Operating in 100 percent humidity conditions and in a hazardous and corrosive environment.

(4) Panning 360 degrees and tilting 270 degrees and with minimum optical zoom ratio of 10:1 plus a minimum digital zoom ration of 4:1 to facilitate the assessment of all laterals and defects with optimum picture quality provided by focus and iris adjustment.

c. Provide a backup (spare) camera either on the project site or at a nearby location so performance of the Work is not delayed.

d. When usage of standard CCTV equipment is not feasible due to access issues, pipe condition, and/or depth of water flow, floating camera equipment may be used.

(1) Floating HD Camera: the camera shall be capable of recording 360-degree view using a fisheye lens without tilting or panning.

e. Camera, television monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of the County. Picture resolution shall be a minimum of 460 television lines (TVL).

f. Accurate footage counter to display on the monitor the exact distance of the camera from the centerline of the starting manhole.

g. Compatible with the version of NASSCO PACP used by the CCTV software and the reports and submittals generated from the software.

Article 5. FIELD QUALITY CONTROL

a. The following measurements shall be collected for each accessible manhole and included in the PACP exchange database:

(1) Utilize GPS equipment to obtain X and Y state plane coordinates with a submeter accuracy.

(2) Field-measure the vertical distance from the top of the manhole frame to the invert in accordance to NASSCO PACP standards.

b. Pipeline Assessment:

(1) Each sewer section shall be assessed from the upstream manhole to the downstream manhole if possible.

(2) For the upstream and downstream manholes on each segment of pipe that is assessed, pan and tilt from the invert and take digital still photos that clearly depict the entirety of the manhole interior, including cone section.

(3) Assess the full length of each sewer between access points. When the camera is unable to pass an obstruction even though flow is continuing, perform a reverse setup of the CCTV equipment from the opposite access point.

(4) Perform all CCTV assessments using personnel who are trained and certified (current standing) in the use of NASSCO's PACP.

(5) Multiple upstream and/or downstream sewer segments can be televised from a single manhole setup location as long as each manhole-to-manhole video section restarts its footage counter at zero and a separate video file for each assessment is submitted.

(6) The CCTV camera shall travel through the lines using its own power unless a tethered floating unit is used. The pictures taken of the entire inside periphery of the pipe shall be clear and visible. Picture quality and definition shall be to the satisfaction of the County.

(7) Stop the camera at all service laterals and pan at such an angle that an internal view of the service lateral is available to determine if the lateral is active, inactive, or plugged. Take photos:

(a) include a brief description of the subject of the photo directly on the photo.

(b) catalogue and link in the CCTV database so the photos correspond with the length along the sewer line where the photo of the recorded observation was taken.

(c) JPEG format and at least 50 kilobytes in size.

(8) Adjust the camera height such that the camera lens is always centered in the pipe

being televised.

(9) Retrieve camera equipment that becomes stuck within a sewer.

(10) Submit CCTV inspection videos, where reversal setups are not required, in one continuous video section from manhole to the immediately adjacent manhole and not in multiple files. If a reverse setup is required, two complete inspections and video are acceptable.

c. Calibrate camera footage on a weekly basis in the presence of the County with an above ground tape measure and simultaneous CCTV footage counter.

d. Project Notifications: Notify the County immediately if:

(1) A collapsed pipe or other significant pipe failure is discovered.

(2) The conditions for CCTV assessment are found to be unsafe or impractical.

(3) A manhole is buried, cannot be found, or cannot be accessed. Include a diagram in PDF file format that clearly indicates the location of the manhole, identifies its Asset ID, and lists the procedures that were used to attempt to locate the manhole.

(4) Any defects that pose immediate danger to the public are observed (i.e., missing, or broken manhole covers, sinkholes, etc.).

(5) Any major pipe blockages, manhole surcharging, or potential overflow conditions are observed.

(6) The pipe configuration in the field is different than shown on the Drawings. Include a diagram in PDF file format that clearly indicates the location of structures in relation to immediately adjacent structures.

(7) Any significant obstructions are found within permanent sewer easement, even if these obstructions do not impact the Work.

e. Public Notifications: Provide 48-hour notice prior to the assessment of any pipe segment, distribute door-to-door a door hanger, approved by the County, describing the work to be performed to notify the owner of every property, including residences and businesses, that may be affected. Door hangers shall be double-sided with the notification information in the English language on one side and in the Spanish language on the reverse side. Affected properties shall include, but not be limed to, properties on which:

(1) A sewer to be accessed is located.

(2) A manhole for accessing a sewer to assessed is located.

(3) An existing sewer easement that could be used to access the sewer is located.

(4) A temporary right-of-entry agreement with the property owner and the contractor for accessing a sewer or manhole on the property.

(5) An existing sewer lateral serving the property directly connects to a sewer to be assessed or manhole to be accessed for the sewer assessment.

Article 6. DATA QUALITY CONTROL

a. Review quality and accuracy of each submittal of CCTV assessment data and revise as needed to correct any inaccuracies prior to providing submittal to the County.

b. Quality Review:

(1) County requires a 30-day period to review sewer assessment data/videos after each submittal has been received.

(2) Payment applications will not be processed until the sewer assessment data/videos have successfully passed the quality review and have been accepted by the County.

(3) Additional 30-day review periods apply to each resubmittal of data/videos determined to be unacceptable by the County.

(4) Re-inspection is required when digital videos are inaccurate or of such poor quality that the County is unable to evaluate the condition of the sewer or locate sewer service connections.

(5) Provide CCTV assessment data contained on each portable external hard drive in the most recent version of PACP exchange format. Include video indexing for all observations. CCTV assessment data to be submitted:

(a) Database file

(b) Still photos in JPEG file format for each observation

(c) Video for each inspection in MPEG1 file format.

(d) Summary report for each pipe segment in PDF format.

END OF SECTION

SECTION 2.9

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CLEANING OF SEWERS

SECTION 2.9 - CLEANING OF SEWERS

Article 1. GENERAL INFORMATION

1. Section includes cleaning of sewer pipe and fittings installed and/or rehabilitated, complete as shown on the approved drawings and as specified herein.

2. Cleaning includes proper high-pressure water jetting, rodding, bucketing, brushing, and flushing of sewers and manholes prior to inspection by closed circuit television, pipeline rehabilitation or replacement, point repairs, manhole preparation, and testing operations.

3. Clean all sewers to remove debris, roots, intruding services, deposits, and other blockages to a minimum of 95 percent open. Perform sewer cleaning work to an acceptable level as necessary to perform a thorough television inspection of sewer. If pipe condition is such that cleaning may cause a potential collapse, then pipe shall be televised without attempting to clean it to 95 percent condition, pending approval by County.

4. Submit one complete set of documentation regarding inspections and work performed. Based on work scope, submit written reports, photographs and External Hard Drives that incorporate color video and data per SECTION 2.8 – TV INSPECTION OF SEWER PIPELINES.

5. Submit a safety plan prior to performing any on-site work that includes the following as a minimum:

    a. Confined Space Entry

    b. Personal Protective Equipment

Article 2. QUALIFICATIONS STATEMENTS

1. Contractor shall have a minimum of five years' experience in sewer line and underground structure cleaning. Submit a list of at least three customers who have had similar work complete. Furnish trained and qualified technicians with proper experience operating equipment that is being used on for the work.

Article 3. DEFINITIONS

1. Light Cleaning: Small amounts of debris existing within sewer line and where sewer reaches do not require heavy cleaning, as defined below, and that produce little or no debris. Minimum of 2 jetting passes.

2. Heavy Cleaning: Large deposits of debris or heavy root growth existing within sewer line and where sewer reaches require debris removal of depths up to 25 percent of pipe height.

3. Excessive Heavy Cleaning: Large deposits of debris or heavy root growth existing within sewer line and where sewer reaches require debris removal exceeding the definition of Heavy Cleaning, and time required to clean and inspect the line must be at least twice the average time required to clean and inspect other sewers of comparable length and diameter.

Article 4. MEASUREMENT

1. Light Cleaning: Clean sewer using standard industry procedures of high-pressure water jetting equipment or other approved equipment. Costs related to cleaning of such sewers shall be included in Contractor's unit prices for CCTV and Light Cleaning.

    a. Basis of Measurement: By linear foot, measured to the nearest 0.1-foot.

    b. Basis of Payment: TV inspection, data compiling according to NASSCO PACP standards, and audio-video recording of pipeline.

2. Heavy cleaning: Heavy cleaning must be designated as such by the County and approved by County prior to work taking place. Include costs related to cleaning of such sewers in Unit Prices for Heavy Cleaning. Costs related to televising of such sewers following heavy cleaning shall be included in Unit Prices for CCTV and Light Cleaning. Compensation for heavy cleaning of a particular line will only be paid if:

    a. Heavy cleaning was authorized by County prior to performance of the work.

    b. Contractor proves that both significant time and effort was necessary to clean the line, (i.e. time required to clean and inspect the line must be at least twice the average time required to clean and inspect other sewers of comparable length and diameter.

    c. Adequate video proof of 'before' blockage, debris, grit or grease build-up, or other condition is provided.

    d. A submerged camera does not justify a need for heavy cleaning; proof that submergence was due to a blockage or heavy debris and not a sag in the line will be required.

    e. Heavy Cleaning will be paid for on a lineal foot basis only for length required to be cleaned, i.e., from downstream manhole to approximate location of heavy cleaning. This may or may not include entire pipe section, unless otherwise approved by County.

    f. Basis of Measurement: By linear foot measured to the nearest 0.1-foot.

    g. Basis of Payment: TV inspection, data compiling according to NASSCO PACP standards, and audio-video recording of pipeline.

3. Excessive Heavy Cleaning: Pipes that contain excessive blockages will be paid on a time and material basis, upon approval by County. A full-time inspector is required to oversee time and material work. Provide direct water source as required. County may determine any individual pipe be cleaned on a time and material basis.

Article 5. EXECUTION

1. Remove debris, roots, intruding services, deposits, and other blockages to a minimum of 95 percent open as necessary to perform a thorough television inspection of sewer. If pipe condition is such that cleaning may cause a potential collapse, televise pipe without attempting to clean it to 95 percent condition, pending approval by County.

2. Preparation

a. Select, based on pre-construction CCTV inspection, cleaning equipment to address conditions of manhole and sewer lines at the time the work commences to adequately remove dirt, grease, rocks, sand, and other materials and obstructions from sewer lines and manholes to allow performance of other work.

b. Take satisfactory precautions to protect sewer lines from damage that might be caused by improper use of cleaning equipment. Whenever using hydraulically propelled cleaning tools that depend upon water pressure to provide their cleaning force, or any tools that retard flow of water in sewer line, take precautions to ensure that water does not cause damage or flooding to public or private property.

c. No fire hydrant shall be obstructed in case of a fire in area served by hydrant.

d. Remove water meters, piping, and related equipment from fire hydrants at end of each workday.

3. Equipment

a. Hydraulic Sewer Cleaning Equipment:

(1) Equipment: movable dam type constructed so that a portion of the dam may be collapsed at any time during cleaning operation to protect against flooding of sewer.

(a) Movable dam shall be same diameter as pipe being cleaned and shall provide flexible scraper around outer periphery to ensure total removal of grease. If sewer cleaning balls or other such equipment which cannot be collapsed instantly are used, take special precautions against flooding of sewers and public or private property.

b. Mechanical Cleaning Equipment:

(1) High Velocity Jet (Hydrocleaning) Equipment:

(a) Have a minimum of 500 feet of high-pressure hose.

(b) Have a selection of two or more velocity nozzles that can produce a scouring action from 15 to 45 degrees in all size lines to be cleaned. Also include a high velocity gun for washing and scouring manhole walls and floor.

(c) Be capable of producing a minimum of 80 gallons per minute flows from a fine spray to a long-distance solid stream and delivering up to 1000 psi. Be able to carry its own water tank, auxiliary engines, pumps, and hydraulically driven hose reel. Locate controls so equipment can be operated above ground. Select flowrates and pressures as required for each size of sewer, type of debris, and amount of debris, and as recommended by nozzle manufacturers.

(d) Have a water tank, auxiliary engines and pumps, and a hydraulically driven hose reel.

(e) Have root cutting blades that are hydraulically spun.

(2) Bucket machines shall be in pairs and with sufficient power to perform the work in an efficient manner. Machines shall be belt operated or have an overload device. Machines with direct drive that could cause damage to the pipe shall not be acceptable.

(3) Power rodding machines shall be either sectional or continuous type capable of holding a minimum of 750 feet of rod. Rod shall be specifically treated steel. To ensure safe operation, machine shall have a fully enclosed body and an automatic safety release clutch or relief valve.

4. Application

a. Provide appropriate screening to stop passing of materials into downstream sewers. Sludge, dirt, sand, rocks, grease, and other solid or semisolid residue, debris, and material resulting from cleaning operations shall be removed at downstream manhole of section of sewer being cleaned. Passing material from manhole section to manhole section which could cause line stoppages, accumulations of sand in wet wells, or damage to pumping equipment shall not be permitted.

b. Remove debris, residue, and other materials resulting from cleaning operations from site at end of each workday and shall be disposed of in an approved and lawful manner. Under no circumstances will accumulation of debris, residue, and other matter be permitted on site beyond stated time, unless prior written authorization is given for storage in totally enclosed containers. Contractor shall be fully responsible for the disposal of debris at the end of each working day.

c. Specifics regarding the scheduling, monitoring, disposal fees (if any) and approved methods and procedures for disposal must be arranged with

d. Flushing of sanitary sewers to facilitate cleaning activities without the capture of solids and debris is expressly prohibited.

e. Retrieval of equipment lodged in pipes or a wet well is Contractor's responsibility and shall be performed at Contractor's expense.

f. Cleaning Precautions: During sewer cleaning operations, satisfactory precautions shall be taken in use of cleaning equipment. When hydraulically propelled cleaning tools (which depend upon water pressure to provide their cleaning force) or tools which retard flow in sewer line are used, precautions shall be taken to ensure that water pressure created does not damage or cause flooding of public or private property being served by sewer. When possible, flow of sewage in sewer shall be utilized to provide necessary pressure for hydraulic cleaning devices. When additional water from fire hydrants is necessary to avoid delay in normal work procedures, water shall be conserved and not used unnecessarily.

g. No sewer cleaning shall take place in a particular sewer segment until upstream pipe segments have been cleaned. If cleaning is done in a downstream pipe segment to facilitate overall cleaning operations, segment shall be re-cleaned at no additional cost to County, after pipes upstream of that segment have been cleaned.

h. Sewer line walls shall be cleaned adequately to provide for proper operation of joint testing and sealing equipment or internal inspection to discern structural defects, misalignment, and infiltration/inflow sources. Cleaning shall be performed immediately prior to joint testing and sealing and internal inspection to preclude build-up of debris from infiltration/inflow sources and discharges from upstream pipeline sections.

i. Designated sewer manhole sections shall be cleaned using hydraulically propelled, high velocity jet, or mechanically powered equipment. If cleaning of an entire section cannot be successfully performed from one manhole, equipment shall be set up on other manhole and cleaning again attempted. If, again, successful cleaning cannot be performed or equipment fails to traverse entire manhole section, it will be assumed that a major blockage exists, and cleaning effort shall be repeated with other types of equipment. Immediately report any blockages to County.

j. Water for sewer cleaning shall be purchased and obtained at locations in accordance with utility owner. If water is obtained from a potable supply, provide appropriate backflow prevention devices as required by authority having jurisdiction to protect potable system from cross connections and contamination. Prevent cross contamination of any public or private water systems used for this purpose.

5. Field Quality Control

a. Acceptance of sewer line cleaning is contingent on satisfactory completion of television inspection. If television inspection shows cleaning to be unsatisfactory, re-clean sewer line and re-inspect until cleaning is shown to be satisfactory.

b. If internal joint testing and sealing is to follow cleaning, give particular attention to adequacy of cleaning to ensure that proper seating of sealing packer can be achieved.

c. Inspection of cleaning operations will be made daily by the County.

6. Final Cleaning

a. Upon cleaning of underground sewer lines or structures, removal debris from finish grade and clean work areas so conditions at conclusion of the work are equal to or better than areas prior to work of this Section.

END OF SECTION

SECTION 2.10

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SEWAGE PUMPING STATIONS

SECTION 2.10 – SEWAGE PUMPING STATIONS

Article 1. GENERAL INFORMATION

1. These requirements pertain to pumping stations which will serve multiple and/or industrial or other developments which discharge sewage by gravity to a pumping station site. The information contained in this section is meant to serve as a general guide for pumping station design. All pumping station designs must be submitted to the Carroll County Bureau of Utilities (County) for review and approval prior to construction.

2. These County standard design guidelines are based not only on recognized design and regulatory provisions, but also experience and standard operating/maintenance procedures. Operation 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 pump stations.

3. Prior to approval, detailed construction drawings, specifications, design calculations and pump curves must be submitted for review by the County. The drawings will be reviewed for general design, general dimensions and apparent suitability and will be approved or returned for revisions. Such approval will not relieve the Contractor of the responsibility for furnishing equipment which will satisfactorily perform under the conditions specified.

4. Sanitary sewage pumping stations shall be properly designed to conform to all applicable regulations of the Maryland Department of the Environment (MDE), Occupational Safety and Health Administration (OSHA) and the Maryland Department of Labor, Licensing & Regulation.

5. Design features of the structure and mechanical equipment shall consider 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, expandability, and efficiency. Pumping stations may be built-in-place or be a prefabricated package.

6. Special consideration must be given to the fact that wet wells are considered a hazardous Class 1, Division 1 environment.

7. The engineer shall make special reference to the MDE Design Guidelines for Wastewater Facilities manual. All pumping stations require a design review and Construction Permit by the MDE. MDE has issued design requirements in the latest edition of “Design Guidelines for Wastewater Facilities” which act as a supplement to the Ten State Standards. Ultimately the design must meet or exceed MDE and Carroll County design conditions.

8. 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.

9. All gears, chains, couplings, projecting set screws, keys and similar rotating or reciprocating parts shall be protected in accordance with the American National Standards Institute (ANSI).

10. To the extent practical, wastewater pumping station designs shall conform to the design standards given herein. The design standards shall be applied to design conditions in a careful and thoughtful manner. Deviations from the design standards must be brought to the attention of the Bureau of Utilities. Waivers of the Design Manual must be justified to the Bureau in writing, from an engineering evaluation standpoint and include consideration of life cycle costs and ease of

maintenance. Approval or denial of the waiver request will be by return letter signed by the Chief of the Bureau of Utilities.

Article 2. GENERAL REQUIREMENTS

1. Pumping Station Pre-Design/Analysis Meeting with Bureau of Utilities:

    a. Prior to substantial design development work taking place the developer shall schedule a pre-design meeting with the County. This pre-design meeting will be necessary to verify the pumping station design criteria will be met, understand project timing, and determine the administrative requirements necessary to proceed with the project.

    b. 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 any detailed drawings and specifications, the designer shall perform a hydraulic analysis together with a graphic sketch plan and submit to the Bureau of Utilities for review and comment.

2. Permits:

    a. All aspects of the site design shall be in accordance with County and local municipal zoning and Bureau of Development Review requirements.

    b. All pumping stations shall meet the requirements of the Carroll County Building Code.

    c. The Contractor shall secure, in the name of the County, all permits that are required in the name of the County such as those from MDE and the Maryland State Highway Administration (MDSHA).

    d. The Contractor shall secure, in their own name, all required construction permits such as local street opening permits, electrical permits, plumbing permits, etc. Costs of all permits, including all bonds required, shall be the sole expense of the Contractor. Any existing street, highway or other improvements disturbed during construction shall be restored to the satisfaction of the appropriate municipality or property owner before the facilities will be approved for final acceptance by the County.

Article 3. SITE DESIGN CRITERIA

1. Pumping stations shall be located as far as possible from populated areas. Natural screening and remoteness of the site shall be primary elements of site selection wherever possible. Where pump stations are sited in proximity to developed areas, the architecture of the station shall be compatible with the surrounding area. Predominant wind direction for odor dispersion and building aspects such as generator exhaust and noise shall be considered.

2. All pumping stations shall be designed to minimize noise in accordance with COMAR 26.02.03 or the latest version.

3. Land required for pumping stations, including necessary vehicular access routes to an existingor proposed public roadway shall be owned in fee simple by Carroll County. In determining the space required for the facility attention shall be given to the width provided for the access road to ensure adequate space for grading and drainage.

4. The site design and location must conform to all applicable portions of subdivision regulations

requirements for site development plans.

5. Sewer tributaries of pumping stations commonly dictate site selection. Adjacent drainage areas potentially served by the pumping station must also be considered.

6. Wastewater pumping stations shall be sited to remain operational and permit access during a 100-year return frequency flood. The pumping station top slab elevation shall be set a minimum of two feet above the 100-year floodplain elevation.

7. Direct impacts to wetlands shall be avoided wherever possible and minimized within wetland buffer areas.

8. The pumping station site shall be properly graded to eliminate any storm water problems and/or ponding conditions and shall include positive drainage away from structures generally limited to no greater than 4 percent slopes. Land grading outside of the pumping station perimeter fence shall not exceed 3 to 1 slope. Wherever possible slopes shall be 4 to 1 or less. The use of retaining walls on or adjacent to the pumping station is not permitted.

9. After grading, the site shall be seeded and landscaped. Provisions shall be made to include shrubbery or trees in the landscaping to enhance the appearance of the station. The Contractor is responsible for obtaining a good stand of grass until the time of first cutting.

10. The site shall be of sufficient size to accommodate the pumping facilities, a minimum of two parking spaces and adequate paving to permit the turn-around of a single unit utility vehicle with a wheelbase of 20 feet and width of 8 feet 6 inches.

11. The access road and turn-around at the pumping station shall have a paved surface. The minimum width of the paved surface of the access road shall be 12 feet 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.

12. Pumping stations that have long driveways (exceeding 100 feet) from the public roadway shall be provided with a second gate at the driveway entrance to the station access road to prevent loitering.

13. At least two test borings shall be taken at the building location to determine soil types, rock, water table elevations, soil bearing values etc. When in soil standard penetration tests shall be taken at intervals not to exceed five feet. When in rock, the rock shall be cored with a double tubed core barrel sized NWX and length of individual core runs shall not exceed five feet. Borings shall be taken to a depth of not less than fifteen feet below the bottom of the proposed structure. Borings shall be taken deeper as necessary, depending on soil conditions.

14. Fencing

    a. The County must approve all final fencing decisions. Special screening requirements will need to be met for pumping stations located within residential developments, or near historic areas.

    b. In general, the site shall be fenced with vinyl-coated (black or green) chain link fence with barbed wire 6 feet high with sliding/rolling link fence gate and personnel gate. The driveway gate shall be a minimum of 14 feet wide to accommodate a full-size pump/vacuum truck with 1ft of clearance on either side. The personnel gate must be separate from the sliding/rolling gate. Locking devices must be provided on both gates.

Additional property line fencing may be required as determined by the County.

c. Barbed wire, conforming to ASTM A121, shall consist of two 12 ½-gauge twisted line wires with 14-gauge round aluminum wire barbs, having 4 points and spaced 5 inches on center. Line wire shall have a vinyl coating to match the fence chain link. Barbed wire support arms shall be single arm, for 3 strands of barbed wire and be at an angle of 45 degrees, with the top strand of barbed wire being 12in above and 12in out from the fence line.

15. Lighting

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

b. The site shall be provided with overhead dusk-to-dawn exterior lighting with shatter-proof bulbs and no outside switches. This lighting shall adequately illuminate the site entrance, building doorways, wet well access hatch, and generator.

c. All interior non-confined spaces shall have adequate lighting to effectively illuminate all areas within the pumping station.

16. Water Supply

a. All provisions within the Carroll County Plumbing Code shall be satisfied. Service shall include all permits, fees, and charges for the provision thereof.

b. Where public water supply is available, furnish and install a 1-inch diameter metered water service terminating at a frost-proof yard hydrant in the case of a submersible type pumping station, and terminating inside the drywell in the case of a wetwell/drywell pumping station.

c. Where connected to a public water supply, the service shall include a water meter and RPZ backflow preventer (as required by the Carroll County Plumbing Code). For packaged and submersible stations this assembly may be mounted on a concrete pad with a heat trace and insulated cover.

d. Where public water supply is not available, furnish and install a well and well pump with all controls, power supply, frost-proof hydrant, and necessary appurtenances. The well and well pump must be capable of producing a minimum of 5 gpm at a pressure of 50 – 70 psig at the hydropneumatic tank.

e. All stations shall have either an exterior frost-proof yard hydrant or hose bib.

17. Power Supply

a. The power supply for each new pump station shall be three-phase power, minimum 240V. Additionally, all new pump motors shall operate on three-phase power. Phase converters or de-rated variable frequency drives (VFDs) shall not be allowed. Any exceptions to this requirement must be reviewed by the County on a case-by-case basis.

Article 4. HYDRAULIC DESIGN CRITERIA

1. The ultimate design flow rate shall be the peak flow rate for the service area plus I/I allowance.

Wastewater pumping stations shall be designed to the ultimate design flow rate and shall include all existing and future users and shall consider wastewater composition. The ultimate design shall incorporate those parcels identified by Bureau of Planning as being part of the Buildable Land Inventory (BLI) and represent a full built-out EDU count. Existing institutional, commercial, and industrial flows shall be determined by a study of the establishments. The pumping units shall be selected to satisfy both the initial and ultimate design hydraulic peak flows. If not feasible, the initial flow rate and an intermediate flow rate based on an approved interim state of development will be considered by the County.

2. Wastewater composition can vary depending upon the proportion of design flow generated by non-domestic users. Non-domestic user wastewater composition shall be investigated. Consideration and all necessary provisions shall be taken to ensure wastewater pumping station equipment and materials are suitable for the anticipated composition of the wastewater. Consultation with the Bureau of Utilities is required in the event that the composition affects standard material and equipment requirements.

3. Peaking factors shall be incorporated to all design conditions. Refer to the MDE Design Guidelines for Wastewater Facilities for these factors. Pumping units can be upgraded by means of impeller changes (and considering the existing motor size), speed changes, or both.

4. At least one standby pump shall be included in the design and equipped to be operational. Pumps shall be of such capacity that with the largest unit out of service, the remaining pumps will deliver the peak flow.

5. Proposed pumping stations must satisfy the hydraulic conditions of the system. The designer shall perform a complete hydraulic analysis for the pumping station. Analysis shall consider potential impacts on existing force mains, gravity sewers and downstream pump station(s). Pump stations shall be designed to operate at the appropriate discharge head and flow rate.

6. Stations shall be designed such that the following feet per second (fps) velocity tolerances are met at all design points:

Suction Piping:	3.0 fps – 6.0 fps
Discharge Piping:	3.0 fps – 8.0 fps
Forcemain Piping:	2.0 fps – 8.0 fps

7. The design friction factor for new ductile iron pipe shall be C=120.

8. The Contractor shall furnish a complete hydraulic design calculation for all pumping equipment and design points. Supply the manufacturer's information and relevant pump characteristic curves based on laboratory tests of existing similar pumps. The curves shall show the capacity, head, efficiency and brake horsepower throughout the head and capacity range. Pump curves shall be shown for single pump operation, as well as for multiple pump operation in stations having three or more pumps.

9. The designer shall fully investigate water hammer and provide additional necessary surge protection of the pumping stations as required. Where the maximum water hammer pressure exceeds the weakest piping system component by a safety factor of 1.1, strengthen those elements affected, reevaluate pipe size and velocities or select an appropriate device to control water hammer. Hydraulically operated, time adjustable, pump valves and spring type, oil-cushioned elbow hydraulic surge relief valves at a minimum are the preferred choices. No pressure vessel/surge tank type devices will be acceptable. The decision to strengthen piping system components instead of utilizing a water hammer control device or different pipe size shall be based upon a life cycle cost

economic comparison.

Article 5. CLASSIFICATION OF PUMP STATIONS

1. Very Small Stations (Grinder)

    a. Defined as less than 25 EDUs and less than 20 gpm. Duplex pumps are grinder pumps with a discharge of 1.5 or 2-inch diameters.

        (1) The County prefers to avoid low pressure sewer systems but will review applications for low pressure sewer systems on a case-by-case basis.

        (2) They can be package, prefabricated, or built-in-place. 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.

        (3) Such stations shall not accept flows from more than a single parcel. Flow metering is not required.

        (4) The County will not accept dedication of very small pump stations. Ownership and maintenance of these stations shall be the responsibility of the property owner.

2. Small Stations (Grinder)

    a. Defined as 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 2 inches and 3 inches.

    b. 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.

    c. Flow metering is required.

3. Medium Stations (Trash)

    a. Defined as stations that pump between 80 and 500 gpm with up to 100 hp motors. These stations must be submersible or suction lift type and are typically a duplex design but can be triplex.

    b. These stations are to be designed for future growth expansion by replacing existing impellers or making provisions for an additional pump.

        (1) Expansion design shall be incumbent upon the developer during the initial design phase.

        (2) Consider the motor size needed before impellers are replaced, otherwise a motor overload could occur.

        (3) Should the expansion planning determine that future flow will exceed 500 gpm, the station shall meet the requirements set forth for Large Stations.

c. Pumps shall handle 3-inch solids with a 4-inch discharge. The discharge size is critical for future expansions.

d. Controls are to be in an appropriately sized building. Splash baffles on interior walls or splash proof NEMA rated control panels may be required.

e. Flow metering is required.

4. Large Stations (Trash)

a. Defined as stations that pump over 500 gpm. These stations must be of the suction-lift or wet well/dry well type. All underground structures must be type II concrete.

b. A magnetic flow meter capable of continuously recording pumped flows shall be provided.

c. All other requirements set-forth for Medium Stations are also applicable for Large Stations.

Article 6. WET WELL DESIGN

1. The inside of the wet well and all surrounding areas within a 10ft diameter and 18in high envelop are considered a Class 1, Division 1 hazardous location. All equipment inside this envelop shall be suitable for this environment and be explosion proof.

2. 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 15 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

3. The County may require additional wet well volume (beyond standard state design criteria) to ensure a safety factor can be maintained based on staff's ability to respond during emergency situations.

4. 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 adjusting the level controls.

5. 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.

6. The differential between pump start and off levels shall not be less than 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 1-foot above the top of the pump volute.

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

maintenance personnel.

Article 7. EMERGENCY DESIGN CRITERIA

1. MDE Design Guidelines for Wastewater Facilities shall be followed for determining the auxiliary power source, overflow detention structure, standby pumping unit, and pump-around connection coupling facility.

2. Design pumping station such that all maintenance needs can be completed out of the weather, including work on any panels.

3. Emergency Power

    a. Backup power is required for all stations, except as otherwise provided herein. The backup power shall be connected to the station through an automatic transfer switch (ATS) such that backup power is established immediately.

    b. In addition to backup power, all stations shall have a portable generator receptacle with a manual transfer switch incorporated into the design such that a portable generator could be utilized to power the station.

    c. 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.

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

4. Pump Bypass

    a. The pump station force main shall include a tee with standpipe arrangement to allow for future bypass pumping operations. The standpipe assembly shall be isolated from the forcemain with a plug valve, include a drainpipe to the wet well with isolation gate valve, and a blind flange tapped for a 6" MPT connection situated 3 ft above grade.

Article 8. PIPES AND FITTINGS

1. Suction and discharge piping shall be Class 52 (min) ductile iron: ANSI A21.50 and ANSI A21.51. Fittings shall be gray iron or ductile iron: ANSI A21.10, up to 12 inches inclusive, 250 psi rated. Flanged joints shall be used inside structures. Mechanical joints shall be used for buried pipe.

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

Article 9. VALVES

1. All valves of the same type shall be provided by the same manufacturer. Isolation valves for wastewater service are to be plug valves unless otherwise approved by the County.

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.

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. Unless otherwise noted, valves shall have a minimum working pressure the same as the working pressure as the pipe they connect to.

5. No valves shall be placed within the wet well. All valves within the pump station site shall be placed within a vault.

6. Gate Valves:

    a. Valves shall meet the requirements of AWWA C509.

    b. Gate valves shall have cast-iron bodies with a rising stem design and Class 125 flanged end connections.

    c. Rising stem valves shall be sealed with adjustable and replaceable packing; valve design must permit packing replacement under operating system pressures with only moderate leakage.

    d. Bonnet and gland bolts shall be stainless steel.

    e. Discs shall be wedge type of rubber coated ductile iron construction.

    f. Valves shall be equipped with handwheel operators.

    g. Except as otherwise specified, valves shall be rated for the following working pressures:

Valve Size	Pressure (psig)
3 inches to 12 inches	200
14 inches to 20 inches	150
24 inches and greater	50

    h. All valve bodies shall be hydrostatically tested to at least twice the rated working water pressure. In addition, valves shall be seat-tested, bi-directional at the rated working pressure, with seat leakage not to exceed one fluid ounce per inch of valve diameter per hour.

    i. Unless otherwise indicated, valves 12 inches and smaller shall be capable of installation in the vertical or horizontal position and sealing in both directions at the rated pressure.

    j. Exposed valves 16 inches and larger to have valve by-pass.

    k. Provide geared operator and chainwheel, chain and chain guides for valves with handwheel centerline more than 7 feet above operating level.

    l. All valves shall be marked per AWWA Standards, including name of manufacturer, valve size and working pressure and year of manufacture.

    m. Valve operation shall be counterclockwise for potable water, clockwise for wastewater and other non-potable waters. Provide permanent label showing "OPEN" and arrows.

n. Resilient seated valves shall be coated, interior and exterior, with fusion bonded epoxy per AWWA C550.

o. Gate shall be encapsulated with synthetic rubber. It shall be bonded and vulcanized in accordance with ASTM D429 Method B.

p. Resilient seated design manufactured by Kennedy Valve; M&H Valve or Clow Corp.; or approved equal.

7. Plug Valves:

a. Plug valves shall be of the offset disc type, 1/4 turn, non-lubricated, serviceable (able to be repacked) under full line pressure and capable of sealing in both directions at the rated pressure. The disc shall be completely out of the flow path when open.

b. All size plug valves shall have a full port area of 100 percent.

c. Valves shall be rated at minimum 175 psi WOG (water, oil, and gas) working pressure for sizes 4 inch to 12 inch inclusive and at minimum 150 psi WOG working pressure for sizes 14 inch and larger.

(1) All plug valves under this paragraph shall be performance, leakage and hydrostatically tested in accordance with AWWA C517, except as modified herein.

(2) At the above rated minimum working pressures, the valves shall be certified by the manufacturer as permitting zero leakage for a period of at least 5 minutes with pressure applied in either direction.

d. Valve bodies shall be of cast iron, 30,000 psi tensile strength, ASTM A126, Grade B, or of ductile iron, ASTM A536 and of the top entry, bolted bonnet design, cast with integral flanges conforming to the connecting piping. All exposed bolts, nuts and washers shall have Type 316 stainless steel hardware.

e. The valve plug shall be cast iron ASTM A126, Grade B, or ductile iron, ASTM A536, Grade 65 45-12, be removable without removing the valve from the line and have an integral upper and lower shaft which shall have seals on the upper and lower journals to prevent entrance of solids into the journals.

f. Shaft bearings shall be permanently lubricated, rigidly backed TFE, stainless steel or bronze at both upper and lower stem journals. The operator shaft shall have easily replaceable seals, which shall be externally adjustable and repackable without removing the bonnet from the valve or shall have self-adjusting packing.

g. The valve seating surface shall provide full 360-degree seating by contact of a resilient seating material on the disc mating with welded in high nickel content overlay seating surface in the body.

h. Discs shall have a full resilient facing of neoprene or Buna N.

i. Plug valves specified herein shall be Millcentric by Milliken or approved equal.

8. Check Valves:

    a. Check valves shall be swing type and shall meet the requirements of AWWA C508. Valves shall be iron body, bronze mounted, single disc, minimum 175 psi working pressure for 4-inch to 12-inch, 150 psi working pressure for 14-inch to 30-inch, non-shock and hydrostatically tested at 300 psi. When there is no flow through line, disc shall hang lightly against its seat in practically a vertical position. When open, disc shall swing clear of waterway. Valves shall be so constructed that disc and body seat may easily be removed and replaced without removing valve from line.

    b. Check valves shall have bronze seat and body rings, bronze or ductile clapper arm and bronze nuts on the bolts of bolted covers. Shaft assembly and key shall be made of stainless steel. Hinge shaft shall extend from body of valve, sealed with stuffing box, packing and gland. Shaft side plug bearing, stuffing box and gland shall be bronze, packing shall be reinforced Teflon, both side plug and stuffing box shall be provided with grease fittings.

    c. Valves less than 10 inches diameter shall be furnished with outside lever and weight. Valves 10 inches diameter and larger shall be furnished with outside lever and spring.

    d. Where check valve position switches are required as shown on approved drawings, check valves shall be furnished complete with position switch mounting bracket and actuation lever mounted to stem shaft. Where outside lever and weights are required, stem shaft shall extend both sides of valve body and position switch assembly shall be mounted on opposite side of lever and weight assembly.

    e. Check valves shall be manufactured by American Flow Control; M&H/Clow/Kennedy; Golden Anderson; Mueller; or approved equal.

Article 10. ANCILLARY EQUIPMENT

1. Wet Well Aerator:

    a. The aerator shall be a side channel, two stage, low volume, high pressure, regenerative blower with an air release valve, and plumbing for two wet well aeration ejectors for the general purpose of aerating and agitating the liquid in the wet well.

    b. The blower motor shall be a 3 hp unit capable of operating continuously.

    c. The aerator piping shall be schedule 80 PVC with two cam lock connections within the wet well for connection of the 1 ¼-inch OD, 1-inch ID reinforced double walled EPDM air hose of variable lengths for connection to the aerator ejectors. Cam lock fittings shall be stainless steel.

    d. The aeration ejector shall be an 18-inch HDPE tube fitted to a stainless-steel support atop a 5-inch diameter steel base weighing no less than 10 pounds. The interior of the ejector tube will be fitted with no less than four circular bubble cleaning disks made of HDPE with one flat edge each, situated in an antipodal manner as to cleave and spin large bubbles as they rise through the tube. The reinforced, double walled nose must enter the ejector from the top. The ejector shall emit bubbles upwards only. No air entering the unit shall escape the bottom end of the tube near the intakes of the pumps situated near the bottom of the wet well.

e. The exterior components shall be installed within a locking and silencing fiberglass enclosure. The enclosure shall reduce the noise of the blower, be ¼-inch minimum thickness with a hinged top and two stainless steel support cables. The enclosure shall completely cover the blower, manifold, and have an exit hole molded into the cover to allow for air plumbing and electrical items to enter the enclosure. The cover shall have three 12-inch x 12-inch louvered vents for sufficient airflow. The Base of the enclosure shall be ¼-inch thick and 4-inch high.

f. Aerator shall be the Wet Well Wizard by Reliant Water or approved equal.

2. Dehumidifier:

a. The Contractor shall install an automatic refrigeration type dehumidifier to maintain the relative humidity of the air in the pump chamber as low as possible. The dehumidifier shall be capable of removing three gallons of moisture per twenty-four hours and shall be automatically controlled by an adjustable thermostat and a panel- mounted humidistat. The condensation shall drain to a sump.

3. Sump Pump:

a. The Contractor shall install in each pumping station a submersible sewage or grinder sump pump with motor mounted directly above the impeller. The volute casting shall have feet to support the impeller entrance the proper distance above the bottom of the sump. The pump shall have a minimum capacity of 100 gpm. The pump shall be controlled by a level control switch, capable of operation on a 2" differential water level. It shall discharge to the wet well through a 1-1/4 inch to 2-inch pipe with two check valves and a gate valve within the pump chamber.

4. HVAC:

a. Mechanical ventilation shall be provided for the pump chamber and wet well. The equipment shall be independent of each other and must be capable of providing the number of air changes per hour as dictated by the requirements of MDE and OSHA.

(1) 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 the motor room or pump room.

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

(3) Provide calculations showing that excess heat from pumps and other equipment will be adequately removed from the building. Otherwise, air conditioning must be provided to keep electrical equipment from failing.

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

6. Wiring:

a. The pumping station shall be completely wired at the factory, except for the power feed

lines, and shall be in accordance with the National Electric Code. All wiring in the pumping station shall be color-coded as indicated on the wiring diagram. Minimum wire size shall be #12 AWG copper. All wiring outside the panel shall be in rigid galvanized steel conduit, 3/4" minimum, except for 115-volt accessory items which are provided with connecting insulated service cord by the manufacturer. Accessory items such as the sump pump, dehumidifier and air compressors shall be plugged into polarized, grounded convenience outlets, located close to their installed position so that such items can be readily removed and serviced if necessary.

7. Heater:

    a. Electrical heaters shall be installed in the station and sized to maintain a minimum ambient temperature of 60° F in the drywell. The heater shall be thermostatically controlled. The heaters shall not be placed within two (2) feet of the control panel.

8. Station Painting:

    a. In wetwell/drywell pumping stations the following shall apply:

        (1) Metal Surfaces: All motors, pumps, bases, brackets, ladders, piping, and steel supports shall be properly primed and painted with two coats of rust inhibitor paint in strict accordance with the manufacturer's recommendations.

        (2) Plastic Surfaces: One coat of epoxy primer followed by one coat of acrylic urethane.

        (3) Concrete and Masonry Walls and Ceilings: One coat of epoxy primer followed by one coat of washable enamel paint.

        (4) All paint, painting procedures and application methods shall be as recommended by a reputable paint manufacturer and approved by the County.

Article 11. PUMP REQUIREMENTS

1. A minimum of two pumps (one duty, one standby) must be provided and installed.

2. Provide one complete set of all tools that are necessary for the maintenance and repair of the pumps. One pressure grease gun for each type of grease required for pumps and motors shall be furnished.

3. Spare parts shall consist of one extra set of ball and/or roller bearings, two sets of mechanical seals for each pump, and one extra shaft sleeve for each pump size.

4. Ejector Pumps:

    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 of dwelling units. These may be a simplex design. At no point shall ejector pumps be used to service an entire dwelling unit.

5. Grinder Pumps (Small Stations):

a. Grinder pump units shall be installed in either concrete, high-density polyethylene, or fiberglass- reinforced polyester basins for outdoor installations only. Indoor installations will not be permitted.

b. The grinder pump package shall consist of the basin, grinder pump(s) and motor(s), quick disconnect, pump removal system, junction box, start-stop level controls, motor high temperature shutoff, motor seal leak alarm, high water alarm, shutoff valve, pump check valve and redundant check valve, anti-siphon valve, discharge piping and fittings, and all internal wiring terminating in a junction box.

c. The grinder pump and motor are to be specifically designed and manufactured so they can operate completely submerged in wastewater. Electrical power cord is to be sealed, with individual conductors additionally sealed, thus eliminating water entering the motor by following individual conductors inside the insulation. Wire sizing and voltage drop associated with run lengths over 100 feet shall comply with NEC rules.

d. The combination pumping elements and grinder unit shall be attached to a common motor and pump shaft made of stainless steel. The grinder unit shall be on the suction side of the pump impeller inlet leaving no exposed shaft to permit packing of ground solids. Both stationary and rotating cutters shall be made of hardened and ground stainless steel.

e. The pump-motor shaft shall be sealed by mechanical carbon and ceramic-faced seals or similar material. An electric sensing probe shall be mounted in the seal chamber to detect any water leakage past the lower seal before damage is done to the motor. The seal probe circuit sensitivity shall not be affected by cable length between the motor and the seal probe circuitry in the control panel. This probe shall be connected to an indicator light in the control panel.

f. The shaft shall be supported by two radial and thrust ball bearings and a lower bronze radial sleeve guide bushing for radial load from grinder impeller. Ball bearings shall be designed for 50,000 hours B-10 life.

g. The rotor winding and rotor are to be mounted in a sealed, submersible type housing which is filled with clean high dielectric oil or air as pump design dictates. A heat sensor or thermostat shall be located in the motor winding and shall be provided to detect over temperature and stop the pump. When the temperature drops to a safe level, the pump will automatically reset.

h. For residential applications, submersible motor shall be constant speed, suitable for operation on a 240 Volt, 60 HZ, single-phase service. Submersible motors for non-residential applications shall be constant speed, suitable for operation on a 240 Volt, single-phase service or a 120/208 or 480 Volt, three-phase service. The motors shall be of proper size to drive the pump at any point on the pump curve. Thrust bearings shall be of the ball type. The motor shall be a capacitor start capacitor run type with high starting torque.

i. Motor shall be amply rated for the head and capacity values specified, on continuous duty, without exceeding 1.0 service factor load at the minimum capacity design point, and without exceeding the motor full-service factor load at any head between shutoff and 10 feet TDH, which is the minimum expected dynamic head to be found in this installation.

j. For non-residential installations, the use of explosion-proof motors and the provision of a spare pump are recommended.

6. Valves:

a. Check Valves - The pumps shall be equipped with a factory-installed integral ball check valve built into the discharge pipe. This valve shall provide a full-ported passageway when open and shall introduce a friction loss of less than six inches of water at maximum rated flow. The valve body shall be made of cast iron. Ball check valves shall include a corrosion resistant non-metallic ball and rubber-sealed seat.

b. Ball Valve - The pump shall be equipped with an isolation ball valve which shall be of PVC (Schedule 80), bronze or stainless-steel construction, three-piece design, full port, with TFE seals and seat valves shall have screwed end connections and shall be lever-operated with an extension handle extended vertically to a supporting bracket fixed not more than twelve (12) inches below finished grade. Valves shall be as manufactured by Jamesway Corporation, Worcester Controls or approved equal.

c. Redundant Check Valve:

b. All pumps shall include one additional separate check valve per unit for installation in the discharge line inside the pump basin to ensure maximum protection against backflow.

c. The valve shall be gravity operated, ball type. The check valve shall provide a full-ported passageway when open and shall introduce a friction loss of less than six inches of water at maximum rated flow. Working and internal parts shall be at least equal to those specified above for the check valve.

d. The valve body shall be a high gloss, injection molded part made of PVC Type I-II with hub and socket compatible with 1 ½ inch PVC pressure pipe, SDR 21.

e. Dimensions for hub and socket shall be in accordance with commercial standards C5-272-65.

d. Anti-Siphon Valve - The pump shall be constructed with a positively primed flooded suction configuration. As added assurance that the pump cannot lose prime even under negative pressure conditions in the discharge piping system, the pump shall be equipped with an integral anti-siphoning, air relief valve in the discharge piping. This valve shall be of PVC and shall be mounted horizontally in the discharge piping, between the redundant check valve and the shut off valve. The anti-siphon valve will automatically close when the pump is running and open to atmosphere when the pump is off.

e. Flexible Discharge Coupling - The pump discharge piping within the pump basin and the discharge force main shall be connected with a flexible discharge coupling to accommodate differential settling of the force main and the pump basin. Flexible discharge couplings shall be made of an inner corrugated hose sheathed in an outer braid. Flexible discharge couplings shall be constructed of stainless steel and shall be rated for 345 psi.

7. Basins

a. Either precast reinforced concrete, high-density polyethylene or fiberglass basins may be provided. However, concrete basins shall be used in areas subject to traffic loadings. All

basins shall register a minimum 4 inch above finished grade to prevent infiltration of surface water. The basin shall be located in an area not subject to ponding or flooding.

b. For residential installations, the County recommends the basin have a minimum net effective storage volume of 140 gallons between the pump shut-off elevation and the invert of influent line from the connected structure.

c. For non-residential installations, the County recommends a minimum operating tank volume of 250 gallons, or 24 hours of storage, whichever is greater, be provided. If anticipated daily sewage flow exceeds the available storage volume, the designer should perform backup calculations for the anticipated flow rate. Non-residential storage requirements may be reduced by provision of a back-up power source and a spare pump.

d. The basin shall be provided with a concrete anti-flotation collar (minimum of 1 cubic yard (cy) of concrete) to prevent flotation of the basin at high groundwater elevation when the basin is empty.

e. Watertight seals are required for all power and control connections within the basin as follows:

(1) between control panel motor feeders and junction box

(2) between junction box and motor leads

(3) between motor leads and pump housing

(4) for all control device conduits/leads and junction boxes inside basin

8. Submersible Pumps:

a. 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.

b. 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 by maintenance personnel.

c. 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.

d. 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.

e. Pump casing shall be of ASTM-A48 cast iron. Pump casing of the single volute type, ribbed to prevent excessive deflection and hydrostatically tested to twice the design head, or 150% of the shutoff head, whichever is greater. Volute sized at all points to pass solids which can pass through the impeller and internally finished to provide smooth,

unobstructed flow.

f. Non-clogging type impellor of ASTM-A48 cast iron, statically, dynamically, and hydraulically balanced, capable of passing 3" solids. Key seat the impeller and secure it to the shaft by a hex head impeller nut.

g. Pump shaft to be stainless steel of sufficient strength and size to safely transmit the maximum torque developed by the drive unit. Shaft sized to provide rigid support of the impeller and prevent excessive vibration.

h. Pump shaft bearings shall be ball or roller type, oil lubricated. Upper bearings to support full dead load and hydraulic thrust. Design bearings with a 20,000-hour B10 minimum bearing life per AFBMA test procedure.

i. Provide each pumping unit with a double mechanical shaft seal, running in an oil-filled reservoir, composed of two separate lapped faced seals, each consisting of one stationary and one rotating tungsten carbide ring each held in contact by a separate spring, so that the outside pressure assists spring compression in preventing the seal faces from opening.

j. Protect the compression spring against exposure to the pumped liquid. Seal the pumped liquid from the oil reservoir by one face seal and the oil reservoir from the motor chamber by the other.

9. Pump Accessories: Provide the following accessories with each pumping unit.

a. Stainless steel chain of adequate strength and length to permit raising of the pump to the outside of the wet well for inspection and removal. Chain must have large secondary links attached at minimum 10' intervals.

b. Stainless steel guide rails.

c. Stainless steel upper guide rail brackets.

d. Pump mooring plate with discharge elbow and lower guide rail support brackets.

e. Power cable of adequate length. Any extra cable length shall be neatly coiled and secured to the wet well structure such that it does not interfere with the removal of the submersible pump.

10. Dry Pit Submersible Pump (Wet Well/Dry Well) (Medium to Large Stations)

a. This type of station is preferred by the County.

b. The submersible pumps in dry wells shall follow the same material requirements of those installed in wet wells. Dry well installations shall have flanged suction connections to the wet well and be such that the submersion of the pumps and motors in the dry well will not cause a functional loss of the pumps.

c. 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.

d. The pump shaft shall be sealed by self-aligning, double tandem mounted mechanical seals immersed in an oil bath chamber. Seals shall be stainless steel construction with a carbon rotating seal face and stationary ceramic seal face on the upper seal, and silicon carbide rotating seal face and silicon carbide or tungsten carbide stationary seal face on the lower seal. Ceramic shaft sleeves of 400 Brinell hardness or greater, shall be provided in all cases.

e. Bearings shall be capable of a minimum 10,000 hours AFBMA-10 bearing life.

f. A manually operated brass valve shall be provided to vent the pump volute.

g. 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.

h. 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.

11. Self-Priming suction lift (Wet well with above grade pumps) (Medium to large stations)

a. General:

(1) The station, including pump enclosure, wet well, manholes, meter pits, and other structures constructed below grade (except pump enclosure) shall be watertight and must meet current ASTM Specifications.

b. Pump Station Enclosure:

(1) The station enclosure shall provide sufficient inside area for maintenance personnel to perform normal operation and maintenance inside, sheltered, and free from foul weather. The enclosure shall consist of a base to support the pumps and a cover.

(2) Materials:

i. The enclosure and its contents shall be designed for wind, snow, and seismic loads in accordance with ASCE 7-10 and all other local building codes.

ii. The station enclosure shall be manufactured of molded fiberglass reinforced orthophthalic polyester resins with a minimum of 30% fiberglass, and a maximum of 70% resin. Glass fibers shall have a minimum average length of 1¼ inches. Major design considerations shall be given to structural stability, corrosion resistance, UV stabilization, and watertight properties. The polyester laminates shall provide a balance of mechanical, chemical, and electrical properties to insure long maintenance free life.

iii. All interior surfaces of the housing shall be gel coated with a polyester

resin. Interior surfaces of the enclosure cover shall be white for maximum light reflectivity. The base shall be of a darker color.

iv. The pump station shall be furnished with 1-inch-thick foam insulation which shall be applied to the walls, door, and roof to achieve an R-6 insulation factor. A gasketed seal around the door shall also be included.

v. The outside of the enclosure shall be coated with a suitable pigmented resin compound to insure long, maintenance free life. The fiberglass enclosure shall be a regular product of the pump station manufacturer.

c. Enclosure Base:

(1) Station base shall be constructed of pre-cast, reinforced concrete encapsulated in a fiberglass mold.

(2) Holes through the base shall be provided for suction and discharge lines, air release lines, level control line, and electrical conduits.

(3) Station base shall incorporate a suitable flange designed for securing the pump station to the concrete pad in accordance with the station plans.

(4) The station base shall be designed to limit vibrations which may impact the mechanical components of the pump station.

d. Enclosure Cover:

(1) The enclosure cover shall be provided with a hinged fiberglass reinforced access door. Minimum dimensions of the door shall be 36 inches wide by 78 inches high for access by maintenance personnel to station interior. Door shall be a minimum 1 7/8 inch thick and shall be hinged with a minimum of two heavy-duty stainless-steel hinges to the enclosure cover. Door shall be furnished with a padlockable handle connected to a latching mechanism. Latch shall engage door casing or maximum security against vandalism. All mounting hardware for door casing and door must be concealed or of such type as to prevent vandalism with ordinary tools.

(2) Removable panels shall be supplied on two sides of the enclosure for additional access to equipment. Location and size shall permit access for routine maintenance functions such as pump and motor inspection, drive belt adjustment, and pump clean out. Non-hinged panels shall be secured with stainless steel tamper-proof hardware

e. Exhaust Fan:

(1) A shuttered exhaust fan with a minimum capacity of 500 CFM to change the air in the enclosure once every minute, shall be mounted in the end wall approximately opposite the hinged door opening. An air intake vent shall be mounted in the hinged door assembly.

12. Self-Priming Suction-Lift non-clog pumps:

a. The pumps shall be suction-lift, non-clog sewage pumps with flanged suction and

discharge openings. Two pumps with space for a third shall be provided as a part of the packaged pump station. Each pump shall have the same characteristics. Each pump shall have a minimum 6-in suction and a 6-in discharge and shall be capable of passing solids at least 3-in in diameter.

b. The pumps shall be by Gorman Rupp, Smith & Loveless or approved equal.

c. Pump Casings:

(1) The casings shall be cast iron, of sufficient strength to withstand all stresses and strains of service at its most severe operating pressure and shall be in accordance with ASTM A48, Class 30 or 35. Casings shall be designed for handling wastewater containing solids. A suitable handhole shall be provided in the discharge side to provide convenient access to the impeller and interior parts of the pumps. The inner contours of the handhole covers shall match the contours of the casings. The casings shall be provided with vent, drain and gauge connections. Discharge connections shall be 125 lb. ANSI Standard flanges. The vent connections shall be provided at the high point of the volutes. Casings shall be hydrostatically tested at 1-1/2 times the pressure developed by the pump at shutoff head.

d. Impellers:

(1) The pump impellers shall be cast in Austempered Ductile Iron with a minimum Brinell Hardness of 400 with integral pump out vanes on the back shroud. The impellers of all pumps shall be dynamically balanced.

(2) The design of the impeller and shape of the blades shall be such that rags and other material shall not clog the pumps nor seriously affect their efficiency. All passages shall be large and clear and capable of passing 3-in spheres. The impeller shall be thread onto the pump shaft and be secured with a lock screw, so that the impeller cannot be loosened by torque from either forward or reverse rotation.

e. Wear Plate:

(1) The pump shall be fitted with a replaceable wear plate. Replacement of the wear plate, impeller, seal, and suction check valve shall be accomplished through the removable cover plate without removing suction or discharge piping.

(2) Adjustment of the impeller face clearance (distance between impeller and wear plate) shall be accomplished by external means. The adjusting mechanism shall provide a means to make discrete calibrated movements in increments of .005 inches. No special tools, measuring devices, feeler gauges, or other tools shall be required to make these impeller-to-wear plate clearance adjustments.

(3) Clearances between the impeller and wear plate shall be maintained by a 4-point external shimless cover plate adjustment system with four collar and adjusting screws. Provide 4-point incremental clearance adjustment. Each of the 4 points shall be lockable to prevent inadvertent clearance increases

or decreases due to equipment vibration. The 4-point system shall provide equal clearance gaps at all points between the impeller and wear plate. Systems that require realignment of belts, couplings, sheaves, etc., each time a clearance adjustment is performed shall not be acceptable. Cover plate shall be capable of being removed and reinstalled without disturbing the clearance settings. Clearance adjustment systems that utilize less than 4-point system will not be considered.

f. Cover Plate:

(1) Cover plate shall be Gray Iron 30 and when removed provides complete access to pump interior. Cover plate removal must provide ample clearance for removal of stoppages, and the allow removal or service to the impeller, seal, wear plate or suction flap valve.

(2) Replaceable wear plate (Hardened): Secured to the cover plate by four (4) welded studs and nuts. The wear plate shall be cast in Hardened Alloy Steel with a minimum Brinell Hardness of 400. The wear plate shall be of sufficient width to maintain the manufacturer's recommended clearance between the entire edge of each impeller vane and the wear plate. Wear plate attachment hardware shall have Unified National Standard threads and shall be located out of the direct flow path of the liquid into the impeller. Two (2) Buna-N O-rings shall seal cover plate to the pump casing.

(3) O-ring Seals: Two (2) Buna-N O-rings shall seal cover plate to the pump casing. The inner cover plate O-rings shall provide a seal between the suction chamber and the discharge chamber of the pump casing to eliminate the possibility of recirculation at the wear plate.

g. Shaft and Bearings Shaft and Shaft Sleeve

(1) Shaft shall be constructed of Alloy Steel No. 4150 and shall employ an Alloy Steel No. 4130 shaft sleeve.

(2) A mechanical cartridge seal shall seal the pump shaft against leakage. The stationary sealing member and the mated rotating face shall be silicon carbide.

(3) Separate oil filled cavities, vented to atmosphere, shall be provided for shaft seal and bearings.

(4) The bearing cavity shall have an oil level sight gauge and fill plug with check valve.

(5) The seal cavity shall have an oil level sight gauge and fill plug with vent.

(6) The shaft bearings shall be isolated from the seal cavity with an air gap to provide positive protection of the bearings in the event of a seal leak and to provide for external monitoring of the seal integrity.

(7) Replaceable seal plate shall be constructed of Austempered Ductile Iron with a minimum Brinell Hardness of 400 and shall be bolted to the bearing housing.

Article 12. ELECTRIC MOTORS

1. General:

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

2. Above Grade Motors

    a. The pump motors shall be, totally enclosed fan cooled (TEFC), open drip-proof induction type, suitable for 3-phase, 60 Hz, 230/460-volt electrical service. The motors shall have a service factor of 1.15. They shall have normal starting torque and low starting current, as specified for NEMA Design B characteristics.

    b. The motors shall not be overloaded at the design condition, nor at any head in the specified operating range.

    c. Motors shall be NEMA Premium Efficient, per NEMA MG-1, Table 12-12.

    d. Motors shall be suitable for use with variable frequency drives.

    e. Motors shall have Class F insulation, Class B temperature rise, 40° ambient. Insulation shall be of non-hygroscopic materials which resist moisture and are fungus resistant.

    f. Each motor shall have oversized, grease-lubricated ball bearings with the thrust bearing at the bottom locked in position to eliminate shaft endplay. The motor shaft shall be solid stainless steel.

    g. The motor-pump shaft shall be centered, in relation to the motor base, within 0.005. The shaft run-out shall be limited to 0.003.

    h. A special varnish treatment shall be applied to the stator windings and rust preventative compounds shall be used to coat the rotor and stator air gap surfaces and protect the motor against corrosion.

Article 13. SUBMERSIBLE MOTORS

1. Motor casing shall be of ASTM-A48 cast iron.

2. Provide a motor having Class F insulated windings (which are moisture resistant) housed in watertight casing. The motor shall have cooling characteristics suitable to permit continuous operation in a totally, partially, or non-submerged condition. Motors shall be rated Class 1, Group D hazardous.

3. Equip each motor with a liquid sensing device to prevent damage to the motor in the event of a shaft seal failure.

4. Where submersible motors are to be installed in a dry pit, they shall have a cooling jacket to maintain satisfactory pump operating temperatures in the non-submerged environment.

Article 14. FORCE MAINS

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. All force mains are required to be ductile iron and shall meet the requirements set forth in SECTION 2.2 – WATER MAINS, and SECTION 2.11 – FORCE MAINS.

2. The minimum and maximum velocities are 2 fps and 8 fps, respectively. When pumping rates will not satisfy velocity requirements, pump capacities or force main size must be adjusted accordingly.

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. Crown elevations that are higher than force main outlets shall be avoided. This always keeps force main full.

5. At locations where the force main will not remain full or is in the vicinity of an air relief valve the interior shall be coated with Protecto 401 epoxy lining.

6. In areas of corrosive soils, the force main shall be encapsulated with a polyethylene wrap to prevent the exterior corrosion of the ductile iron.

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

8. Bypass Pumping Standpipe Assembly:

    a. All pumping stations are required to have a tee, standpipe, and two plug 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 standpipe 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.

    b. 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.

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

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

Article 15. WET WELL

1. Underground wet well structures shall be made of precast reinforced concrete that incorporate a slag cement design to provide high sulfate resistance.

2. Coatings

    a. Exterior Coating: Brushed dampproofing applied to the exterior of all precast wet wells shall be an asphalt emulsion reinforced with fibers conforming to ASTM D1227, Type II, Class 1. The dampproofing shall be Hydrocide 700B by Sonneborn Building Products, Division of ChemRex Inc., Minneapolis, MN; Karnak 220 Asphalt Emulsion by Karnak

Corporation, Clark, NJ or approved equal.

b. Interior coating shall be either an HDPE liner, PVC liner or a 100% solids epoxy liner installed at the pre-caster facilities.

3. Access doors must be of aluminum and sized for safe removal of equipment.

4. Provide a davit crane or other means by which to remove submersible pumps from the wet well.

Article 16. VALVE CHAMBER

1. A separate valve chamber shall be provided on the discharge side of the wet well. In a wet well/dry well arrangement, the requirements herein may be satisfied within the dry well.

2. The valve chamber shall accommodate a check valve and a plug valve for each pump and shall be large enough to comfortably accommodate the valves and fittings.

3. A NEMA 4 switch shall be provided on each check valve to signal open/close operation. The switches shall have N.O. (normally open)/N.C. (normally closed) contacts rated 120 volts, 10 amps. These switches shall be connected to the pump fail circuitry.

4. The valve chamber shall be provided with an aluminum hatch cover with a non-skid pattern.

5. Chamber shall be minimum 6 feet – 6 inches deep with aluminum access ladder with rungs at 12 inches on center or steps of ½ inch reinforcing bar encased with copolymer propylene. A 3-inch diameter drain shall be provided from the floor of the chamber to the wet well. The floor shall be sloped towards the drain. The drain shall have a check valve to prevent backflow from the wet well in case of high-water level in the wet well.

6. A 120V single phase receptacle shall be provided in the valve chamber for operation of a dehumidifier.

7. Provide a davit crane or other means by which to remove equipment from within the valve chamber.

Article 17. DRY WELL

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.

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

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. 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.

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.

6. Provide a davit crane or other means by which to remove equipment from the dry well.

Article 18. METER CHAMBER

8. A separate meter chamber shall be provided on the discharge side of the valve chamber. The valve chamber shall accommodate a magnetic flow meter and restrained dismantling joint on the downstream side of the meter. A buried plug valve and box shall be installed on the downstream side of the meter chamber.

9. The meter chamber shall be provided with an aluminum hatch as manufactured by USF Fabrication, Inc., Bilco, Halliday Products or approved equal. Chamber shall be a minimum 6 feet - 6 inch deep precast or reinforced concrete structure with aluminum access ladder with rungs at 12 inches on center or steps of ½ inch reinforcing bar encased with copolymer propylene.

10. A 3-inch diameter drain shall be provided from the floor of the chamber to the wet well. The floor shall be sloped towards the drain. The drain shall have a trap and check valve to prevent backflow from the wet well in case of high-water level in the wet well.

11. A 120V single phase receptacle shall be provided in the meter chamber for operation of a dehumidifier.

12. Provide a davit crane or other means by which to remove equipment from the meter chamber.

Article 19. INFLUENT MANHOLE

1. An influent manhole collecting all the gravity sewers that flow to the pumping station shall be provided. The influent manhole shall be located on the pumping station site. A gravity sewer shall carry wastewater from the influent manhole to the wet well. The influent manhole shall be capable of being isolated from the pumping station wet well by means of a yard valve.

Article 20. INFLUENT GRINDER

1. An influent wastewater grinder shall be provided. The influent grinder shall be of the vertical twin rotor type and be in the influent manhole. The influent grinder shall be capable of being lifted out of the manhole by means of stainless-steel guide rails without entering. The influent grinder motor shall be explosion proof and rated NEMA 4X.

Article 21. ELECTRICAL CONSTRUCTION

2. As part of the overall electrical design, an Arc Flash study of the station shall be completed and submitted to the County.

3. The Contractor shall meet with the electric company to determine all requirements at the site for service and metering. Any excess charges by the utilities for furnishing the required service shall be the responsibility of the Contractor.

4. The Contractor shall furnish and install a service pole at each pumping station if the service is overhead. Service conductors and raceways shall be installed from the generator building underground to the service pole and up the pole terminating in an approved entrance fitting. The power company will furnish and install an overhead service drop to the pole and connect to service conductors. Poles shall be guyed if required to offset pull of power company's service drop.

5. If the service is underground, the Contractor shall furnish and install underground conduit, current transformer cabinet, and meter base. Current transformer cabinet or self-contained meter base, as

necessary, shall be mounted on the generator building. The utility companies will furnish and install the service lateral.

6. A grounding grid shall be provided at the service pole. Metal raceways, metal enclosures of electrical devices, transformer frames, neutral conductor and other equipment shall be completely grounded in accordance with the National Electrical Code. All necessary conduit, conductors, clamps, connectors, etc. for the grounding system shall be furnished and installed by the Contractor.

7. The panel board shall be rated for the voltage present, dead-front type, lockable with thermal-magnetic bolt-on circuit breakers, neutral and ground bus, typed circuit directory.

8. Lightning protection shall be provided on the feeders immediately on the load side of the main disconnect switch, grounding lead as short as possible to grounding system, Innovative Technology, Inc. "P-Plus" series, no equal. A plug-in protector shall be used which has receptacles and RJ-11 jack for the telephone/dialer connections, Innovative Technology, Inc. Model PIU, no equal.

9. Install sealing fittings or an air-break wherever a conduit passes into a hazardous area or extends between areas having widely different temperatures.

10. Wires and cables minimum size shall be #12, medium hard drawn copper. For 600-volt service and under, wire shall have Type THHN-THWN insulation. Wire size of #10 and larger shall be stranded. All wiring shall be color coded in accordance with current NEC requirements.

11. All necessary permits and fees for this work shall be secured and paid for by the Contractor. Inspection shall be by an approved inspection agency licensed by the State of Maryland and final certificate of approval shall be delivered to the County prior to acceptance.

Article 22. CONTROLS

1. Control Building

    a. All appropriate electrical controls (including automatic transfer controls) shall be mounted permanently in a building. The building shall also house the pump control panel and the backflow preventer, meter, and hose bibb for installations using public water unless otherwise approved by the County. The building shall be a masonry type building with split face block exterior blending aesthetically with the surrounding environment. Interior walls shall be of block construction; dry wall material shall not be allowed. Construction details of the building shall be subject to approval by the County. Neither temporary structures nor fiberglass housings will be accepted.

    b. Prefabricated structures will be considered as part of a manufactured, package pump station system from a single vendor.

    c. The building shall be of brick and block design with pitched roof and wooden roof trusses. There shall be no exposed woodwork on the outside of the building. All exterior woodwork shall have vinyl or aluminum coating. The building shall be constructed over the dry well. Stairs shall be provided for access to the pumps and piping. The wet well shall be accessed only from outside. The building shall have a lightning protection system. Doors shall be heavy duty, bulletproof metal with deadbolts and locks keyed to the Bureau of Utilities system. Exterior lights shall be wall mounted vandal proof controlled by an on-off switch. The finished floor and all electrical equipment shall be located at least two feet above the 100-year flood elevation. Ventilation openings shall be protected with aluminum louvers and bird screens. Floors shall be sloped to floor

drains piped to the influent manhole of wet well. The building shall be furnished with a service sink with both hot and cold water, telephone line and toilet room with waste piped to the influent manhole or wet well. The building shall conform to all Carroll County building codes and zoning regulations.

d. 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.

e. A toilet room shall be provided with toilet, lavatory, hot water heater, towel dispenser, soap dispenser and mirror.

f. The building shall be heated by electric unit heaters with integral thermostats sized to maintain a minimum inside temperature of 60 degrees. Ventilation shall be by means of wall mounted exhaust fans with backdraft dampers operated by thermostats and freezestats and intake louvers with motor operated dampers. Ventilation shall be designed for a minimum of six air changes per hour. Provisions shall be made, if applicable, to ensure against condensation forming on controls and other major items of equipment.

g. A separate generator room shall be provided for housing the emergency generator and fuel tank. The generator room shall have a roll-up metal garage door for access and shall be equipped with a floor drain outside the fuel containment area, piped to the influent manhole or wet well.

2. Control Equipment

a. 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.

b. 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.

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

d. Automatic alarms shall have individual circuit breakers.

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

f. Alarms shall be provided and connected to the remote transmitting unit.

g. 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.

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

3. Pump Controls:

   a. One circuit breaker disconnect unit per pump with magnetic trip sized for individual pump protection. This unit shall provide the maximum electrical motor protection available, serving as a circuit breaker and manual disconnect switch.

   b. One across-the-line starter per pump, sized in accordance with NEMA horsepower standards. All large stations are required to have pump motors operated with variable frequency drives (VFDs).

   c. One normally open (N.O.) auxiliary contact for run status and one normally closed (N.C.) auxiliary contact for stop status, overload relay, and all other controls and accessories necessary for proper operation and protection.

   d. Low voltage (24 VAC) level sensing circuitry for intrinsically safe relaying.

   e. Solid state alternator for duplex controls.

   f. Individual toggle type selector switches to provide "Auto-Off-Hand" control of each pump.

   g. 24 Volt AC control transformer protected by circuit breakers or fuses on both the primary and secondary.

   h. Terminals shall be provided for connection of the level sensors.

   i. A removable dead-front panel shall be provided to protect the operator.

   j. All operator controls, toggle switches, circuit breakers, etc. shall be accessible without removing the dead-front panel.

   k. NEMA 1 enclosure with latch mechanism Duplex 3-phase 240-volt or 480-volt power supply as dictated by the power company and motor requirements.

   l. A relay that automatically reconnects the control circuit to Pump No. 2 if the Pump No. 1 circuit breaker trips.

   m. High level and low-level alarm relays with unpowered contacts and terminals shall be included.

   n. Pump running transformer type pilot lights (red) mounted on operator's control panel. Pump stopped pilot lights (green) mounted on operator's control panel.

   o. Non-resettable running time meters mounted on operator's control panel.

p. Seal leak detector for each pump with unpowered relay contacts for alarming.

q. 3-phase power monitor with adjustable settings, stops pump for low voltage, single phasing, and phase reversal.

r. One pump to be locked off during generator operation with ability to switch to another pump should selected pump fail.

s. A "Hand-Off-Auto" selector switch provided for each of the two pumps controlled with the following operation:

(1) Hand Position: In this position, the pump controlled by the switch will run regardless of the wet well level. The pump will continue to run until the switch is turned to "Off" or "Auto".

(2) Auto Position: In this position, the operation of the pumps is controlled automatically by the level sensors in the wet well as follows:

i. The control circuit is placed in standby mode when the liquid level rises to tilt the lowest level sensor that is a redundant cutoff and low water alarm.

ii. As the level continues to rise, the control circuit is energized when the pump off level sensor rises.

iii. As the level continues to rise and the next level sensor is tilted, the first (lead) pump will start. In this step, the pumps will alternate on successive cycles. If Pump No. 1 starts first on one cycle, Pump No. 2 will start first on the next cycle. This insures equal operating time and wear on each pump.

iv. As the level in the well is pumped down, the pump(s) will continue to operate until the level drops just below the pump off level sensor.

v. If the level in the well continues to rise with one pump in operation, the second pump will be turned on when the level reaches the lag pump on high water alarm level float.

vi. If the water continues to rise, the high-water alarm level sensor will activate an alarm.

4. Wet Well Level Measurement Devices

a. Ultrasonic Level Sensors: Ultrasonic level sensors shall be non-contact type with the transducer encapsulated in Kynar or some other chemical- and corrosion-resistant housing. Transducers shall be capable of being completely submerged without damage.

b. Pressure Transducers: Pressure transducers shall have a transmitter assembly of 316

stainless steel or titanium with a bottom diaphragm. Sensors shall be suspended by cable. Cable shall include a vent tube for the transducer. Sensor shall be suspended with a tension-relieving mounting clamp from a four-inch (100 mm) flange. Clamp and flange shall be 316 stainless steel.

c. Mercury Float Switch Controller: Provide a backup control system consisting of mercury float switches and other necessary appurtenances. The floats shall be sealed float-type mercury switches and shall be sealed in a solid polypropylene shell. The support wire shall have a heavy neoprene jacket. A weight shall be attached to the cord above the float. Two float switches shall be used for backup low level and backup high level control. The float switches shall hang in the sump and be supported by a stainless-steel bracket and cord snubber to allow flexibility in setting the levels. All mounting structures and hardware shall be stainless steel. Mechanical Piping and Appurtenances

Article 23. REMOTE TRANSMITTING ALARM SYSTEM

1. Remote transmitting alarm units shall be provided at each pumping station. Units shall be as manufactured by OmniSite.

2. An alarm system capable of monitoring the following functions and transmitting the relevant signal to the designated location shall be installed:

    a. Wetwell/Drywell Type Pumping Stations

        (1) Power failure
        (2) High wet well
        (3) Low wet well
        (4) Water in drywell
        (5) Generator failure
        (6) Louver failure
        (7) Pump failure

    b. Submersible Type Pumping Stations

        (1) Power failure
        (2) High wet well
        (3) Low wet well
        (4) Seal Leak
        (5) Generator failure
        (6) Louver failure
        (7) Pump failure

    c. Suction Lift Type Pumping Stations

        (1) Power failure
        (2) High wet well
        (3) Low wet well
        (4) Generator failure
        (5) Louver failure
        (6) Pump failure

Article 24. FLOW METERING

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

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

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

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

5. A flow metering device which is capable of continuously recording pumped flows and displaying instantaneous flow rate and totalized flow shall be provided. Meter shall be a COPA- X, Series 10D14654, magnetic flowmeter by ABB. It shall have a polyurethane liner; ANSI 150, 304 stainless steel flanges and metering tube; 316 SST bullet nose type electrodes; Division 2, Hazardous Location, safety rating; operating on 120 V ac, 60 Hz power; 120 V ac, 60 Hz remote mounted electronics; occasional submergence enclosure; process temperature to 190° F; 4-20 mA dc output signal. Meter shall be factory calibrated with a copy of the report in the O & M manual. Meter grounding shall be in accordance with the manufacturer's recommendations. Meter shall be capable of running empty indefinitely without damage to any component. Meter shall also have communication capabilities to allow for output of flow signal via future telemetry by others.

6. A flow converter / transmitter shall be furnished with the meter. It shall operate on 120 V, 60 Hz power, have an isolated 4-20 mA output into a 0 to 1,000 ohms; with a NEMA 4X wall mount; connecting signal cable between flow meter and signal converter; and a seven-digit, non-reset totalizer on the face of the enclosure and a scalable pulse output to drive the totalizer with a multiplier power of 10.

Article 25. HEADWORKS

1. All wastewater pumping stations shall be protected by suitable headworks. Design engineer shall evaluate the extent of headworks required, for example, grit removal, bar screen, grinder unit, odor control, etc., for County approval.

2. At a minimum, all pumping stations are required to be equipped with a grinder unit.

Article 26. ACCEPTANCE TESTING AND START-UP

1. Field tests shall be carried out at the expense of the Contractor to ensure that pumps and all equipment meet the design criteria. The duration of such tests will be determined upon the complexity of the station ranging from 2 to 30 days of operation. The County's personnel will witness the field tests.

2. The Contractor shall provide the services of fully qualified manufacturer's representatives for services during installation, at start-up, and for instructing the County's personnel in the operation, routine maintenance, and troubleshooting for all equipment, mechanical and electrical, furnished with the pumping station. Contractor shall full load test the generator for 4 hours continuously using Contractor-furnished load bank. Notify the County 48 hours prior to the test. If testing stops for any reason, correct the problem, and start new 4-hour test. Submit test results.

3. The Contractor shall provide five bound copies of a manual fully explaining the operation, routine maintenance and troubleshooting for equipment. The manuals shall include copies of all shop drawings with all required revisions. These manuals must be submitted to the County for approval prior to acceptance.

4. The manuals must include information relative to suppliers of spare and replacement parts.

END OF SECTION

SECTION 2.11

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FORCE MAINS

SECTION 2.11 - FORCE MAINS

Article 1. GENERAL INFORMATION

1. Force mains described and specified in this section are sewers which convey sewage under high pressure from pumping stations to locations in the gravity sewer system.

2. Force mains shall be installed in strict accordance with these specifications, and any applicable practices and precautions required for gravity sewer are equally applicable to the installation of pressure sewers. These include, but are not limited to, excavation, pipe bedding, concrete encasement and backfilling.

3. The use of polyvinyl chloride (PVC) pipe and fittings will not be permitted.

Article 2. MATERIALS AND EQUIPMENT

1. Ductile Iron Pipe and Fittings

   a. Ductile Iron pipe shall be as outlined in SECTION 3.2 – WATER MAINS except as specified herein.

   b. Interior Lining

      (1) Cement mortar lining shall only be used in pipe and fittings that are continuously filled or full flow not exposed to the atmosphere. The cement mortar lining with an asphalt seal coat shall conform to ANSI Specification A21.4 or AWWA C104, latest edition, except the thickness of linings should not be less than 1/8-inch.

      (2) Hydrogen sulfide resistant linings shall be used in all pipe and fittings with partial flow depth or exposed to the atmosphere (in the vicinity of air release valves, terminal manholes, etc.). These linings shall be one of the following:

         (a) Protecto 401 ceramic-filled amine cured epoxy lining shall be as manufactured by Indurall. The lining thickness shall be 40 mils minimum. Application shall be performed by an applicator approved by the coating manufacturer, in accordance with manufacturer's instructions and under controlled conditions at the applicator's shop or the pipe manufacturer's plant. Applicator shall submit a certified affidavit of compliance with manufacturer's instructions and requirements specified herein.

         (b) Calcium aluminate mortar shall be made of fused calcium aluminate cement and fused calcium aluminate aggregates as manufactured by Lafarge Calcium Aluminates or approved equal. The minimum lining thickness shall be 0.125 inches for 6-inch through 12-inch pipe, 0.1875 inches for 14-inch through 24-inch pipe and 0.250 inches for 30-inch through 54-inch pipe. The interior and exterior of the spigot end and the interior of the socket end, including a portion of the pipe barrel, shall be coated with a minimum of 8 mils of epoxy prior to lining.

         (c) Polyethylene lining shall consist of a blend of polyethylene powders applied to the interior of a preheated pipe. The nominal lining film thickness shall be 40 mils minimum. Polyethylene lining of ductile iron pipe shall be done at pipe manufacturer's plant; fittings shall be done at pipe manufacturer's plant,

or at experienced shop approved by the pipe manufacturer. Applicator shall submit a certified affidavit of compliance with manufacturer's instructions and requirements specified herein.

2. Plug Valves

   a. Plug valves shall be of the offset disc type, 1/4 turn, non-lubricated, serviceable (able to be repacked) under full line pressure and capable of sealing in both directions at the rated pressure. The disc shall be completely out of the flow path when open. Plug valves specified herein shall be Millcentric by Milliken or equal.

   b. All buried valves shall open counterclockwise and be especially constructed for buried service. Exterior ferrous metal surfaces of all buried valves shall be blast cleaned in accordance with SSPC SP 6 and given two shop coats of an approved two-component coal tar epoxy paint.

   c. All size plug valves shall have a minimum port area of 80 percent.

   d. Valves shall be rated at minimum 175 psi WOG (water, oil, and gas) working pressure for sizes 4-inch to 12-inch inclusive and at minimum 150 psi WOG working pressure for sizes 14-inch and larger.

   e. All plug valves under this paragraph shall be performance, leakage and hydrostatically tested in accordance with AWWA C504, except as modified herein. At the above rated minimum working pressures, the valves shall be certified by the manufacturer as permitting zero leakage for a period of at least 30 minutes with pressure applied to the seating face.

   f. Valve bodies shall be of cast iron, 30,000 psi tensile strength, ASTM A126, Grade B, or of ductile iron, ASTM A536 and of the top entry, bolted bonnet design, cast with integral flanges conforming to the connecting piping. All exposed bolts, nuts and washers shall have Type 316 stainless steel hardware.

   g. The valve disc shall be cast iron ASTM A126, Grade B, or ductile iron, ASTM A536, Grade 65 45-12, be removable without removing the valve from the line and have an integral upper and lower shaft which shall have seals on the upper and lower journals to prevent entrance of solids into the journals.

   h. Shaft bearings shall be permanently lubricated, rigidly backed TFE, stainless steel or bronze at both upper and lower stem journals. The operator shaft shall have easily replaceable seals, which shall be externally adjustable and repackable without removing the bonnet from the valve or shall have self-adjusting packing.

   i. The valve seating surface shall provide full 360-degree seating by contact of a resilient seating material on the disc mating with welded in high nickel content overlay seating surface in the body.

   j. Discs shall have a full resilient facing of neoprene or Buna N.

3. Valve Boxes

a. All buried valves shall be provided with extension-type, roadway-type valve boxes. Valves boxes shall be cast iron and shall be two-piece telescoping screw-type construction. Valve boxes shall have 5 1/4-inch shafts, shall have covers marked "SEWER", and shall be coated inside and out with a tar or asphalt compound. Valve boxes shall be manufactured by Capital Foundry of VA, Inc., Bingham & Taylor or Tyler Pipe.

4. Air Release Valves

a. The valves shall be designed for sewage service and shall be non-clogging with cast iron or 316 stainless steel body, bronze or 316 stainless steel trim and 316 stainless steel floats. Valves shall be provided with shutoff valve, blow-off valve and quick disconnect hose connection and backflushing hose and valve.

b. Valves shall be sized according to manufacturer's recommendations based on main size, main capacity and pressure.

c. Valves shall be similar to those manufactured by APCO/DeZurik, A.R.I., Golden-Anderson, Val-Matic or approved equal.

d. Valve chamber shall be standard precast concrete manhole construction in accordance with ASTM C478, and shall be of adequate size to permit entry around valve for servicing and maintenance. Manhole base shall be provided with drain. Manhole cover shall be adequately vented to ensure discharge or intake of free air.

5. Flushing Stations

a. For long forcemains, flushing stations will be required. The number and location of the stations will be at the discretion of the County.

6. Detectable Warning Tape

a. Detectable warning tape shall be polyethylene film encasing a metallic core, minimum 6 inches wide and 4 mils thick, color-coded green for sewer, bearing in black letter – CAUTION: SEWER LINE BELOW.

Article 3. INSTALLATION

1. General

a. Ductile iron pipe shall be installed in accordance with AWWA C600.

2. Excavation

a. Refer to SECTION 2.4 – SANITARY SEWERS for these requirements.

3. Bedding

a. Refer to SECTION 2.4 – SANITARY SEWERS for these requirements.

4. Laying Pipe

a. Refer to SECTION 3.4 – SANITARY SEWERS for these requirements.

b. Construction Control:

(1) During the installation of a force main, the pipe shall be laid at a constantly increasing grade to each high point, air release manhole, or point of discharge, as indicated on the Drawings. Provide sufficient construction control to assure that there are no sags or loss in grade in the force main which could tend to accumulate air.

c. Permissible Deflection of Joints

(1) If deflection is required, the amount of deflection shall not exceed the maximum limits as specified in the AWWA Standard C600, or those specified by the pipe manufacturer.

d. Fittings and Valves

(1) General

(d) Valves and fittings shall be set and jointed to pipe in the manner specified previously for cleaning, laying and jointing pipe.

(2) Valve Chamber

(e) Provide a precast concrete manhole for every air release and vacuum valve as specified in SECTION 3.6 - MANHOLES. The manholes shall be constructed of sufficient size to permit entry for valve repairs and protect the valve and pipe from impact where they pass through the manhole walls. All valves and fittings shall be supported as indicated on the detail drawings.

5. Thrust Restraint and Blocking

a. Restraint of pipe and fittings shall be provided at all tees, crosses, bends, wyes, pipe ends, or at other locations that have unbalanced pressure forces. Restraint shall be provided by one of the following:

(1) Pipe manufacturer's restrained joint system as approved by the County.

(2) Minimum restrained lengths required for pipe anchorage with restrained joints as shown on the detail drawings.

(3) Megalug mechanical joint restraint by EBAA Iron Inc., or approved equal.

(4) Metal harness or tie rods

(5) Metal harness or tie rods of adequate strength to prevent movement shall be used.

(6) Restrained pipe length shall be the same as those for restrained joints.

(7) Steel rods or clamps shall be suitable to be buried. The minimum number shall be as follows:

(a) Use a minimum of two ¾-inch diameter rods for pipes 6 inches and smaller.

(b) Use a minimum of four 1-inch diameter rods for pipes 8 inches through 14 inches.

(c) Minimum restrained length required for pipe anchorage with metal harness and tie rods shall be the same as those indicated for restrained joint pipe.

b. Concrete anchor blocks

(1) Concrete anchor blocks shall be designed for a minimum allowable soil bearing pressure of 2000 psf.

(2) Minimum anchor blocks shall be as shown on the detail drawings.

6. Backfilling

a. Refer to SECTION 2.4 – SANITARY SEWERS for these requirements.

7. Surface Restoration

a. Refer to SECTION 2.4 – SANITARY SEWERS for these requirements.

Article 4. TESTING AND INSPECTION

1. Pressure Test

a. After the pipe has been laid and backfilled as specified, all newly laid pipe shall be subjected to a hydrostatic pressure of 150 psi or 150 percent of the normal working pressure, whichever is greater, in accordance with AWWA C600.

b. Where any section of a force main is provided with concrete reaction backing, the hydrostatic pressure test shall not be made until at least 5 days have elapsed after the concrete reaction backing was installed. If high early strength cement is used in the concrete reaction backing, the hydrostatic pressure test shall not be made until at least 2 days have elapsed.

c. Air release valves shall be installed but isolated during testing of the pipeline.

d. Duration of Pressure Tests

(1) The duration of each pressure test shall be 2 hours.

e. Procedure

(1) Each section of pipe shall be slowly filled with water and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory of the County. The pump, pipe connections, and all necessary apparatus, including gauges, shall be furnished by the Contractor and are subject to approval by the County. Make all taps into the pipe and furnish all necessary assistance for conducting the tests. Supply either a container calibrated in 0.1-gallon increments, or a laboratory certified calibrated

water meter calibrated to an accuracy of 0.1 gallons.

f. Expelling Air Before Test

(1) Before applying the specified test pressure, all air shall be expelled from the pipe. If permanent air release valves are not located at all high points, make the necessary taps at such points before the test is made. After the test has been completed, remove and plug the taps or leave them in place at the direction of the County.

g. Examination Under Pressure

(1) Any cracks or defective pipes, fittings or valves discovered in consequence of this pressure test, shall be removed, and replaced, and the test shall be repeated.

(2) If the pressure does not drop within the 2-hour test period, the test shall be deemed to be successful.

END OF SECTION

SECTION 2.12

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MANHOLE REHABILITATION AND LINING SYSTEMS

SECTION 2.12 - MANHOLE REHABILITATION AND LINING SYSTEMS

Article 1. GENERAL INFORMATION

1. Manhole rehabilitation work described and specified in this section may require, patching manhole exterior; stopping infiltration with chemical grout; rebuilding invert and benching; resetting or replacing manhole frame and cover assemblies; installing chimney seals, adjusting elevation of manhole frame and cover.

2. Eliminate active infiltration observed in the frame seal, chimney (corbel for brick manholes), cone, wall, bench, invert, holes, or pipe connections prior to applying a manhole lining system.

3. Reinstall existing manhole rings and covers removed to allow the completion of the rehabilitation work. Restore the site to its pre-maintenance condition.

4. Sewer flows to be maintained for duration of all manhole rehabilitation work.

5. The Contractor to perform the manhole rehabilitation and manhole lining shall be fully qualified, experienced, and equipped to complete the work in a timely and satisfactory manner.

6. Manhole rehabilitation shall be completed in strict accordance with these specifications, and any applicable practices and precautions required for new manholes are equally applicable to the installation of rehabilitated manholes. These include, but are not limited to, excavation, manhole bedding, concrete encasement, and backfilling.

Article 2. MATERIALS AND EQUIPMENT

1. Active leaks: To stop active leaks in the manhole, use any of the following of the following materials and procedures to stop the active leaks prior to lining.

   a. Premixed Fast-Setting, Volume-Stable Waterproof Cement Plug: Hydraulic cement, graded silica aggregates, special plasticizing and accelerating agents, containing chlorides, gypsums, plasters, iron particles, aluminum powder or gas-forming agents, or promote the corrosion of steel it may come in contact with. The cement plug shall comply with the following minimum requirements:

Minimum Requirements		
Compressive Strength	ASTM C 109	>1000 psi, 1hr. >2500 psi, 24 hrs. >4000 psi, 7 day
Tensile Strength	ASTM C 496	650 psi
Bond Strength	ASTM C 882 (modified)	270 psi, 4 hrs. 880 psi, 28 day
Set Time		<5.0 minutes

   b. Waterproof cement plug shall be CEMTEC Hydraulic Cement as manufactured by A.W. Cook Cement, or equal.

   c. Chemical Grout: Repair work shall be in accordance with ASTM F 2414-04, and manufacturers recommended installation methods. Use in accordance with the manufacturer's recommendations for the specific application. Be of a formula that is

suitable for application in a manhole that is susceptible to frost, if applicable for the regional climate.

(1) Drilling and injection method shall use a hydrophilic polyurethane chemical grout manufactured by Avanti or equal unless otherwise approved by the County.

(2) Exterior chemical curtain grouting method shall use a hydrophobic polyurethane chemical grout manufactured by Avanti or equal unless otherwise approved by the County.

(3) Expanded Gasket Procedure shall use Oil Free Oakum with hydrophilic polyurethane chemical grout manufactured by Avanti or equal used for sealing larger cracks and manhole joints, unless otherwise approved by the County.

2. Patching, repointing, filling and repairing non-leaking holes, cracks and spalls in the concrete and masonry manholes

a. Rapid Cure Vertical Grade repair mortars shall be a one part, polymer modified, fast setting, silica fume, fiber reinforced mortar designed for vertical and overhead repairs from ¼" to 2" in one lift. The product may be applied by hand trowel or sprayed with a low-pressure pump. These will be used for resurfacing, patching and filling bug voids in concrete and masonry surfaces with the following minimum requirements:

Physical Properties		
Compressive Strength	ASTM C 109	>1800 psi, 1 hr. >2600 psi, 24 hr. >3000 psi, 28 days
Bond	ASTM C 882	>1600 psi, 28 days
Flexural Strength	ASTM C 293	990 psi
Shrinkage	ASTM C 596	0% at 90% R.H.
Set Time	At 77ºF	Initial Set – 35 minutes (max) Final Set – 50 minutes

b. Rapid Cure Vertical Grade repair mortar shall be CEMTEC Silatec Rapid Cure Vertical Grade by A.W. Cook Cement, or equal.

c. The material used to mix product shall be clean and potable. No material (other than water) shall be used with or added to the patching product without prior approval or recommendation from manufacturer.

3. Quick turn-around resurfacing and areas of harsh hydrogen sulfide conditions

a. For concrete resurfacing at quick turn-around areas utilize an ultra-high solids, high build, amine cured epoxy mortar formulated for use in highly corrosive hydrogen sulfide (microbial induced) environments and meets the following minimum requirements:

Physical Properties		
Adhesion	ASTM D 4541	>300 psi, Concrete Failure

Abrasion Resistance	ASTM D 4060	1,000g 1000 cycles CS-17 Wheel – 80 mg loss
Durometer Hardness	ASTM D 2240	Shore D 73
Flexural Strength	ASTM C 580	675 psi
Moisture Absorption	ASTM C 413	<0.03%
Modulus of Elasticity	ASTM C 580	15,040 psi
Tensile Strength	ASTM C 307	1,980 psi

b. Quick turn-around resurfacing shall be a high build corrosion protection mortar consisting of Dura-Plate 6100 Epoxy blended with 28 lbs. of Type DP Aggregate per 2-gallon mix of resin as manufactured by Sherwin-Williams, or equal.

4. Interior flexible chimney seals

a. Provide a flexible chimney seal that is 100 percent Volume Solids, High Build, Aromatic, Polyurea formulated for use in highly corrosive hydrogen sulfide (microbial induced corrosion) environments where a tough, flexible, impact resistant, waterproof, quick turnaround chimney seal is required. The applied thickness shall be 100 mils DFT and meet the following minimum requirements:

Physical Properties		
Adhesion	ASTM D 4541	350 psi, Concrete Failure
Durometer Hardness	ASTM D 2240	Shore D 50
Elongation	ASTM D 638	530%
Tear Strength	ASTM C 624	525 psi
Tensile Modulus	ASTM D 638	100% Modulus – 1,400 psi 300% Modulus – 1,800 psi
Tensile Strength	ASTM C 638	2,440 psi

b. Flexible chimney seal shall be Envirolastic AR530 Chimney Seal Cartridge System as manufactured by Sherwin-Williams, or equal.

Monolithic Manhole Lining System requirements

a. Do not install manhole lining until other manhole cleaning and rehabilitation has taken place.

b. Design and install monolithic manhole lining system to protect concrete, brick mortar, and other manhole surfaces from corrosion. Design products to stop infiltration, root intrusion, and further deterioration in manhole. Interior surfaces to be protected shall include walls, benches, inverts, pipe junctions and chimney (corbel). Table below outlines different monolithic manhole lining systems and respective product specification Articles for each lining system. The pH limits listed below are typical and type of manhole lining used shall be as shown on the Drawings or as directed by the County.

(1) Portland Based Cementitious Liner: No or very mild hydrogen sulfide conditions, pH of 4.0 or higher.

(2) Calcium Aluminate Cementitious Liner: Mild to harsh hydrogen sulfide conditions, pH of 2.0 or higher.

(3) Epoxy Liner: Harsh hydrogen sulfide conditions, pH of 1.0 or higher. Structures with very turbulent flow such as pump station wet wells and forcemain discharge structures.

(4) Cured-in-Place Manhole (CIPM) Liner: Harsh hydrogen sulfide conditions, pH of 1.0 or higher. Structures with very turbulent flow such as pump station wet wells and forcemain discharge structures. Severe infiltration and structural integrity issues.

Cementitious Manhole Monolithic Lining System (CMMLS)

d. CMMLS system shall be a monolithic, Portland based or calcium aluminate cementitious liner system suitable for use as a trowel- or spray-applied monolithic surfacing in sewer manholes.

e. Minimum thickness of Portland based cementitious lining shall be 1-inch thick.

f. Minimum thickness of calcium aluminate based cementitious lining shall be 1-inch thick.

g. Cementitious lining system shall be:

(1) Type 1: Portland-based Cementitious Liner [no sulfide conditions (substrate surface of pH 4.0 or higher)].

(a) Acceptable Manufacturers and Products:
i. Strong MS-2A.
ii. Quadex QM-1s Restore.
iii. Standard Cement Re-liner MSP.
iv. Permacast MS-10,000.
v. Mainstay ML-72.
vi. Dinjer CMS 10K.
vii. Or equal.

(b) Portland-based cementitious liner product shall be used to form a structural monolithic liner covering interior substrate surfaces and have following minimum requirements:

Minimum Requirements			
Compressive Strength	ASTM C 109	28 days	>9000 psi
Tensile Strength	ASTM C 496	28 days	>800 psi
Flexural Strength	ASTM C 293	28 days	>1200 psi
Shrinkage @90% R.H.	ASTM C 596	28 days	0%
Bond	ASTM C 882	28 days	>2000 psi
Density, When Applied	-	-	134 ± 5lbs/ft3

Freeze/Thaw	ASTM C 666	N/A	300 cycles no visible damage

(c) Portland-based liner shall be made with Type I Portland Cement and shall be used according to manufacturer's recommendations in applications where there are no sulfide conditions (substrate surface of pH 4.0 or higher). Material shall meet or exceed industry standards and shall not have any basic ingredient that exceeds EPA maximum allowable limits for heavy metals. Water used to mix product shall be clean and free from contaminants. Questionable water shall be tested by a laboratory per ASTM C 94 procedure. Potable water need not be tested.

(2) Type 2: Calcium Aluminate Cementitious Liner [mild sulfide conditions (substrate surface of pH 2.0 or higher)].

(a) Acceptable Manufacturers and Products:
i. Strong MS-2C.
ii. Quadex Aluminaliner.
iii. Standard Cement Maximum CA.
iv. Permacast CR-9,000.
v. Mainstay ML-CA.
vi. SewperCoat.
vii. Or equal.

(b) Calcium aluminate cementitious liner product shall be used to form a structural monolithic liner covering interior substrate surfaces and shall have the following minimum requirements:

Minimum Requirements			
Compressive Strength	ASTM C 109	28 days	>9000 psi
Tensile Strength	ASTM C 496	28 days	>800 psi
Flexural Strength	ASTM C 293	28 days	>1500 psi
Shrinkage @90% R.H.	ASTM C 596	28 days	0%
Bond	ASTM C 882	28 days	>2000 psi
Density, When Applied			134 ± 5lbs/ft3
Freeze/Thaw	ASTM C 666	N/A	300 cycles no visible damage

(c) Calcium aluminate cementitious liner shall be made with calcium aluminate cement and shall be used according to manufacturer's recommendations in applications where there are mild sulfide conditions (substrate surface of pH 2.0 or higher). Liner product shall be reinforced with alkaline resistant fiberglass rods or other similar fibers not less than ½-inch in length. Material should meet or exceed industry standards and shall not have any basic ingredient that exceeds EPA maximum allowable limits for heavy metals. Water used to mix product shall be clean and free from contaminants. Questionable water shall be tested by a laboratory per ASTM C 94 procedure. Potable water need not be tested.

h. When cured, CMMLS shall form a continuous, tight-fitting, hard, impermeable surfacing which is suitable for sewer system service and chemically resistant to chemicals or vapors normally found in domestic sewage.

i. CMMLS shall cover complete interior of existing sewer manhole including benches (shelves). Lining shall effectively seal interior surfaces of sewer manhole and prevent any penetration or leakage of groundwater infiltration.

j. Lining shall be compatible with thermal condition of existing sewer manhole surfaces. Surface temperatures will range from 20 degrees F to 100 degrees F.

k. If an internal flexible chimney seal is provided, then lining shall be installed 1-inch below bottom of manhole frame. If no internal flexible chimney seal is provided, then lining shall be installed to 2 inches to 3 inches above bottom of manhole frame.

l. Cured system shall be continuously bonded to brick, mortar, concrete, chemical sealant, grout, pipe, and other surfaces inside sewer manhole.

m. Chemical sealants, grouts or patching materials used to seal active manhole leaks, to patch cracks, to fill voids and to otherwise prepare manhole surface prior to application of system shall be fully compatible with the system.

n. System shall provide a minimum service life of 25 years.

Epoxy Monolithic Manhole Lining System (EMMLS) [harsh sulfide conditions (substrate surface of PH 1.0 or higher)]

o. EMMLS shall be a resin-filled system suitable for use as a trowel-, spray- or spin-applied monolithic lining in sewer manholes. Resin shall be 100 percent epoxy resin. EMMLS shall conform to ASTM C 722. EMMLS materials shall be suitable for specified design conditions and meet the following requirements:

Physical Properties		
Adhesion	ASTM D 7234	>2,000 psi, Concrete Failure
Abrasion Resistance	ASTM D 4060	1,000g 1000 cycles CS-17 Wheel – <90 mg
Compressive Strength	ASTM D 695	15,000 psi
Elongation Percent	ASTM D 638	4.8%
Flexural Modulus	ASTM D 790	590,000 psi
Flexural Strength	ASTM D 790	11,000 psi
Tensile Strength	ASTM D 638	5,600 psi

(1) EMMLS shall provide a minimum service life of 25 years.

(2) Cured EMMLS shall be continuously bonded to brick, mortar, concrete, chemical sealant, grout, pipe, and other surfaces inside sewer manhole.

(3) Cured EMMLS shall provide a minimum total thickness of 0.10 inches (100 mils). Cured lining thickness shall be continuous with proper sealing connections to unsurfaced areas.

(4) Chemical sealants or grouts used to seal active manhole leaks, to patch cracks, to fill voids and to otherwise prepare manhole surfaces shall be compatible with EMMLS.

p. When cured, EMMLS shall form a continuous, tight-fitting, hard, impermeable lining, which is suitable for sewer system service and chemically resistant to any chemicals or vapors normally found in domestic sewage.

q. EMMLS shall bond to sewer manhole being rehabilitated after being placed and cured. EMMLS shall cover complete interior of existing sewer manhole including benches (shelves), inverts (channels or troughs) and pipe connections. EMMLS shall provide a continuous watertight seal or barrier.

(1) EMMLS shall effectively seal interior surfaces of sewer manhole and prevent any penetration or leakage of groundwater infiltration.

(2) EMMLS shall be compatible with thermal condition of existing sewer manhole surfaces. Surface temperatures will range from 20 degrees F to 100 degrees F.

(3) EMMLS shall be separated from manhole frame by a suitable joint. Joint shall be sealed with joint sealing tape.

r. EMMLS shall be Dura-Plate 6100 as manufactured by Sherwin Williams, or an approved equal by Raven Lining Systems, Warren Environmental, Sauereisen, AP/M PermaForm, WBE Dorcas Inc.

5. Cured-In-Place Manhole Liner (CIPM) [harsh sulfide conditions (substrate surface of PH 1.0 or higher)]

a. Manhole liner system shall be a cured-in-place system suitable for use as a monolithic surfacing in sewer manholes. CIPM system shall be Poly-Triplex Liner System, Terre-Hill, or pre-approved equal.

b. Liner design and selection of materials shall be suitable for specified design conditions and shall meet minimum requirements outlined in Table 1. Thicker liners may be required based on design conditions. Liner shall be custom designed to fit each manhole and basis of design shall be submitted to the County in accordance with Paragraph 1.03. It is Contractor's responsibility to supply a CIPM liner that is most suitable for existing conditions and that meets requirements of this specification. Contractor shall assume groundwater at grade for all sites for purposes of liner thickness design unless otherwise instructed by County.

Table 1 Minimum Liner Physical Properties

Manhole Depth (grade to invert)	Minimum Liner Thickness (1) (inch)	Minimum Pre-Saturated Fabric	Minimum Flexural Modulus of Elasticity (psi)	Minimum Compressive Strength (psi) ASTM D695	Chemical Resistance Testing in accordance with ASTM	Chemical Resistance Testing in accordance with

	ASTM D5813	Weight (ounces)	ASTM D790		F1216 Appendix X2	Greenbook Standards
0 to 10 ft	0.117	56	1,000,000	11,000	PASS	n/a
10.1 to 15 ft	0.117	56	1,000,000	11,000	PASS	n/a
15.1 to 20 ft	0.158	68	1,000,000	11,000	PASS	n/a
(1) Minimum liner thickness includes only the strength portion of the liner. Non-structural layers are not included in minimum thickness requirements.						

c. CIPM shall be installed on benches, walls, channels, and inverts of existing manholes. Cured surface shall be smooth and continuous with proper sealing connections to unsurfaced areas. CIPM shall begin below frame and frame/liner interface shall be sealed using an epoxy.

d. CIPM shall provide a minimum service life of 25 years.

e. CIPM shall be continuously bonded to brick, mortar, concrete, chemical sealant, grout, pipe, and other surfaces inside sewer manhole. CIPM shall form a continuous, tight-fitting, hard, impermeable surfacing which is suitable for sewer system service and chemically resistant to chemicals or vapors normally found in domestic sewage. Liner shall effectively seal interior surfaces of sewer manhole and prevent any penetration or leakage of groundwater infiltration.

f. Finished liner shall be repairable at any time during life of structure. Liner shall be flexible and have an elongation sufficient to bridge up to a 1/4-inch settling crack, without damaged to liner. Liner shall be able to bridge expansion cracks that may occur.

Article 3. INSTALLATION

1. General

a. Notify property owners who discharge sewage directly to manhole being surfaced that their service will be discontinued while lining is being placed, cured and active pipe and service connections reopened. Notify individual property owners at least 72 hours in advance, giving date, start time, and estimated completion time for the work being conducted. This notification shall be coordinated with distribution of door hangers.

b. When existing surfaces adjacent to areas where work is scheduled may be damaged or harmed, provide temporary materials to protect those existing surfaces.

c. Each manhole to be rehabilitated shall be thoroughly cleaned and then inspected for loose or missing bricks, loose mortar, or holes. Remove any protrusions or obstructions into the manhole. Observed leaks shall be eliminated prior to applying the manhole lining system.

d. Provide necessary flow-through piping or bypass pumping of sewage flows where and when rehabilitation work is being performed.

e. Place covers over invert to prevent extraneous material from entering the sewer lines.

f. Damage incurred to the manhole or pipe segments due to methods and equipment employed by the Contractor is the responsibility of the Contractor. Damage to public and private property from sewer surcharging that results from material or equipment left in the manhole or sewer or from any flow blockage is the responsibility of the Contractor. The cost to repair the manhole or pipe segments and expenses incurred by the County as a result of the damage shall be the responsibility of the Contractor.

2. Delivery Storage and Handling

a. Care shall be taken in shipping, handling, and placing to avoid damaging the chemical grouts, cementitious materials, and other manhole rehabilitation products. Extra care may be necessary during cold weather construction. Any lining product or material damaged in shipment shall be replaced as directed by the County.

b. Materials shall be stored, shipped, and handled according to their material safety data sheet and manufacturer's recommendations. Any materials showing deterioration, or which has been exposed to any other adverse storage condition that may have caused damage, even though no such damage can be seen, shall be marked as rejected and removed at once from the work.

c. While stored, the materials shall be adequately packaged and protected. The materials shall be stored in a manner as recommended by the manufacturer.

3. Surface Preparation

a. Pre-Rehabilitation Surface Preparation: Areas to be repaired which requires bonding of new cementitious, epoxy, chemical or waterproofing material to existing cement or masonry shall be prepared as follows.

(1) Clean the area with high-velocity water cleaning equipment to remove all foreign matter, oil, grease, wax and dirt, including removal of bitumastic coatings. Pressure shall not exceed that which may cause any permanent damage to the existing manhole walls or other parts of the structure.

(2) Foreign material remaining after high-velocity water blasting shall be removed from the manhole surface using an acid wash. The acid wash shall be muriatic acid (hydrochloric acid) at a ratio of 1 part acid (HCl) to 10 parts of water. The mixing, application and removal of the acid solution shall be in accordance with the manufacturers' recommendations. The acid solution shall remain on the manhole surface until all foreign material have been removed and completely washed off with water.

(3) Chip or chisel away all loose or defective material from the areas to be repaired. Furnish a firm mechanical key by undercutting whenever possible.

(4) Allow interior surfaces of the manhole to dry before applying epoxy manhole lining systems.

(5) Large voids including holes left by the manhole rung removal shall be filled with quick setting patching mix.

(6) Remove protruding rubber gaskets between wall joints.

e. Sewer Line Protection: Place covers over the invert to prevent material from entering the sewer lines.

f. Drop Connections: Remove any interior drop connections anchored to manhole walls prior to installing the lining system. After installation and proper curing of the liner, reinstall interior drop connections to their original condition prior to removal. If the existing drop connection is already damaged and cannot be reused, request from the County the best course of action.

g. Conduct a visual inspection of each manhole after it is cleaned. All active, hydrostatic infiltration leaks shall be plugged or sealed with an appropriate grout compatible with the lining. Remove all loose mortar and rubble of existing chimney (corbelling), cone, walls, benches, and inverts. Prepare manhole to receive cementitious lining as necessary by reshaping and repairing benches, inverts, cone, walls, and corbelling where required. All interior surfaces shall be prepared as recommended by the lining manufacturer. Minimum requirements are as listed below:

(1) Repair cracks and other voids and fill with suitable non-shrinking cements, sealants, or grouts, including all voids between the existing sewer pipes and manhole walls. Patches shall be smooth and even with the manhole wall.

(2) Suitably prepare surfaces for required bonding of lining as recommended by the manufacturer.

4. Sealing of Leaks in Inverts, Benches, Walls, Cone, and Corbelling

a. Premixed Fast-Setting, Volume-Stable Waterproof Cement Plug: Seal unsealed lifting holes, unsealed step holes, and voids larger than ½-inch in thickness with a waterproof, quick setting mortar. Place waterproof mortar according to manufacturer's instructions.

b. Manhole Sealing by Chemical Grout Application: Chemical grouting shall include the following:

c. Transporting, delivering, and storing the chemical grout shall be according to the manufacturers published directions and requirements.

d. Manhole Preparation: Repair the manhole frame and rings, and complete structural repairs before grouting the manhole. Cut roots and trim roots before grouting the manhole. Remove cracked or deteriorated material from the areas to be grouted.

e. Chemical Grout Formulation: Mix each batch of chemical grout according to the manufacturer's published directions and requirements.

f. Sealing Active Leaks: Use the Expanded Gasket Procedure, drilling and injection procedure and/or chemical curtain grouting to stop active leaks.

(1) Expanded Gasket Procedure (EGP): Perform per ASTM F 2414-04, and the chemical grout manufacturers recommended installation methods. This is performed by soaking dry oil free oakum with hydrophilic polyurethane chemical grout. The

resulting oakum/resin plug shall be forced into the opening until it sets. Perform the EGP to:

(a) Control flowing water in larger cracks, joints, or pipe to manhole boots.

(b) Seal drop or lateral connections, slip line terminal seals and open joints in RCP manholes.

(c) Seal between the corbel and manhole rings.

(d) Seal between the manhole rings and manhole frame.

g. Drilling and Injection Procedure: Perform per ASTM F 2414-04 (2009) and the chemical grout manufacturers recommended installation methods to seal the manhole with chemical grout. Drill injection holes through the manhole at locations recommended by the manufacturer. Inject the chemical grout through the holes under pressure. Injection pressure shall not cause damage to the manhole structure or surrounding surface features. Inject chemical grout through the lowest holes first. Repeat the procedure until the manhole is externally sealed. Grout travel shall be verified by observation of grout to defects or adjacent injection holes. Drill additional injection holes as necessary to ensure grout travel. Do not inject grout from the ground surface. After chemical grout injection is complete, clean injection holes with a drill and patch with a waterproof, quick setting mortar for brick and concrete manholes. Perform the drilling and injection procedure to control flowing water in cracks.

h. Curtain Grouting: Perform per ASTM F 2414-04 (2009) and the chemical grout manufacturers recommended installation methods. Perform the curtain grouting procedure when there are multiple active leaks, and the drilling and injection procedure does not eliminate the active leaks.

5. Invert Channel Coating

a. Coat invert channels with a material compatible with the manhole lining system per the manhole lining manufacturers recommendations to prevent infiltration and to build up the invert channel to the invert elevations of the new sewer main or cured-in-placed lined sewer and to form a smooth flow channel. The entire channel shall be coated. The coating shall be troweled uniformly onto the invert at a minimum ½-inch in thickness or as recommended by the manufacturer. The coating shall extend out onto the bench of the manhole sufficiently to tie into the monolithic liner.

b. The material used for the invert channel shall be suitable for the intended purpose and shall be compatible with the materials used for the manhole lining system. The material for the invert channel shall be as recommended by the cementitious liner manufacturer and installed in accordance with the manufacturers recommended installation instructions and procedures. Coating the invert may be waived when the invert is in excellent condition and upon approval by the County.

6. Locating, Raising, Resetting, and/or replacing manhole frame and cover assemblies

a. Locate and uncover buried manhole frame and covers; remove existing manhole frame and covers; dispose of existing manhole frame and covers if they are not being reused; and install new or reused manhole frame and covers as directed by the County. Repair any damage to the manhole chimney or corbelling caused by the removal of the existing manhole frame at no additional expense to the County.

b. Existing frames and covers to be reused shall be thoroughly cleaned before re-installation.

c. If existing frames and covers are not to be reused, properly dispose of these materials in accordance with local laws and the County's approval.

d. When re-setting existing frames and covers, apply preformed flexible joint sealant Kent Seal No. 2 by Hamilton-Kent or Ram-Nek by K.T. Snyder Company or equal.

e. Install new or reused frames so that the tops of the covers are at the required grade. Utilize bricks or precast concrete grade rings to set the manhole frame and cover to the finished grade. Precast concrete grade rings shall be set in a bed of butyl mastic sealant. Bricks shall be set in a full mortar bed.

7. Cement Exterior

a. For raised manholes with damaged exterior, masonry manholes without an exterior cement coating, manholes where frame and cover assemblies are being replaced or reset, as directed by the County, repair existing or install new cement exterior coating for manholes.

Installation – Cementitious Manhole Monolithic Lining (CMML)

a. When cured, CMML shall form a continuous, tight-fitting, hard, impermeable surfacing which is suitable for sewer system service and chemically resistant to chemicals or vapors normally found in domestic sewage.

b. CMML shall cover complete interior of existing sewer manhole including benches (shelves) and inverts. Lining shall effectively seal interior surfaces of sewer manhole and prevent penetration or leakage of groundwater infiltration.

c. Lining shall be compatible with thermal condition of existing sewer manhole surfaces. Surface temperatures will range from 20 degrees F to 100 degrees F.

d. Clean sewer manhole to be surfaced and dispose of resulting material Coatings that cannot be removed shall be sanded with coarse sandpaper to roughen surface sufficient to obtain and ensure adequate bonding of CMML.

e. Conduct a visual inspection of manhole after it is cleaned. Active, hydrostatic infiltration leaks shall be plugged or sealed with grout. Remove loose mortar and rubble of existing benches and inverts. Remove protruding rubber gaskets between wall seams. Prepare manhole to receive CMML as necessary by reshaping and repairing benches, inverts, and wall where required. Protect pipe connections. Interior surfaces shall be prepared for CMML as recommended by manufacturer.

(1) Cracks and other voids shall be repaired and filled with suitable non-shrinking cements, sealants, or grouts.

(2) Surfaces shall be clean and structurally sound.

f. Liner shall be mixed as specified by manufacturer for 30 seconds to 1 minute after materials have been placed in mixing hopper. Mixing shall be accomplished such that the mix can be sprayed in a continuous manner without interruption until each application is complete.

g. Just prior to application, clean surface, be free of foreign material, and be damp without noticeable free water droplets or running water, but totally saturated. Materials shall be applied to a minimum uniform thickness, to ensure that cracks, crevices, and voids are filled, and a relatively smooth surface remains clean after light troweling. Perform light troweling to compact the material into voids and to set the bond.

h. Covers placed over invert shall be removed and bench sprayed such that a gradual slope is produced from walls to invert with thickness at edge of invert being no less than ½-inch. Round wall/bench intersection to a uniform radius full circumference of the intersection.

i. Caution shall be taken to minimize exposure of applied product to sunlight and air movement. At no time shall finished product be exposed to sunlight or air movement for longer than 15 minutes before replacing manhole cover. In extremely hot and arid climates, shade manhole while reconstruction is in process. Final application shall have a minimum of four hours cure time before being subjected to active flow. Traffic shall not be allowed over manholes for 24 hours after reconstruction is complete.

j. No application shall be made to frozen surfaces or if freezing is expected to occur inside manhole within 24 hours after application. If ambient temperatures are in excess of 95 degrees F, precautions shall be taken to keep mix temperature at time of application below 90 degrees F. Mix water temperature shall not exceed 85 degrees F. Chill with ice if necessary.

k. After preparation has been completed, remove loose material and wash walls again. Bench, invert, or service line repairs shall be made at this time using quick setting patching mix per manufacturer's recommendations.

Installation – Epoxy Monolithic Manhole Lining System (EMMLS)

a. Place EMMLS in manhole. Installation of EMMLS shall be in complete accordance with applicable provisions of ASTM C 722 and manufacturers' specifications. Manufacturer’s representative shall be present during actual installation.

(1) Prior to placing EMMLS, manufacturer's representatives shall approve surface preparation work and installation conditions including temperatures.

(2) Surfaces shall be sufficiently dry and even.

(3) Bottom and horizontal surfaces including benches and channels shall have EMMLS applied to required thickness by hand troweling or spray-on methods.

(4) Side vertical surfaces shall have EMMLS applied to required thickness by manufacturer’s recommended methodology.

(5) Temperature limitations shall be handled as appropriate and as approved by manufacturer.

b. Cutting and sealing of EMMLS at manhole pipe, cured-in-place liner, rungs, and top connections shall provide watertight seals.

8. Installation – Cured-In-Place Manhole Liner (CIPM)

a. CIPM can be performed 24-hours after cementitious repair coating was applied as long as it meets cementitious coating characteristics.

b. Prior to placing liner, the County will inspect and approve surface preparation work. Contractor is responsible for ensuring proper installation conditions, including temperature and moisture.

c. Liner tube shall be fully saturated with selected resin at a site to be designated by Contractor for approval. When fully saturated, liner shall be inserted into manhole per manufacturer's instructions.

d. Once properly inserted and oriented, liner shall be cured strictly according to manufacturer's instructions for that liner system. Heat cure time, cool down time, and temperatures shall be recorded in a log for the County's review.

Article 4. TESTING AND INSPECTION

1. Field Testing and Acceptance

a. The County may enter the manholes to inspect the benching, invert channels, manhole wall/pipe connections, surface preparation, and other parts of the work. Provide forced air ventilation, gas monitors and detectors, harnesses, lights, etc. for the County to enter the manhole and perform the inspection in complete accordance with OSHA requirements.

b. No Active infiltration in the manhole shall be observed in the manhole as confirmed by visual inspection of the County. Infiltration found shall be repaired by the Contractor immediately.

c. The Contractor is responsible for coordinating inspection times with the County.

d. Finished manhole surface shall be continuous and as free as commercially practicable from significant defects. Defects which will affect, in foreseeable future or warranty period, the integrity or strength of manhole shall be repaired at Contractor's expense.

e. There shall be no cracks, voids, pinholes, uncured spots, dry spots, lifts, delamination, or other type defects in liner. If any defects are discovered after liner has been installed, it shall be repaired or replaced in a satisfactory manner within 72 hours and at no additional expense to County. This requirement shall apply for entire warranty period.

f. Active infiltration through lining systems shall be zero.

2. Field Quality Control – Cementitious Manhole Monolithic Lining System (CMML)

a. Cementitious lining shall provide a continuous monolithic surfacing with uniform thickness throughout manhole interior. Contractor shall work with Field Representative to develop an easy method for measuring liner thickness. Use method so Field Representative does not have to enter manhole to measure thickness.

(1) One possible method would be to install pins (such as masonry nail) at four quadrants around manhole spaced every 4 feet vertically. Pins would protrude slightly less than 1-inch from wall. Lining would be installed to cover pins, and Field Representative could verify thickness by checking that no pins are exposed without entering manhole.

(2) Contractor may develop other methods.

(3) Costs associated with measuring liner thickness shall be included in the work. If thickness of lining is not uniform or is less than specified, it shall be repaired or replaced at no additional expense to the County.

b. Contractor shall visually verify absence of leaks and perform a vacuum test. Vacuum test shall be performed as follows:

(1) Vacuum Test: Test rehabilitated manholes using vacuum test method, following manufacturer's recommendations for proper and safe procedures. Vacuum testing of manholes and structures shall be performed after curing of linings. Vacuum testing will not be required on manholes with sewer lines greater than 16 inches in diameter due to safety concerns. Any visible leakage in manhole or structure, before, during, or after test shall be repaired regardless of test results. Vacuum test shall be performed in accordance with ASTM C 1244.

3. Field Quality Control – Epoxy Manhole Monolithic Lining System (EMMLS)

a. Field acceptance of EMMLS shall be based on the County's evaluation of proper monolithic lining of manhole. Field acceptance shall also be based on the County's evaluation of appropriate installation and curing test data along with review of manhole inspections.
b. EMMLS shall provide a continuous monolithic lining with uniform thickness throughout manhole interior. If thickness of EMMLS is not uniform or is less than specified, it shall be repaired or replaced at no additional expense to the County.

(1) The County will measure EMMLS cured thickness by physically cutting through lining (by drilling or coring) and making a direct measurement. Make a minimum of two thickness measurement locations in each EMMLS manhole. A suitable non-destructive type of thickness measurement may also be used.

(2) EMMLS thickness measurement locations shall be repaired by Contractor in accordance with manufacturer's recommendations. These repairs shall be included in 2-year EMMLS warranty.

(3) Contractor shall also perform in-place testing in each manhole to verify adhesion of EMMLS to existing manhole substrate. Adhesion strength tests shall be in accordance with ASTM D 7234 and test area shall be isolated from remaining portion of manhole by coring through liner into substrate. Two tests shall be performed in each manhole at locations directed by the County. Testing shall consist of a calibrated pull test. Equipment

shall be provided by Contractor. Samples shall meet a minimum pressure resistance of 400 psi.

c. There shall be no cracks, voids, pinholes, uncured spots, dry spots, lifts, delaminations or other type defects in EMMLS.

d. Contractor shall submit proposed method for testing for these defects. One of the following tests shall be performed by Contractor as directed by the County.

(1) Vacuum Test: A vacuum test conforming to requirements of ASTM C 1244 shall be performed for every lined manhole or circular structure where practical.

(2) Holiday Detection Test: A high voltage holiday detection system may be used to determine if any holidays (pinholes, voids, etc.) exist in lining. Set sensitivity control of holiday tester to accommodate thickness of applied lining (100-125 volts for each 1 mil thickness). Follow guidelines of holiday manufacturer for correct control settings. One such service is Tinker & Rasor Holiday Tester Model APW.

(3) Should a holiday be detected, it shall be marked, and lining installation Contractor shall repair void according to correct procedure determined by system manufacturer.

(4) Ultrasonic Testing: Per ASTM D 6132.

4. Field Quality Control – Cured-In-Place Manhole Liner (CIPM)

a. Field acceptance of CIPM shall be based on the County's evaluation of proper monolithic lining of manhole. Field acceptance shall also be based on the County's evaluation of appropriate installation and curing test data along with review of manhole inspections.

b. CIPM shall provide a continuous monolithic lining with uniform thickness throughout manhole interior. If thickness of CIPM is not uniform or is less than specified, it shall be repaired or replaced at no additional expense to the County.

(1) The County will measure CIPM cured thickness by physically cutting through lining (by drilling or coring) and making a direct measurement. Make a minimum of two thickness measurement locations in each CIPM manhole. A suitable non-destructive type of thickness measurement may also be used.

(2) CIPM thickness measurement locations shall be repaired by Contractor in accordance with manufacturer's recommendations. These repairs shall be included in 2-year warranty.

(3) Contractor shall also perform in-place testing in each manhole to verify adhesion of CIPM to existing manhole substrate. Adhesion strength tests shall be in accordance with ASTM D 7234 and test area shall be isolated from remaining portion of manhole by coring through liner into substrate. Two tests shall be performed in each manhole at locations directed by the County. Testing shall consist of a calibrated pull test. Equipment shall be provided by Contractor. Samples shall meet a minimum pressure resistance of 400 psi.

e. There shall be no cracks, voids, pinholes, uncured spots, dry spots, lifts, delaminations or other type defects in EMMLS.

f. Contractor shall submit proposed method for testing for these defects. One of following tests shall be performed by Contractor as directed by the County.

(1) Vacuum Test: A vacuum test conforming to requirements of ASTM C 1244 shall be performed for every lined manhole or circular structure where practical.

(2) Holiday Detection Test: Per ASTM D4787, a high voltage holiday detection system may be used to determine if any holidays (pinholes, voids, etc.) exist in lining. Normally sensitivity control of holiday tester is set to accommodate thickness of applied lining (100-125 volts for each 1 mil thickness). Follow guidelines of holiday manufacturer for correct control settings. One such service is Tinker & Rasor Holiday Tester Model APW. Should a holiday be detected, it shall be marked, and lining installation Contractor shall repair void according to correct procedure determined by system manufacturer.

(3) Ultrasonic Testing: Per ASTM D 6132

Article 5. WARRANTY

a. All manhole rehabilitation and lining systems work shall be warranted by the Contractor for a period of 2 years from the date of Substantial Completion. During this period, all defects in the lining shall be repaired in a manner satisfactory to the County or the lining shall be re-applied at no additional expense to the County. At 21 months following substantial completion of the manhole rehabilitation work, the County shall inspect all this work to ensure proper performance. If any deficiencies are found during these inspections, the Contractor shall repair them at no additional expense to the County.

END OF SECTION

APPENDICES

APPENDIX A

CARROLL COUNTY, MD CODE OF ORDINANCES
CHAPTER 51 – SEWER AND WATER

§ 51.01 POLICY AND ADOPTION BY REFERENCE.

(A) **Generally.** This subchapter outlines the rules and regulations for the installation, operation, and maintenance of water and sewer facilities in this county. All matters pertaining to the installation, operation, and maintenance of water and sewer facilities in this county shall be performed and conducted in accordance with the Carroll County Department of Public Works, Bureau of Utilities, or Regulations and Standard Specifications and Design Details for Water and Sewer Construction in Carroll County, as from time to time amended (hereinafter referred to as "the Manual"), and the County Commissioners, or their successor agencies, hereby adopts said Manual by reference and incorporates the same as if fully set forth herein.

The full Carroll County, MD code Chapter 51 can be located online at the following website: https://codelibrary.amlegal.com/codes/carrollcounty/latest/carrollcounty_md/0-0-0-17418

APPENDIX B

GENERAL, WATER, AND SEWER NOTES

General Notes:

1. The Department of Public Works, Bureau of Utilities "Regulations, Standard Specifications and Design Details for Water and Sewerage Construction in Carroll County, Maryland" latest edition are hereby made a part of these documents, including all subsequent addenda or modifications hereto.

2. The contractor shall notify the following companies at least 72 hours prior to starting any construction:
   Baltimore Gas & Electric …… ……410-293-3147
   Verizon ……..……410-393-5793
   Miss Utility ...……1-800-257-7777
   Carroll County Bureau of Utilities ……...……410-386-2164

3. The contractor shall be responsible for notifying the office of the engineer, *(Name & Phone #)* of any discrepancies in the plans or in the relationship of finished grades and existing grades prior to start of construction.

4. The location of existing utilities is shown for the convenience of the contractor only. The Bureau of Utilities (BOU), Carroll County or the engineer do not warrant or guarantee the correctness of the information given. The contractor must verify the existence and location of all utilities to his own satisfaction.

5. Any paving in County roads disturbed by the contractor's operation shall be replaced with 18" of compacted CR-6 to a minimum of 95% modified proctor ASTM D-1557. Permanent paving shall be in accordance with County roads detail No. *(applicable paving detail)*. Permit costs therefore shall be included in unit prices bid and the sole responsibility of the contractor.

6. It shall be distinctly understood that failure to mention specifically any work which would normally be required to complete this project shall not relieve the contractor of his responsibility to perform such work.

7. All safety measures to be implemented during the construction of this project are the responsibility of the Contractor.

8. A Geotechnical Engineer should be consulted during the construction of slopes greater than ten (10) vertical feet at slopes of 2:1 or greater.

9. House connections shall be located as shown. If any adjustment to these locations is proposed by the field engineer or contractor, the developer or his engineer shall be consulted to the proposed change before installation.

10. The contractor is required to obtain a permit from the Bureau of Roads Operations prior to beginning work in a County road right of way. Contact Bureau of Roads Operation at 410-386-6717 a minimum of 72 hours prior to start of construction.

11. The public portion of the *(WHC)* and/or *(SHC)* from the *(Water main and/or (Sewer main)* to the *(meter vault and/or clean out)* at the right of way or easement line falls under the purview of BOU. contractor shall contact the Bureau at 410-386-2164 to schedule pre-construction meeting and inspection a minimum of 72 hours prior to start of construction.

12. Contractor must be pre-qualified with Department of Public Works to construct public water and sewer utility work.

13. The Contractor is responsible for providing/supplying water to site during construction. The Bureau of Utilities bulk water service can be utilized at the contractor's expense. Meter hydrants and connection to existing infrastructure is prohibited. Contact Utilities at 410-386-2164 for bulk water service info.

14. The private portion of the *(WHC)* and/or *(SHC)* from the *(private meter vaults and/or private clean out)* to the *(house or building)* falls under the purview of Bureau of Permits and Inspections. The plumbing inspector shall inspect the private portion of the *(WHC)* and/or *(SHC)*. Contractor shall contact Bureau of Permits and Inspections at 410-386-2674 to obtain required plumbing permit. Inspection of private water and sewer mains and infrastructure shall be the responsibility of the developer/contractor.

15. Maintenance of private on-site water and sewer beyond right-of-way and/or utility easement shall be responsibility of property owner.

Water Notes:

1. All public water main pipe shall be ductile iron pipe (DIP) class 52 or C-900 and approved by BOU. Water main pipe shall be installed in accordance with the manufacturer's specifications and The Department of Public Works, Bureau of Utilities "Regulations, Standard Specifications and Design Details for Water and Sewerage Construction in Carroll County, Maryland" latest edition.

2. The Bureau of Utilities prohibits the manipulation of valves by any party other than Bureau of Utilities staff.

3. Tees, valves, bends fittings, caps, etc. shall be mega lugged and buttressed in accordance with standard details. Provide field lock gaskets in all bell end pipe connections where mega lugs are not required.

4. Fire hydrants shall be strapped to valves and valves strapped to tees at the main in accordance with standard details. Fire hydrant intervals shall be in accordance with specifications based on lot size.

5. A valve is required in each direction at all tees or crosses, high and low points and at specific intervals as noted on approved water and sewer plans. An adjustable roadway valve box shall be furnished and installed with each valve. The rim of the valve box shall be set flush with existing ground or proposed grade.

6. Residential water meters shall be 1" and located within a meter vault constructed and set in accordance with BOU standard detail W-7/W-11 latest version. Extend WHC to right of way or utility easement.

7. Residential water house connections (WHC) shall be 1.5" type 'K' soft copper tubing.

8. Contractor shall tunnel past existing underground utilities as may be necessary to avoid disruptions of any services.

9. Contractor shall not interrupt existing utility services without written permission from the owner of the utility a minimum of 72 hours prior to the interruption. Water connections to existing mains shall be made during the hours of 10:00 AM and 3:00 PM and under the supervision of BOU personnel.

10. Disinfection of water mains shall be carried out in accordance with the standard specifications and design details, Section 4, Subsection 12 - Disinfection of Mains.

11. Public water mains and hydrant connections shall be tested by the contractor in accordance with Section 4, Subsection 15a and b – Testing Mains.

12. If water house connections cross sewer house connections, there shall be a minimum 1'-0" vertical clearance between water and sewer unless otherwise specified. Water shall be above the sewer.

Sewer Notes:

1. All public sewer pipes shall be manufactured in accordance with ASTM D-3034 Standard Specification for Type PSM Poly Vinyl Chloride (PVC) sewer pipe and fittings. All public gravity sewer shall be minimum SDR-26 type or equivalent for standard depths up to 16'. Sewer pipe and fittings shall utilize a rubber ring joint. Mainline shall be minimum 8" inside diameter and SHC's shall be minimum 6" inside diameter. Sewer pipe shall have ASTM embedded material classification of CL. 1, 6" of No. 57 stone all around pipe to 6" above top.

2. All public gravity sewer 16' or deeper shall be C900 DR18 or equivalent with joints in compliance with ASTM D-3139 and gaskets in compliance with ASTM F-477. Public gravity sewer below 25' shall require further evaluation of material type and construction methods to be approved by BOU.

3. All public force main sewer shall be minimum DIP CL. 52 type or equivalent.

4. Sewer house connections (SHC) shall be minimum 6" PVC SDR -26 for the public portion. SHC's shall be per specifications noted above and constructed in accordance with BOU standard details S-15, S-16 and S-21 latest version.

5. Sewer house connections (SHC) shall be located as shown on the approved water and sewer plans, sheets *(provide sheet numbers)* with respect to water service locations and meet clearance requirements, etc., as described below and in the Design Manual noted in item No.1 of General Notes. Any proposed change to these locations must be approved by the BOU, design engineer and Developer.

6. All appurtenances to the public sewer lines shall be constructed in accordance with BOU standard details cited in the approved water and sewer construction plans. In the case of manholes, *(provide type and detail no.)*

7. In addition to the clearances described in the Design Manual Regulations, the sewer lines shall be located a minimum 3'-0" clear of the face of any curbs, poles, utility boxes, guide rail, etc.

8. Sewer manholes shall be set to finished grade upon installation and tapered with black top to meet base paving grade until final paving is installed. Protection of all water and sewer appurtenances is the responsibility of the contractor until public road(s) are conveyed to Carroll County.

9. Upon installation of sewer mains and house connections and after placement of the compacted back fill to original ground line or proposed paving subgrade, the sewer shall be tested for acceptability. The procedures for testing shall be in accordance with the latest version of indicated subsections of the Design Manual as follows:
    1. Tests for acceptability of sewers – Subsection 5-14.
    2. Elevation and alignment checks – Subsection 5-15.
    3. Cleaning of Pipelines – Subsection 5-16.
    4. Air test of sewer for acceptability – 5-17.

APPENDIX C
MDE FLOW PROJECTION TABLES 1 & 2
(for reference only)

Table I - Flow Projection Based Upon Gallons Per Person Per Day

Airports (per passenger)	5
Apartments-multiple family (per resident)	60
Bathhouses and swimming pools	10
Camps:	
Campground with central comfort stations	35
With flush toilets, no showers	25
Day camps (no meals served)	15
Resort camps (night and day) with limited plumbing	50
Luxury camps	100
Cottages and small dwellings with seasonal occupancy	50
Country clubs (per resident member)	100
Country clubs (per non-resident member present)	25
Dwellings:	
Boarding houses	50
additional for non-resident boarders	10
Luxury residences and estates	150
Multiple family dwellings (apartments)	60
Rooming houses	40
Single family dwellings	75-100
Factories (gallons per person, per shift, exclusive of industrial wastes)	35
Hospitals (per bed space)	350
Hotels with private baths (2 persons per room)	60
Hotels without private baths	50
Institutions other than hospitals (per bed space)	125
Laundries, self-service (gallons per wash, i.e., per customer)	50
Mobile home parks (per space)	250
Motels with bath, toilet and kitchen wastes (per bed space)	50
Motels (per bed space)	40
Picnic Parks (toilet wastes only) (per picnicker)	5
Picnic Parks with bathhouses, showers and flush toilets	10
Restaurants (per seat)	25
Restaurants (toilet and kitchen wastes per patron)	10
Restaurants (kitchen wastes per meal served)	3
Restaurants, additional for bars and cocktail lounges	2
Schools:	
Boarding	100
Day, without gyms, cafeterias or showers	15
Day, with gyms, cafeterias and showers	25
Day, with cafeterias, but without gyms or showers	20
Service Stations (per vehicle served)	10
Swimming pools and bathhouses	10
Theaters:	
Movie (per auditorium seat)	1
Drive-in (per car space)	5
Travel Trailer Parks without individual water and sewer hook-ups (per space)	50
Travel Trailer Parks with individual water and sewer hook-ups (per space)	100
Workers:	
Construction (at semi-permanent camps)	50
Day, at schools and offices (per shift)	15

Table II - Guiding Factors for Flow Projection Related with Commercial Establishments, Public Service Buildings, or Dwelling Units

Office Buildings	Gross Sq. Ft. x 0.09 = gpd
Medical Office Buildings	Gross Sq. Ft. x 0.62 = gpd
Warehouses	Gross Sq. Ft. x 0.03 = gpd
Retail Stores	Gross Sq. Ft. x 0.05 = 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
Barber Shops	Gross Sq. Ft. x 0.20 = 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 0.04 = gpd
Service Stations	Gross Sq. Ft. x 0.18 = gpd
Laundries & Cleaners	Gross Sq. Ft. x 0.31 = gpd
Laundromats	Gross Sq. Ft. x 3.68 = gpd
Car Wash without Wastewater Recirculation Equipment.	Gross Sq. Ft. x 4.90 = gpd
Hotels	Gross Sq. Ft. x 0.25 = gpd
Motels	Gross Sq. Ft. x 0.23 = gpd
Dry Goods Stores	Gross Sq. Ft. x 0.05 = gpd
Shopping Centers	Gross Sq. Ft. x 0.18 = gpd

Source Document:
https://mde.maryland.gov/programs/Permits/WaterManagementPermits/Documents/WastewaterDesignGuidelines-2016.pdf

APPENDIX D
Low-Pressure Air Test Calculation Tables
(for reference only)

APPENDIX D

Low-Pressure Air Test Calculation Tables (For Reference Only)

From ASTM F1417-11a: Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air

No test section shall be accepted if air loss is more than a specified leakage rate (in CFM/SF).

Calculate all test times by the following equation:

$$T = 0.085\ DK/Q$$

where:

$T =$ shortest time allowed for the air pressure to drop 1.0 psig (seconds)
$K =$ $0.000419DL$ (but not less than 1.0)
$Q =$ leak rate in cubic feet/minute/square feet of internal surface = 0.0015 CFM/SF
$D =$ measured average inside diameter of sewer pipe (inches)
$L =$ length of test section (feet)

If lateral or service lines are included in the test, their length may be ignored for computing required test time if the test time requirements are met. The maximum permissible air loss shall not exceed 625Q. If the test section fails, time shall be recomputed to include all the lateral lengths using the following equation:

$$T = 0.085 \left[\frac{D_1^2 L_1 + D_2^2 L_2 + \ ... + D_n^2 L_n}{D_1 L_1 + D_2 L_2 + \ ... + D_n L_n}\right]\frac{K}{Q}$$

where:

$T =$ shortest time allowed for the air pressure to drop 1.0 psig (seconds)
$K =$ 0.000419 DL but not less than 1.0
$Q =$ leak rate in cubic feet/minute/square feet of internal surface = 0.0015 CFM/SF
$D_1, D_2, etc =$ nominal diameter of different size of pipe being tested (inches)
$L_1, L_2, etc =$ respective lengths of the different size pipes being tested (feet)

TABLE 1 Minimum Time for a 1.0-psig Pressure Drop for Size and Length of Pipe for Q = 0.0015

NOTE 1: See Practice UNI-B-6.

NOTE 2: Consult with pipe and appurtenance manufacturer for maximum test pressure for pipe size greater than 30 in. in diameter.

Pipe Diameter, in.	Minimum Time, min:s	Length for Minimum Time, ft	Time for Longer Length, s	Specification Time for Length (L) Shown, min:s							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	3:46	597	0.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	0.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10:00	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	22:47	34:11:00	45:34	56:58	68:22	79:46	91:10	102:33:00
27	25:30:00	88	17.306 L	28:51:00	43:16:00	57:41	72:07	86:32	100:57:00	115:22:00	129:48:00
30	28:20:00	80	21.366 L	35:37:00	53:25:00	71:13	89:02	106:50:00	124:38:00	142:26:00	160:15:00
33	31:10:00	72	25.852 L	43:05:00	64:38:00	86:10	107:43:00	129:16:00	150:43:00	172:21:00	193:53:00
36	34:00:00	66	30.768 L	51:17:00	76:55:00	102:34:00	128:12:00	153:50:00	179:29:00	205:07:00	230:46:00
42	39:48:00	57	41.883 L	69:48:00	104:42:00	139:37:00	174:30:00	209:24:00	244:19:00	279:13:00	314:07:00
48	45:34:00	50	54.705 L	91:10:00	136:45:00	182:21:00	227:55:00	273:31:00	319:06:00	364:42:00	410:17:00
54	51:02:00	44	69.236 L	115:24:00	173:05:00	230:47:00	288:29:00	346:11:00	403:53:00	461:34:00	519:16:00
60	56:40:00	40	85.476 L	142:28:00	213:41:00	284:55:00	356:09:00	427:23:00	498:37:00	569:50:00	641:04:00

TABLE 2 Minimum Time for a 0.5-psig Pressure Drop for Size and Length of Pipe for $Q = 0.0015$

NOTE 1: Consult with pipe and appurtenance manufacturer for maximum test pressure for pipe size greater than 30 in. in diameter.
NOTE 2: This test method is reserved for larger diameter pipes, longer test sections, or both.

Pipe Diameter, in.	Minimum Time, min:s	Length for Minimum Time, ft	Time for Longer Length, s	Specification Time for Length (L) Shown, min:s							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	1:53	597	0.190 L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	0.427 L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47	298	0.760 L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	239	1.187 L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	199	1.709 L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
15	7:05	159	2.671 L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	133	3.846 L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51
21	9:55	114	5.235 L	9:55	13:05	17:27	21:49	26:11:00	30:32:00	34:54	39:16
24	11:20	99	6.837 L	11:24	17:57	22:48	28:30:00	34:11:00	39:53:00	45:35	51:17
27	12:45	88	8.653 L	14:25	21:38	28:51:00	36:04:00	43:16:00	50:30:00	57:42	64:54
30	14:10	80	10.683 L	17:48	26:43:00	35:37:00	44:31:00	53:25:00	62:19:00	71:13	80:07
33	15:35	72	12.926 L	21:33	32:19:00	43:56:00	53:52:00	64:38:00	75:24:00	86:10	96:57
36	17:00	66	15.384 L	25:39:00	38:28:00	51:17:00	64:06:00	76:55:00	89:44:00	102:34:00	115:23:00
42	19:54	57	20.942 L	34:54:00	52:21:00	69:49:00	87:15:00	104:42:00	122:10:00	139:37:00	157:04:00
48	22:47	50	27.352 L	45:35:00	68:23:00	91:11:00	113:58:00	136:46:00	159:33:00	182:21:00	205:09:00
54	25:31:00	44	34.618 L	57:42:00	86:33:00	115:24:00	144:15:00	173:05:00	201:56:00	230:47:00	259:38:00
60	28:20:00	40	42.738 L	71:14:00	106:51:00	142:28:00	178:05:00	213:41:00	249:18:00	284:55:00	320:32:00

APPENDIX E

GENERAL, WATER, AND SEWER STANDARD DETAILS

APPENDIX E

GENERAL, WATER, AND SEWER STANDARD DETAILS

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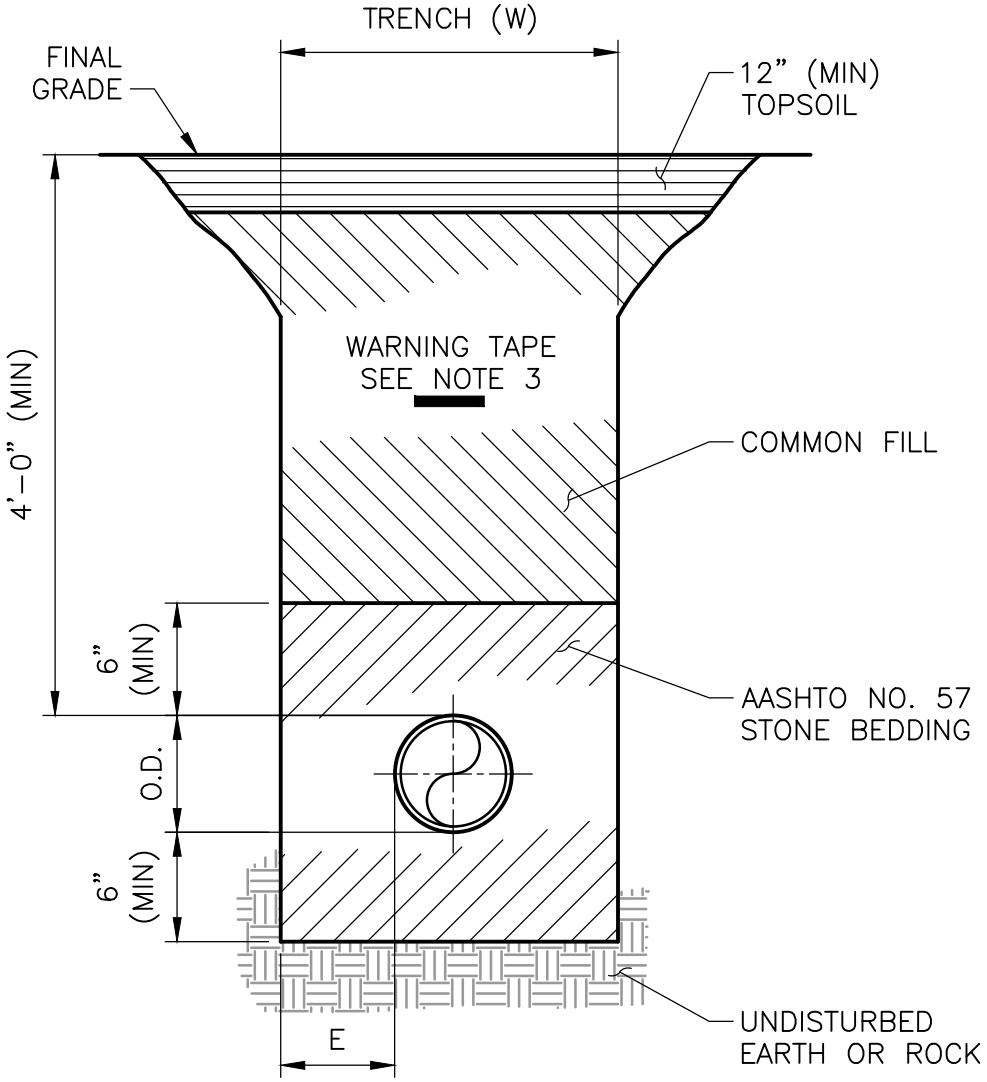
GENERAL STANDARD DETAILS

WATER STANDARD DETAILS

SEWER STANDARD DETAILS



NOTES:

1. TRENCH SIDE SLOPES SHALL BE IN ACCORDANCE WITH OSHA REQUIREMENTS. BEGIN SIDE SLOPES, IF USED, APPROXIMATELY 18" ABOVE TOP OF PIPE (TYPICAL ALL BEDDING TYPES).

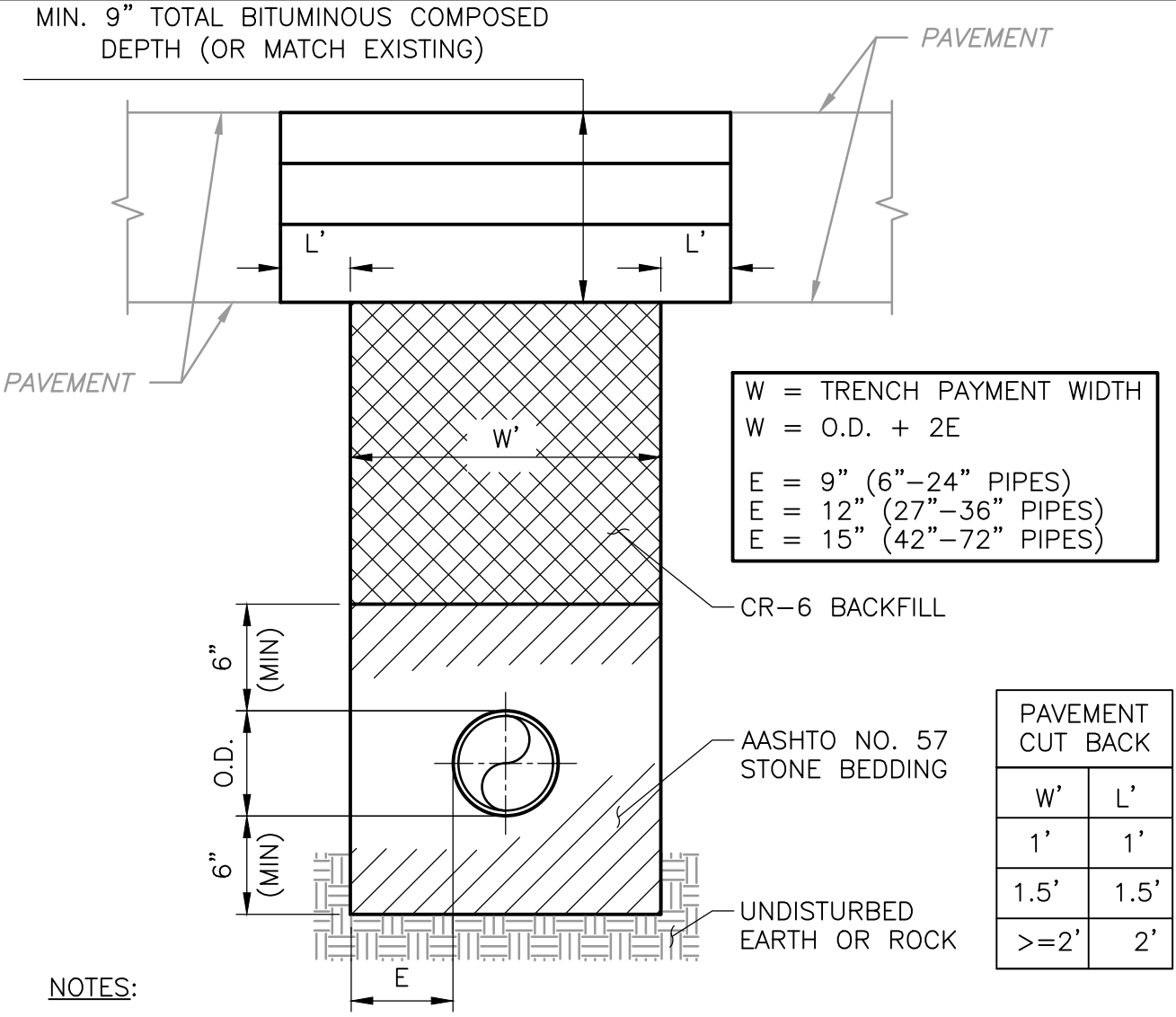
2. PIPES BETWEEN SERVICE VALVE (NOT SHOWN) AND METER VAULT SHALL BE DUCTILE IRON PIPE, REGARDLESS OF TYPE OF PIPE USED ELSEWHERE.

3. ADD MAGNETIC WARNING SAFETY TAPE ABOVE ALL PRESSURE LINES. TAPE SHALL BE PLACED DIRECTLY ABOVE PIPE CENTERLINE. 12–18 INCHES BELOW FINISHED GRADE.

W = TRENCH PAYMENT WIDTH
W = O.D. + 2E

E = 9" (6"–24" PIPES)
E = 12" (27"–36" PIPES)
E = 15" (42"–72" PIPES)

CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES July 11, 2022 DATE Andrew C Watcher CHIEF	RIGHT-OF-WAY RESTORATION	STANDARD DETAIL G-1 Revised 03/2022



PAVEMENT CUT BACK	
W'	L'
1'	1'
1.5'	1.5'
>=2'	2'

NOTES:

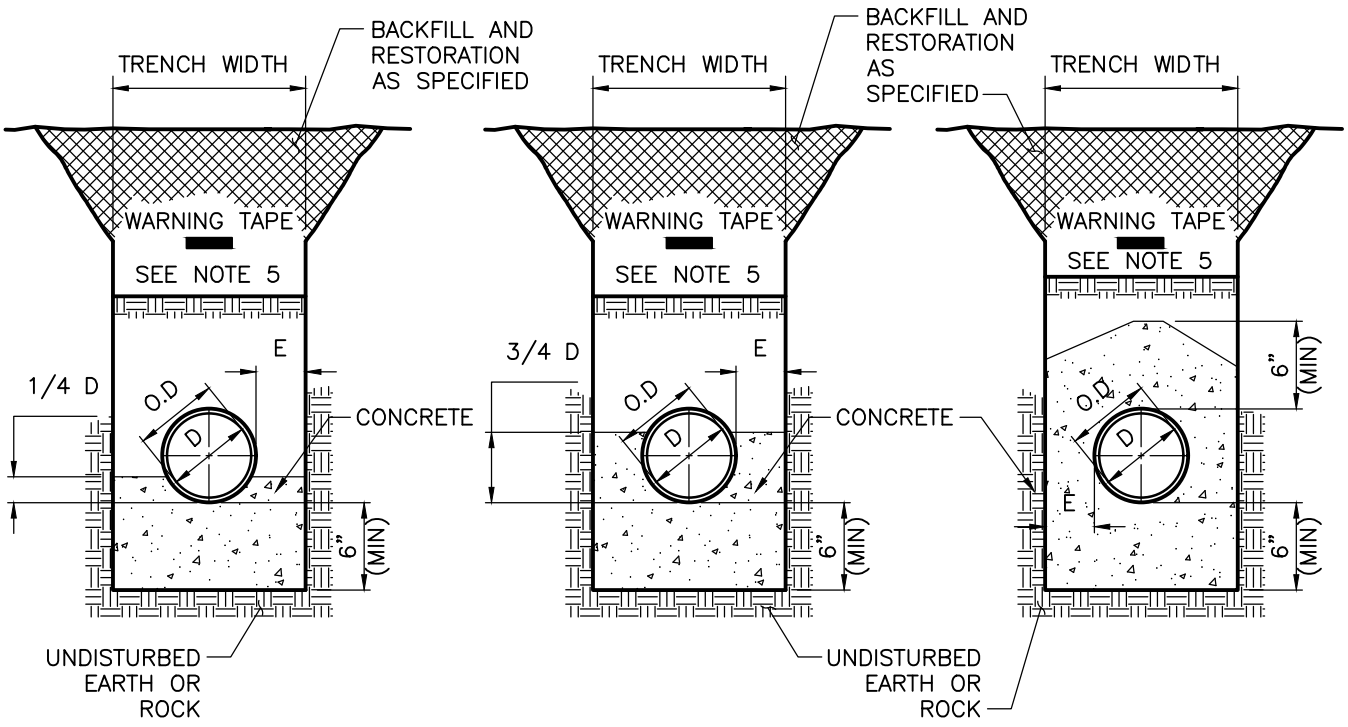
1. BACKFILL & PAVEMENT RESTORATION SHALL BE AS SPECIFIED BY THE LOCAL MUNICIPALITY, SHA, COUNTY MINIMUM STANDARDS, OR MATCH EXISTING (WHICHEVER IS GREATER). SEE NOTE 5 IN APPENDIX B.

2. COUNTY MINIMUM PAVEMENT STANDARDS (OR MATCH EXISTING)
   a. 1½" HOT MIXED ASPHALT (HMA) SURFACE COURSE.
   b. TWO LAYERS HMA BASE COURSE – 7½" TOTAL.
      (1) ONE – 4" LAYER
      (2) ONE – 3½" LAYER

3. SHOULD CONSTRUCTION LEAVE A SECTION OF EXISTING, UNTOUCHED PAVEMENT LESS THAN 2 FEET WIDE, THAT SECTION SHALL BE REMOVED AND INCLUDED IN THE FINAL PAVEMENT RESTORATION.

4. PROVIDE IMPERVIOUS DAM OR BULKHEAD BETWEEN EACH MANHOLE OR EVERY 300 FT, WHICHEVER IS GREATER.

CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	PAVEMENT RESTORATION	STANDARD DETAIL G-2
July 11, 2022 DATE Andrew C Watcher CHIEF		Revised 03/2022



CONCRETE LOW CRADLE

CONCRETE HIGH CRADLE

CONCRETE ENCASEMENT

W = TRENCH PAYMENT WIDTH
W = O.D. + 2E

E = 9" (6"–24" PIPES)
E = 12" (27"–36" PIPES)
E = 15" (42"–72" PIPES)

LOW CRADLE: $CF/F+(Wx(0.333+OD/4))-0.154x(OD)^2$

HIGH CRADLE: $CF/F+(Wx(0.333+(0.750xOD)))-0.632x(OD)^2$

ENCASEMENT: $CF/F+(Wx(0.833+OD))-0.785x(OD)^2-0.25xW$

CONCRETE QUANTITIES – CUBIC FT PER LINEAR FT			
PIPE (D)	LOW CRADLE	HIGH CRADLE	ENCASEMENT
6"	0.94	1.38	2.15
8"	1.09	1.67	2.57
12"	1.40	2.25	3.43
16"	1.73	2.87	4.35
20"	2.09	3.51	5.32
24"	2.47	4.18	6.35
30"	3.6	6.4	9.6
36"	4.3	7.7	11.6
42"	5.7	10.7	15.9
48"	6.6	12.3	18.4

NOTES:
1. QUANTITIES ARE FOR ESTIMATING ONLY.
2. QUANTITIES BASED ON DUCTILE IRON PIPE.
3. FORMULAS SHOWN MAY BE USED FOR PIPE OTHER THAN D.I.P. AND/OR FOR SIZES NOT SHOWN.
4. NO ROCK LARGER THAN 8" AND NO MORE THAN 20% ROCK BY VOLUME.
5. ADD MAGNETIC WARNING SAFETY TAPE ABOVE ALL PRESSURE LINES. TAPE SHALL BE PLACED DIRECTLY ABOVE PIPE CENTERLINE. 12–18 INCHES BELOW FINISHED GRADE.

CARROLL CNTY DEPT. OF PUBLIC WORKS
BUREAU OF UTILITIES

July 11, 2022
DATE

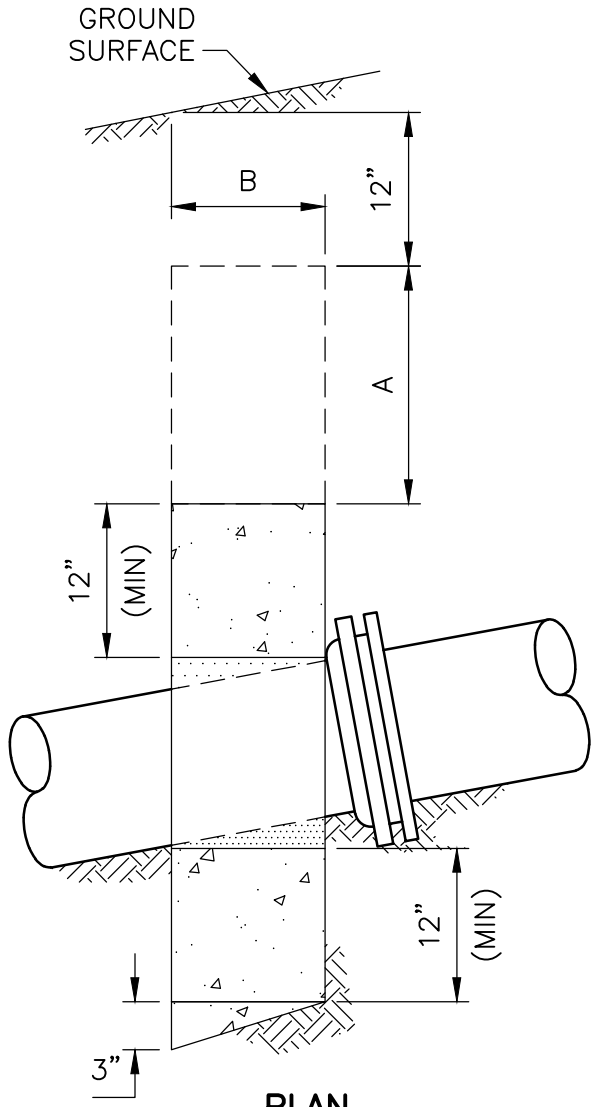
Andrew C Watcher
CHIEF

CONCRETE
CRADLE AND ENCASEMENT

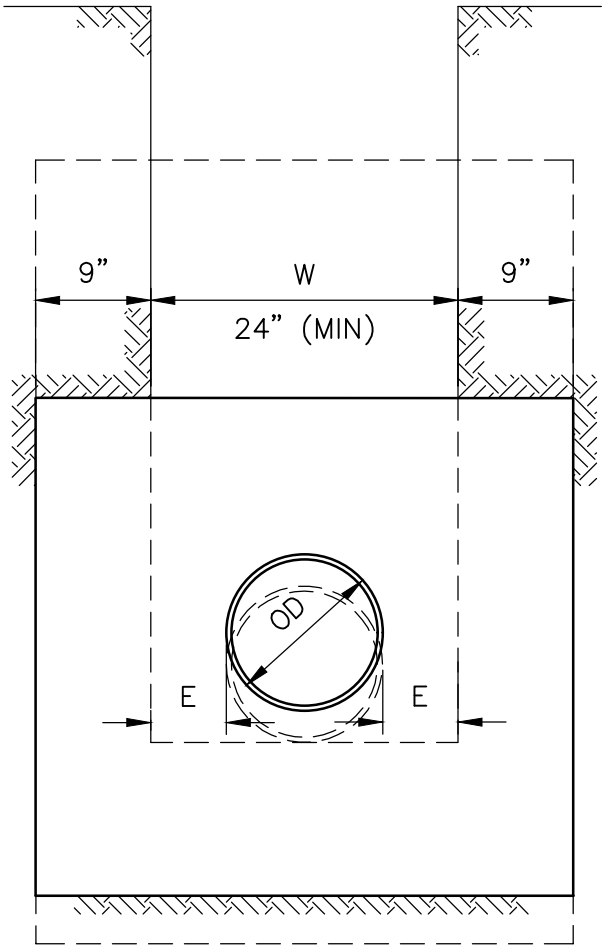
STANDARD DETAIL

G-3

Revised 03/2022



PLAN



SECTION

NOTES:

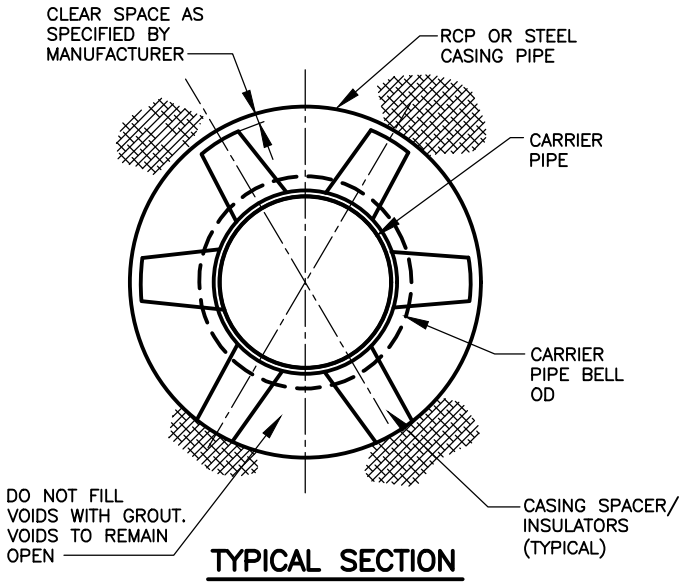
1. PROVIDE NO ANCHORS ON GRADES LESS THAN 20% UNLESS NOTED.
2. PROVIDE ANCHORS EVERY 36 FT ON GRADES BETWEEN 20% AND 34%.
3. PROVIDE ANCHORS EVERY 24 FT ON GRADES BETWEEN 34% AND 50%.
4. PROVIDE ANCHORS EVERY 16 FT ON GRADES BETWEEN 50% AND 70%.
5. ALL ANCHORS TO BE SHA MIX NO.1 CONCRETE PLACED DOWNGRADE OF BELL AS INDICATED.

"A" = EXTENSION OF ANCHOR TO 12" BELOW GROUND SURFACE, WHEN NECESSARY TO PREVENT WASHOUT OF BACKFILL BY SURFACE WATER.

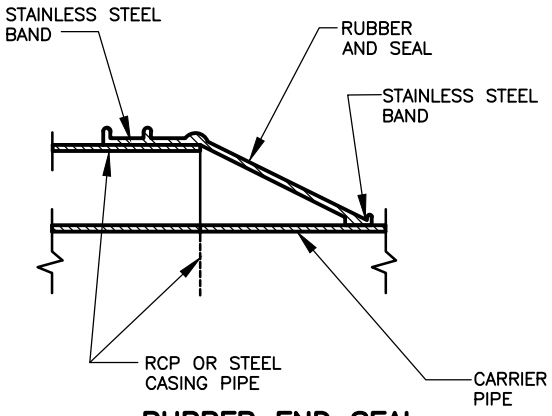
"B" = 12" FOR PIPES 10" DIA OR LESS. 18" FOR PIPES 10" TO 18" DIA

"W" = O.D. + 2E (SEE G-1)

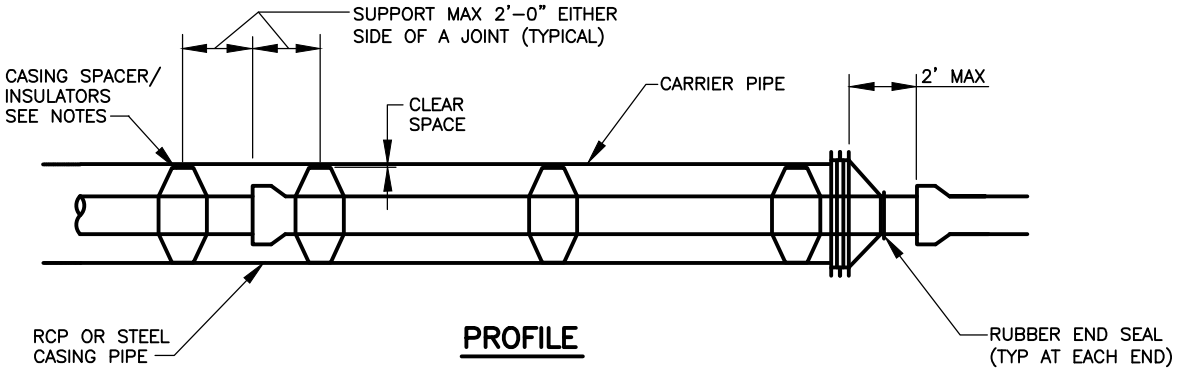
CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	STANDARD CONCRETE ANCHOR FOR PIPE	STANDARD DETAIL G-4
July 11, 2022 DATE Andrew C Watcher CHIEF		Revised 03/2022



TYPICAL SECTION



RUBBER END SEAL



PROFILE

NOTES:

1. MATERIAL AND INSTALLATION REQUIREMENTS SHALL BE IN ACCORDANCE W/STANDARD SPECIFICATIONS.

2. FOR WATER AND SEWER MAIN, THE MINIMUM STEEL CASING DIAMETER SHALL BE 36" WITH A MINIMUM WALL THICKNESS OF 1/2" UNLESS OTHERWISE APPROVED BY SHA OR THE COUNTY. JOINTS SHALL BE WELDED FULL CIRCUMFERENCE.

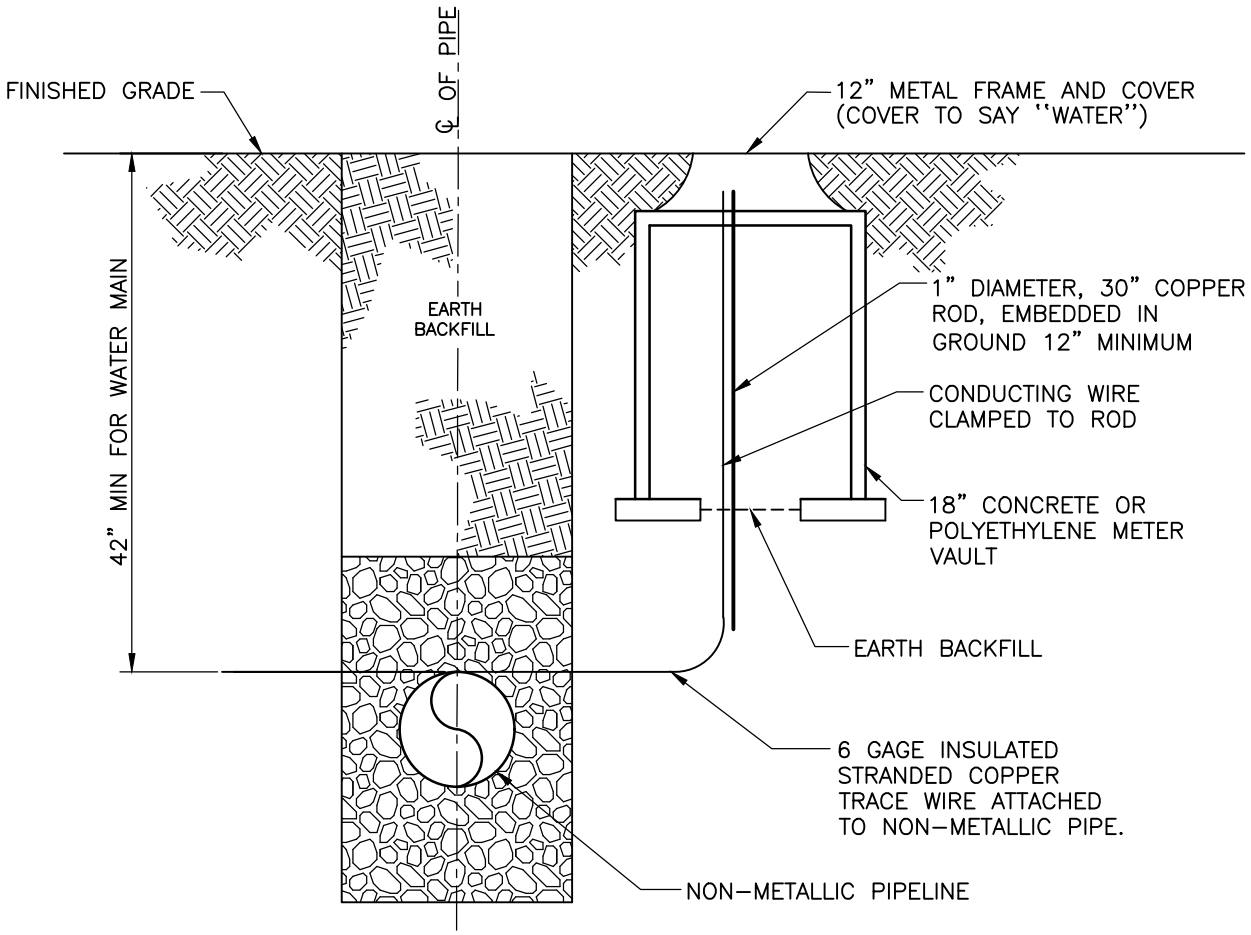
3. REINFORCED CONCRETE CASING SHALL BE MINIMUM STRENGTH CLASS V MINIMUM THICKNESS WALL B, WITH RUBBER JOINTS.

4. CASING SPACER/INSULATORS SHALL BE AS SPECIFIED, OR AS APPROVED BY THE COUNTY FOR INSERTING, SUPPORTING, SPACING AND INSULATING THE CARRIER PIPE.

5. A MINIMUM OF 3 SPACER/INSULATORS PER PIPE LENGTH SHALL BE SPACED PER MANUFACTURER'S RECOMMENDATIONS FOR THE PARTICULAR CASING AND CARRIER PIPES SPECIFIED.

6. A JOINT IN THE CARRIER PIPE SHALL BE PROVIDED WITHIN 2 FEET OF EACH OUTSIDE END OF CASING.

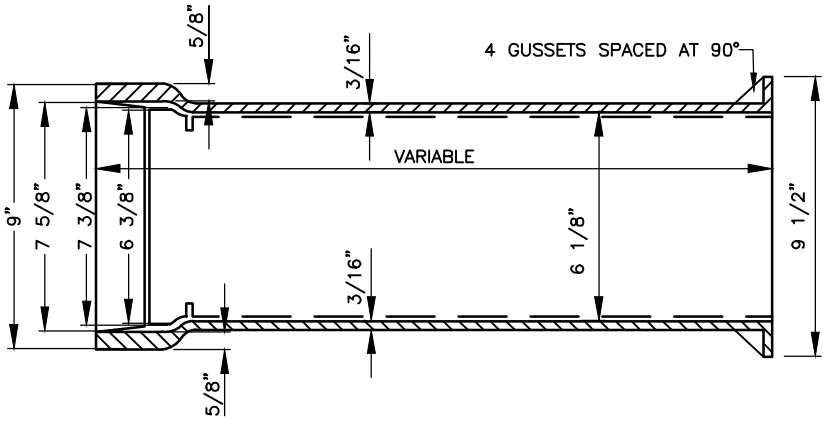
CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	CASING PIPE WITH CASING SPACERS	STANDARD DETAIL G-5
July 11, 2022 DATE Andrew C Watcher CHIEF		Revised 03/2022



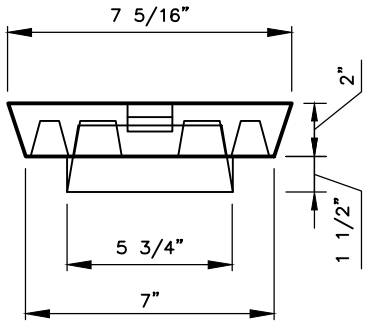
NOTES:

1. TEST STATIONS SHALL BE USED FOR ALL NON-METALLIC PIPE EXCEPT GRAVITY SEWER MAINS UNLESS REQUIRED BY THE COUNTY.
2. TEST STATION SPACING SHALL BE A MAXIMUM OF 400 FEET, OR IMMEDIATELY ADJACENT TO FIRE HYDRANTS, WHICHEVER IS LESS. FOR RECLAIMED WATER OR PRESSURE SEWER, TEST STATION SPACING SHALL BE A MAXIMUM OF 400 FEET, AND PLACED ADJACENT TO EXISTING AT-GRADE STRUCTURES SUCH AS VALVES OR MANHOLES WHERE POSSIBLE.
3. TEST STATION SHALL BE INSTALLED IN NON-TRAFFIC BEARING AREAS. DO NOT INSTALL IN ROADWAY.
4. SEE GENERAL DETAILS FOR TRENCH BEDDING INFORMATION.
5. REFER TO APPLICABLE SPECIFICATION SECTIONS FOR ADDITIONAL REQUIREMENTS.

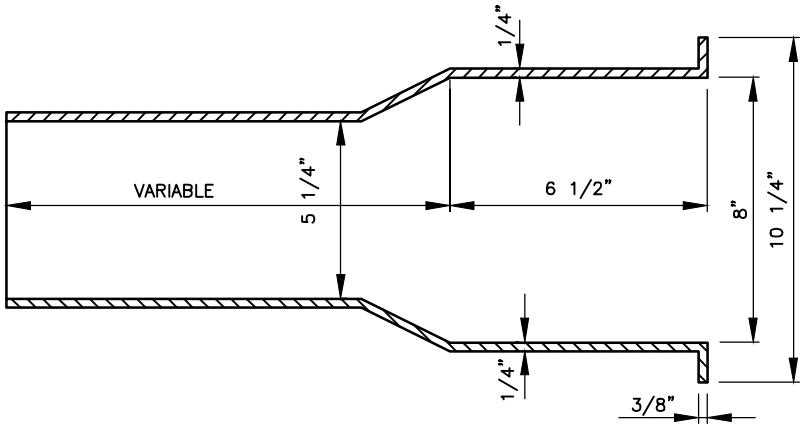
CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	CONTINUITY TEST STATION	STANDARD DETAIL G-6
July 11, 2022 DATE Andrew C Watcher CHIEF		Revised 03/2022



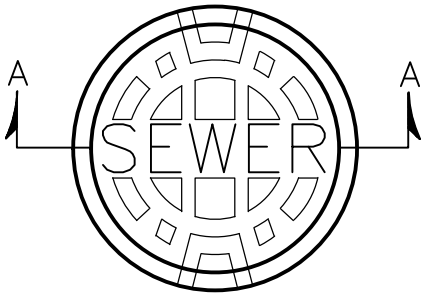
SECTION THROUGH
TOP HALF OF VALVE BOX



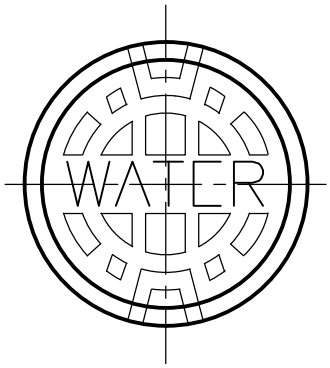
SECTION A–A



SECTION THROUGH
BOTTOM HALF OF VALVE BOX



PLAN VIEW



7" FRAME AND COVER
CAST IRON

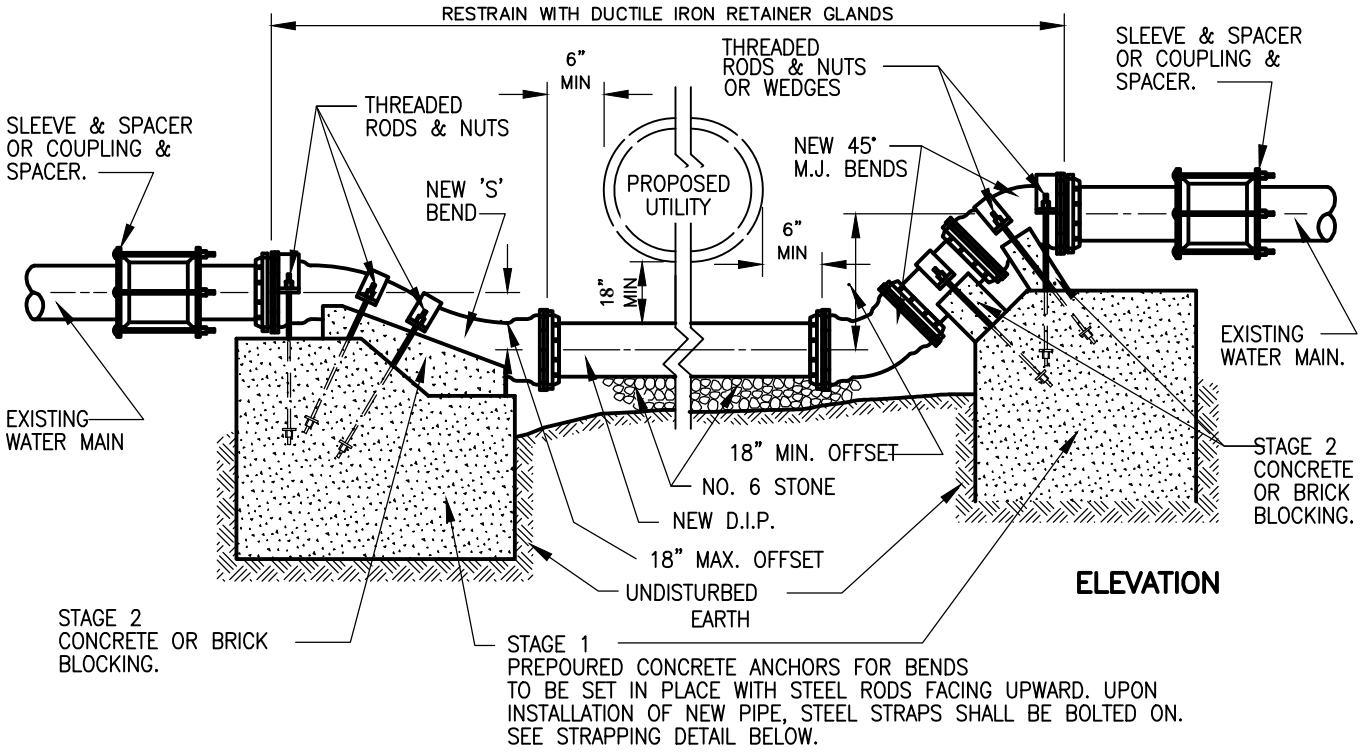
NOTES:

1. ALL VALVES BOXES SHALL BE THE SLIDING TYPE IN PAVED AREAS. USE SCREW TYPE VALVE BOXES IN LAWN AREAS.
2. ALL WATER VALVES SHALL BE MARKED "WATER" AND ALL SEWER VALVES SHALL BE MARKED "SEWER".
3. ENTIRE VALVE BOX AND ASSEMBLY SHALL BE CAST FROM CLASS 35 GREY IRON. ALL PARTS SHALL BE SUPPLIED BY THE SAME MANUFACTURER.
4. INSTALLATION SHALL BE PLUMB.
5. FOR BOXES ADJUSTABLE 23" TO 34"
   TOP SECTION–16"
   BOTTOM SECTION–18"
6. FOR BOXES ADJUSTABLE 34" TO 46"
   TOP SECTION–16"
   BOTTOM SECTION–30"
7. MINIMUM WEIGHT PER BOX– 100 LBS
8. BOTTOM SECTION SHALL REST ON VALVE BONNET.
9. VALVE STEM EXTENSIONS ARE REQUIRED WHEN THE TOP OF THE VALVE'S OPERATING NUT EXCEEDS 8' OF COVER.

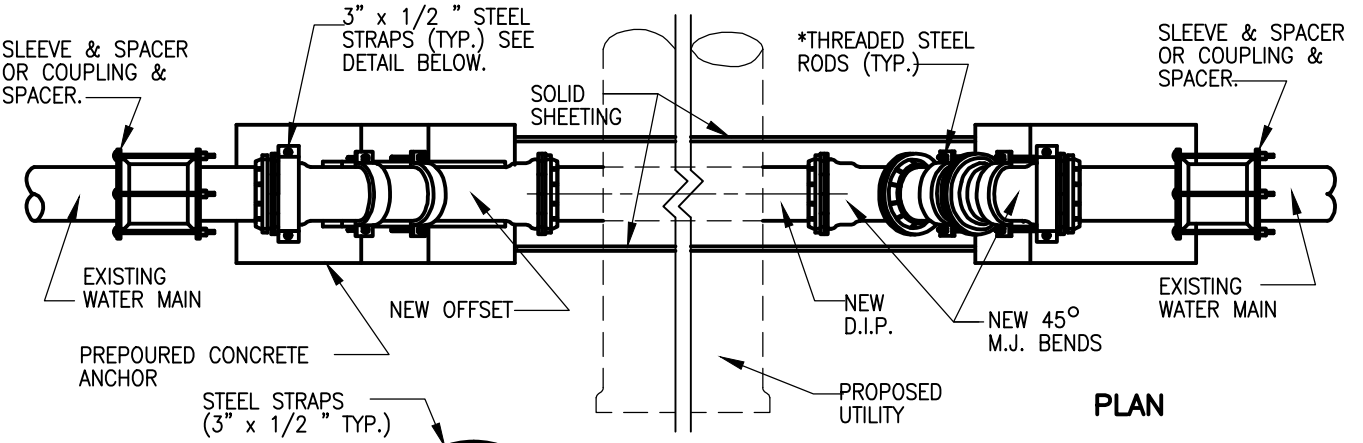
CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES July 11, 2022 DATE Andrew C Watcher CHIEF	VALVE BOX ADJUSTABLE ROUND HEAD	STANDARD DETAIL G-7 Revised 03/2022

'S' BEND ≤ 18" OFFSET

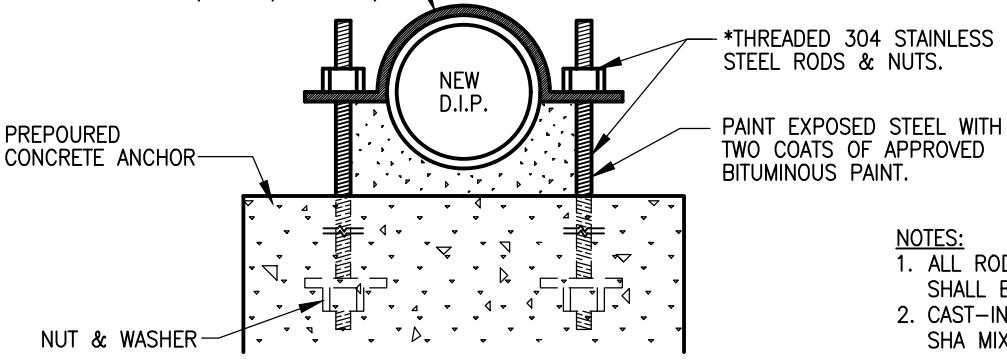
TWO 45° BENDS > 18" OFFSET



ELEVATION



PLAN



STRAPPING DETAIL

NOTES:
1. ALL RODS, NUTS, BOLTS, AND STRAPS SHALL BE 304 STAINLESS STEEL.
2. CAST-IN-PLACE CONCRETE SHALL BE SHA MIX NO. 2.

CARROLL CNTY DEPT. OF PUBLIC WORKS
BUREAU OF UTILITIES

July 11, 2022
DATE

Andrew C Watcher
CHIEF

WATER MAIN RELOCATION UNDER PROPOSED UTILITY

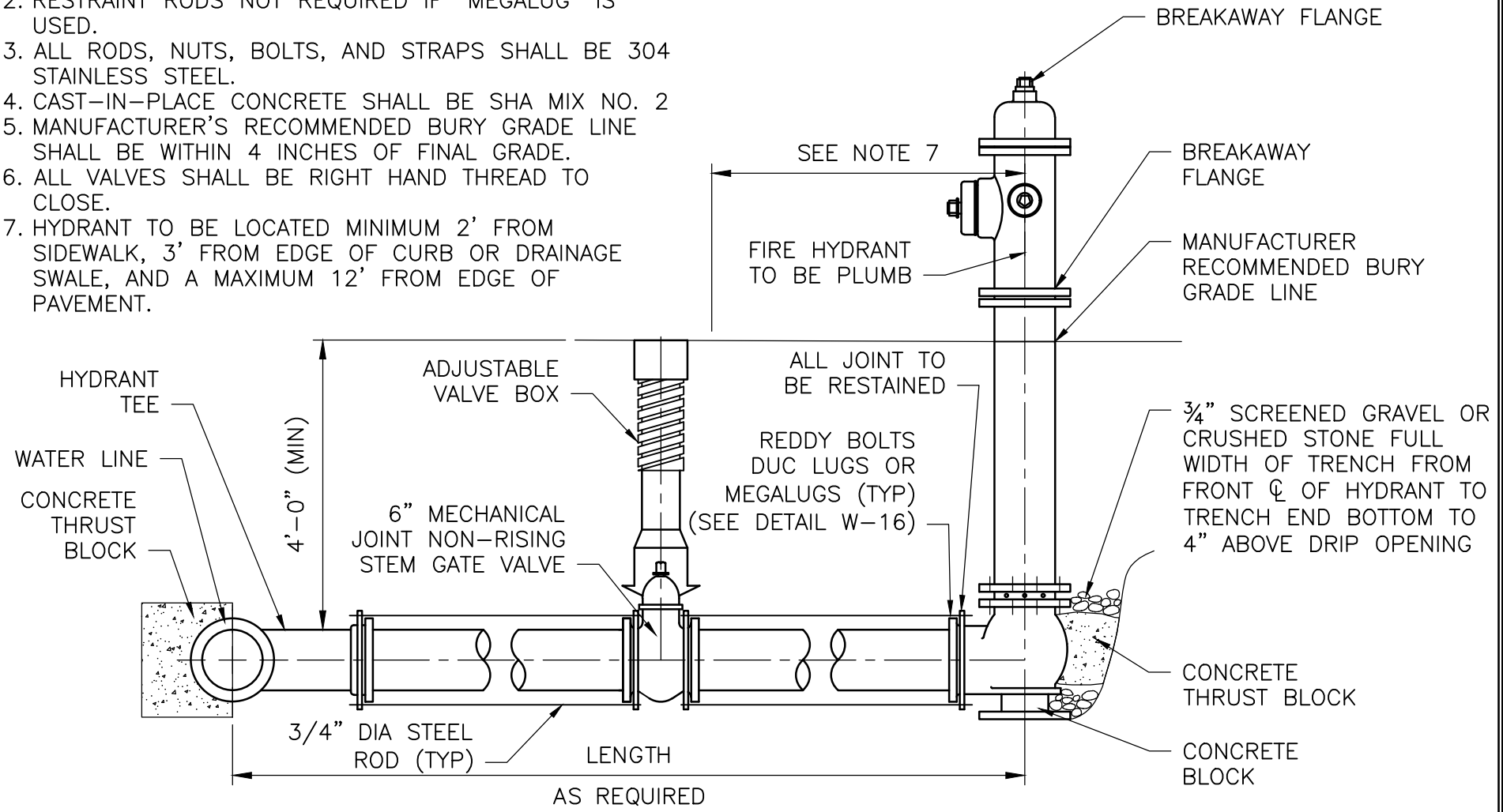
STANDARD DETAIL

W-1

Revised 03/2022

NOTES:

1. "MEGALUG" MECHANICAL JOINT RESTRAINT IS PREFERRED BY THE COUNTY. (SEE DETAIL W–17)
2. RESTRAINT RODS NOT REQUIRED IF "MEGALUG" IS USED.
3. ALL RODS, NUTS, BOLTS, AND STRAPS SHALL BE 304 STAINLESS STEEL.
4. CAST–IN–PLACE CONCRETE SHALL BE SHA MIX NO. 2
5. MANUFACTURER'S RECOMMENDED BURY GRADE LINE SHALL BE WITHIN 4 INCHES OF FINAL GRADE.
6. ALL VALVES SHALL BE RIGHT HAND THREAD TO CLOSE.
7. HYDRANT TO BE LOCATED MINIMUM 2' FROM SIDEWALK, 3' FROM EDGE OF CURB OR DRAINAGE SWALE, AND A MAXIMUM 12' FROM EDGE OF PAVEMENT.



CARROLL CNTY DEPT. OF PUBLIC WORKS
BUREAU OF UTILITIES

July 11, 2022
DATE

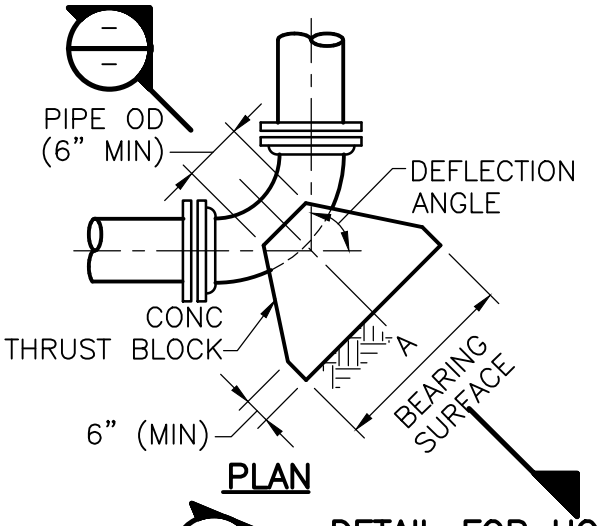
Andrew C Watcher
CHIEF

TYPICAL FIRE HYDRANT SETTING

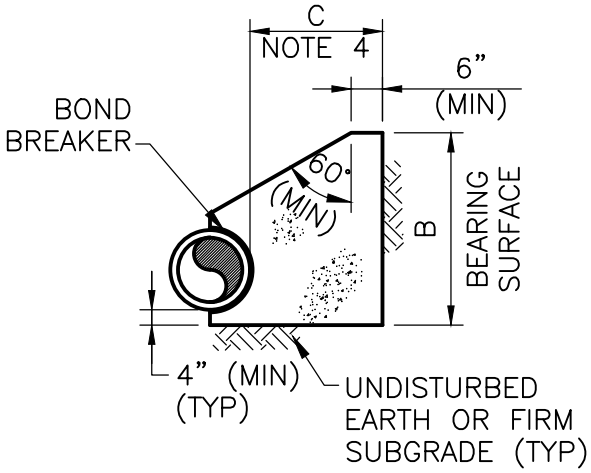
STANDARD DETAIL

W-2

Revised 03/2022

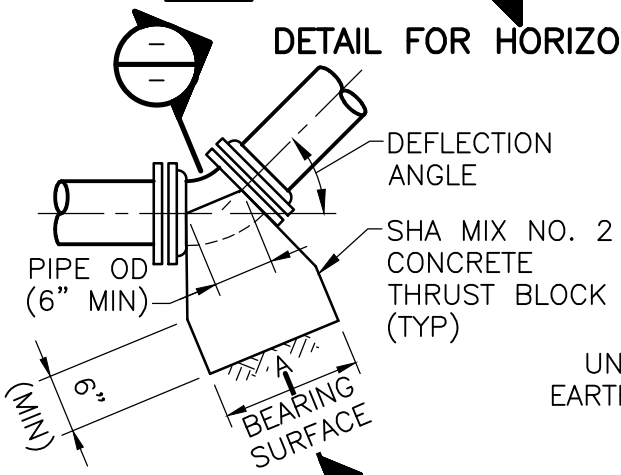


PLAN

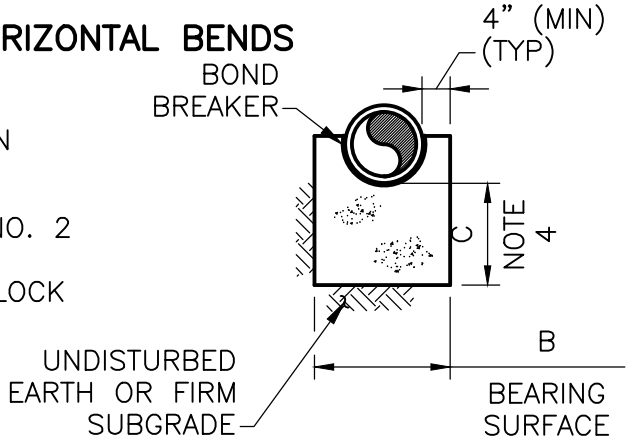


SECTION

DETAIL FOR HORIZONTAL BENDS



ELEVATION



SECTION

DETAIL FOR LOWER VERTICAL BENDS

NOMINAL PIPE SIZE (INCHES)	MAXIMUM PIPE OD (INCHES)	REQUIRED BEARING AREA (SQ FT)					
		90 DEG	60 DEG	45 DEG	30 DEG	22.50 DEG	11.25 DEG
4	4.80	2.9	2.0	1.6	1.1	0.8	0.4
8	9.05	10	7	6	4	3	1.4
12	13.20	22	15	12	8	6	3
18	19.50	48	34	26	17	13	7
20	21.60	58	41	32	21	16	8
24	25.80	83	59	45	30	23	12

NOTES:

1. MAXIMUM TEST PRESURE = 1.5 x 150 PSI
2. MINIMUM ALLOWABLE SOIL BEARING PRESSURE = 2000 PSF
3. BEARING AREA = A x B
4. C SHALL BE GREATER THAN A/2 AND B/2.

CARROLL CNTY DEPT. OF PUBLIC WORKS
BUREAU OF UTILITIES

July 11, 2022
DATE

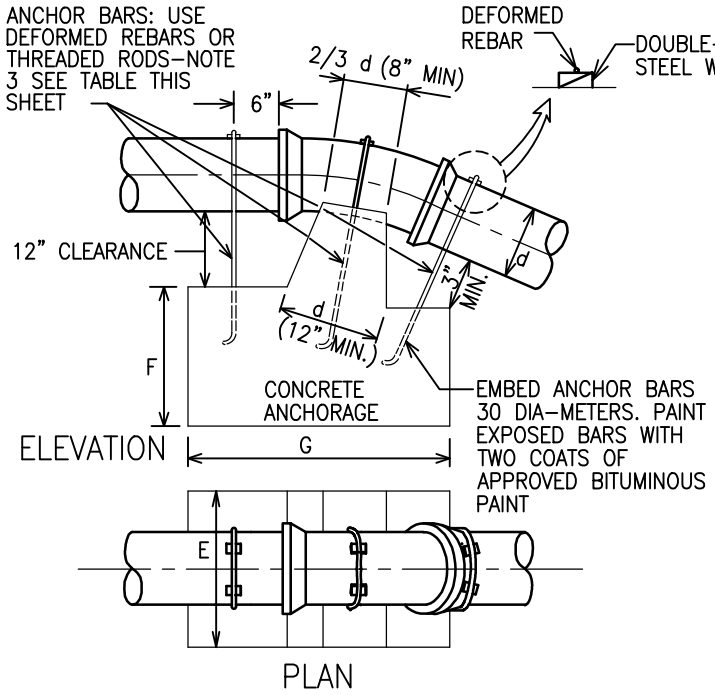
Andrew C Watcher
CHIEF

THRUST-BLOCKS FOR HORIZONTAL BENDS AND LOWER VERTICAL BENDS

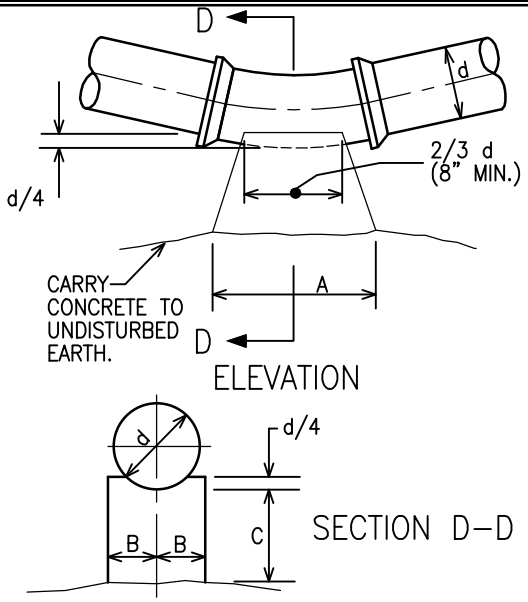
STANDARD DETAIL

W-3

Revised 03/2022



ANCHORAGE FOR VERTICAL BENDS



THRUST BLOCK FOR VERTICAL BENDS

NOTES:

1. ALL CONCRETE TO BE SHA MIX NO. 2.

2. THRUST BLOCK DIMENSIONS SHOWN ARE MINIMUM. DIMENSIONS ARE BASED UPON 3,000 P.S.F. SOIL BEARING PRESSURE, 150 P.S.I. STATIC WATER PRESSURE AND DUCTILE IRON PIPE SIZES. SPECIAL THRUST BLOCK DESIGN IS REQUIRED WHERE PRESSURE EXCEEDS 150 P.S.I. OR WHERE SOIL BEARING PRESSURE IS LESS THAN 3,000 P.S.F.

3A. USE DEFORMED REBAR OR THREADED ROD AS SHOWN FOR ANCHORING DIP. SEE STD. DETAIL PLATE W–1 FOR THREADED RODS. DEFORMED REBARS: TACK WELD STEEL WEDGES TOGETHER & TACK WELD REBAR TO TOP STEEL WEDGE AFTER PLACEMENT.

3B. FOR ANCHORING HDPE PIPE, USE 3" WIDE HEAVY GAUGE 18–8 TYPE 304 S.S. STRAPS & THREADED STEEL RODS & NUTS.
ALTERNATE DESIGNS WILL BE CONSIDERED SUBJECT TO APPROVAL BY THE COUNTY.

PIPE SIZE	ANCHOR BARS *			
	1/64 BEND	1/32 BEND	1/16 BEND	1/8 BEND
6"		3–#6	3–#6	3–#6
8"		3–#6	3–#6	3–#6
10"		3–#6	3–#6	3–#6
12"		3–#6	3–#6	3–#6
16"	3–#6	3–#6	3–#6	3–#6
20"	3–#6	3–#6	3–#6	4–#6
24"	3–#6	3–#6	3–#6	5–#6
30"	3–#6	3–#6	5–#6	5–#7
36"	3–#6	4–#6	5–#7	6–#7

* REBAR # AS INDICATED OR EQUAL DIAM. THREADED ROD.

THRUST BLOCK FOR VERTICAL BENDS

		PIPE SIZE								
		6"	8"	10"	12"	16"	20"	24"	30"	36"
1/64 BEND	A					1'–4"	1'–8"	2'–0"	2'–6"	3'–0"
	B					8"	10"	1'–0"	1'–3"	1'–6"
	C					10"	10"	1'–0"	1'–1"	1'–2"
1/32 BEND	A	8"	8"	10"	1'–0"	1'–4"	1'–8"	2'–0"	2'–6"	3'–0"
	B	7"	8"	9"	10"	1'–0"	1'–2"	1'–4"	1'–7"	1–11"
	C	7"	7"	8"	8"	9"	10"	1'–0"	1'–1"	1'–2"
1/16 BEND	A	9"	1–0"	1'–6"	1'–9"	2'–3"	3'–0"	3'–8"	4'–4"	5'–6"
	B	7"	8"	8"	10"	1'–1"	1'–3"	1'–5"	1'–10"	2'–1"
	C	7"	7"	8"	8"	9"	1'–0"	1'–2"	1'–4"	1'–9"
1/8 BEND	A	1'–3"	1'–8"	2'–3"	2'–10"	3'–6"	4'–4"	5'–6"	6'–8"	8'–1"
	B	7"	9"	10"	1'–0"	1'–4"	1'–8"	1'–10"	2'–4"	2'–9"
	C	7"	8"	10"	1'–1"	1'–4"	1'–8"	2'–1"	2'–6"	3'–1"

ANCHORAGES FOR VERTICAL BENDS

		PIPE SIZE								
		6"	8"	10"	12"	16"	20"	24"	30"	36"
1/64 BEND	E					2'–0"	2'–3"	2'–8"	3'–6"	4'–0"
	F					2'–11"	3'–7"	4'–4"	4'–6"	5'–0"
	G					4'–0"	4'–6"	4'–6"	5'–0"	5'–7"
1/32 BEND	E	1'–6"	1'–8"	2'–0"	3'–0"	3'–6"	4'–0"	4'–3"	4'–6"	5'–0"
	F	2'–0"	2'–7"	2'–11"	2'–8"	3'–5"	3'–8"	4'–4"	5'–5"	6'–3"
	G	2'–6"	3'–0"	3'–4"	3'–5"	4'–0"	5'–0"	5'–9"	6'–6"	7'–4"
1/16 BEND	E	2'–0"	3'–4"	3'–8"	4'–0"	4'–6"	4'–10"	5'–4"	6'–0"	6'–10"
	F	2'–7"	2'–7"	2'–9"	3'–3"	3'–10"	4'–0"	4'–7"	5'–8"	6'–5"
	G	2'–10"	3'–0"	3'–10"	4'–2"	5'–6"	7'–6"	8'–6"	9'–4"	10'–4"
1/8 BEND	E	2'–6"	3'–4"	4'–0"	4'–6"	5'–4"	6'–0"	6'–6"	7'–6"	8'–6"
	F	3'–4"	3'–5"	3'–8"	4'–4"	5'–0"	5'–7"	6'–2"	7'–1"	8'–3"
	G	3'–4"	4'–2"	4'–10"	5'–2"	6'–6"	8'–0"	9'–6"	11'–0"	12'–0"

CARROLL CNTY DEPT. OF PUBLIC WORKS
BUREAU OF UTILITIES

July 11, 2022
DATE

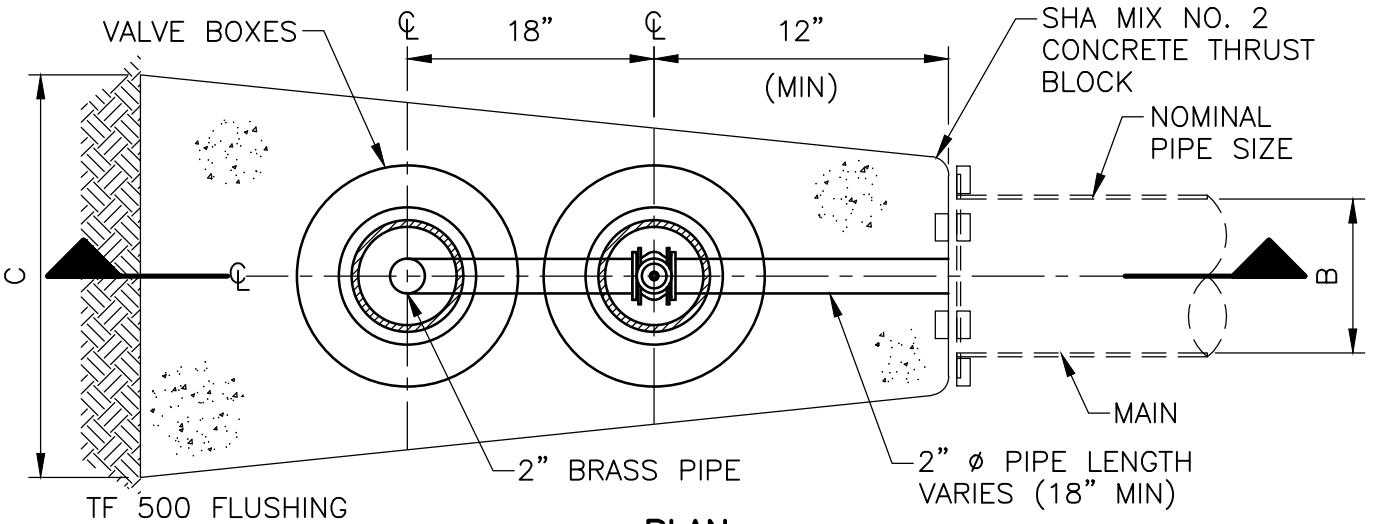
Andrew C Watcher
CHIEF

THRUST-BLOCKS AND ANCHORAGES FOR VERTICAL BENDS

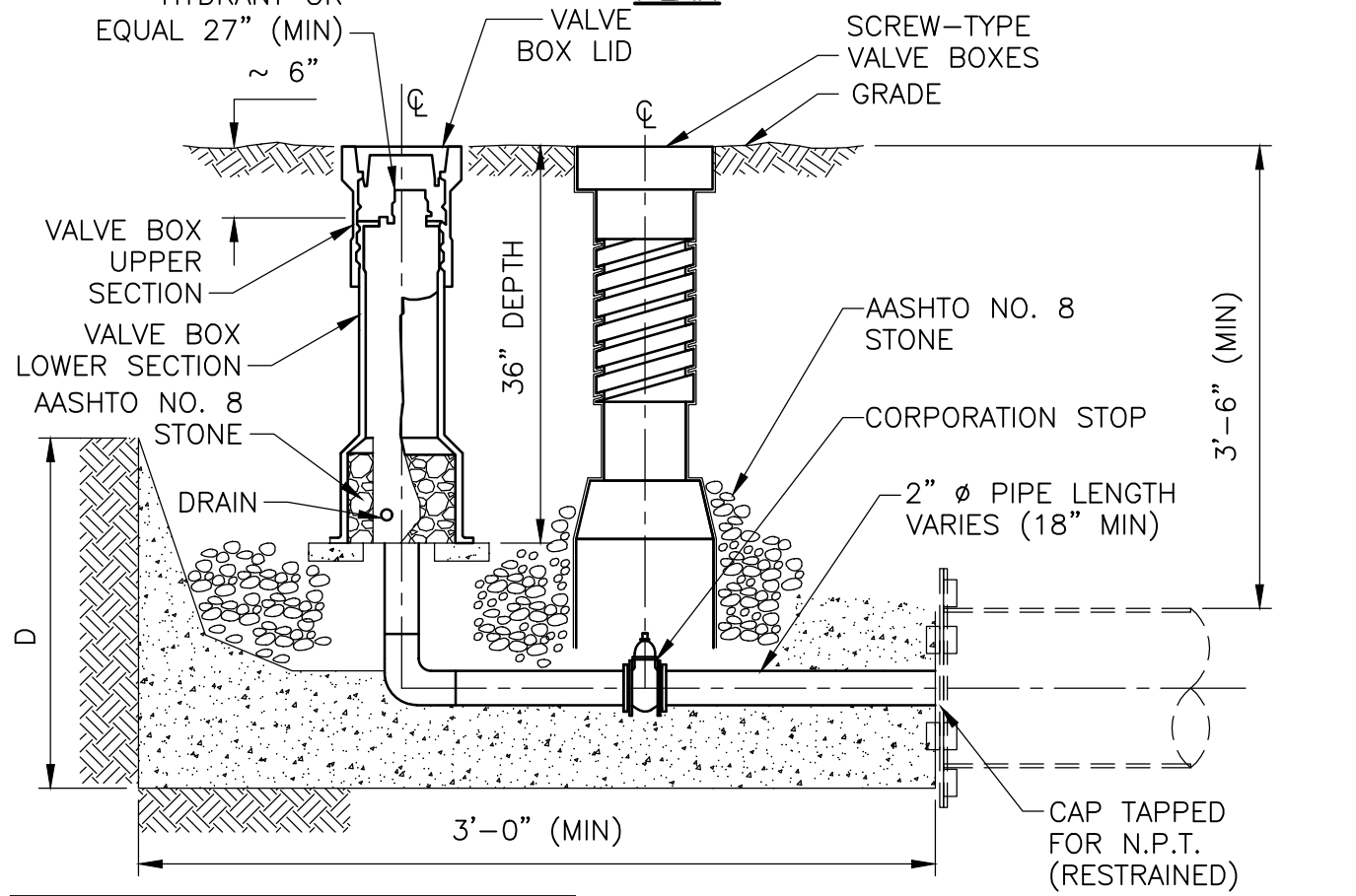
STANDARD DETAIL

W-4

Revised 03/2022



PLAN



SECTION

THRUST BLOCK DIMENSIONS (INCHES)						
B	4	6	8	10	12	14
C	17	17	23	29	34	45
D	10	12	16	20	24	32

CARROLL CNTY DEPT. OF PUBLIC WORKS
BUREAU OF UTILITIES

July 11, 2022
DATE

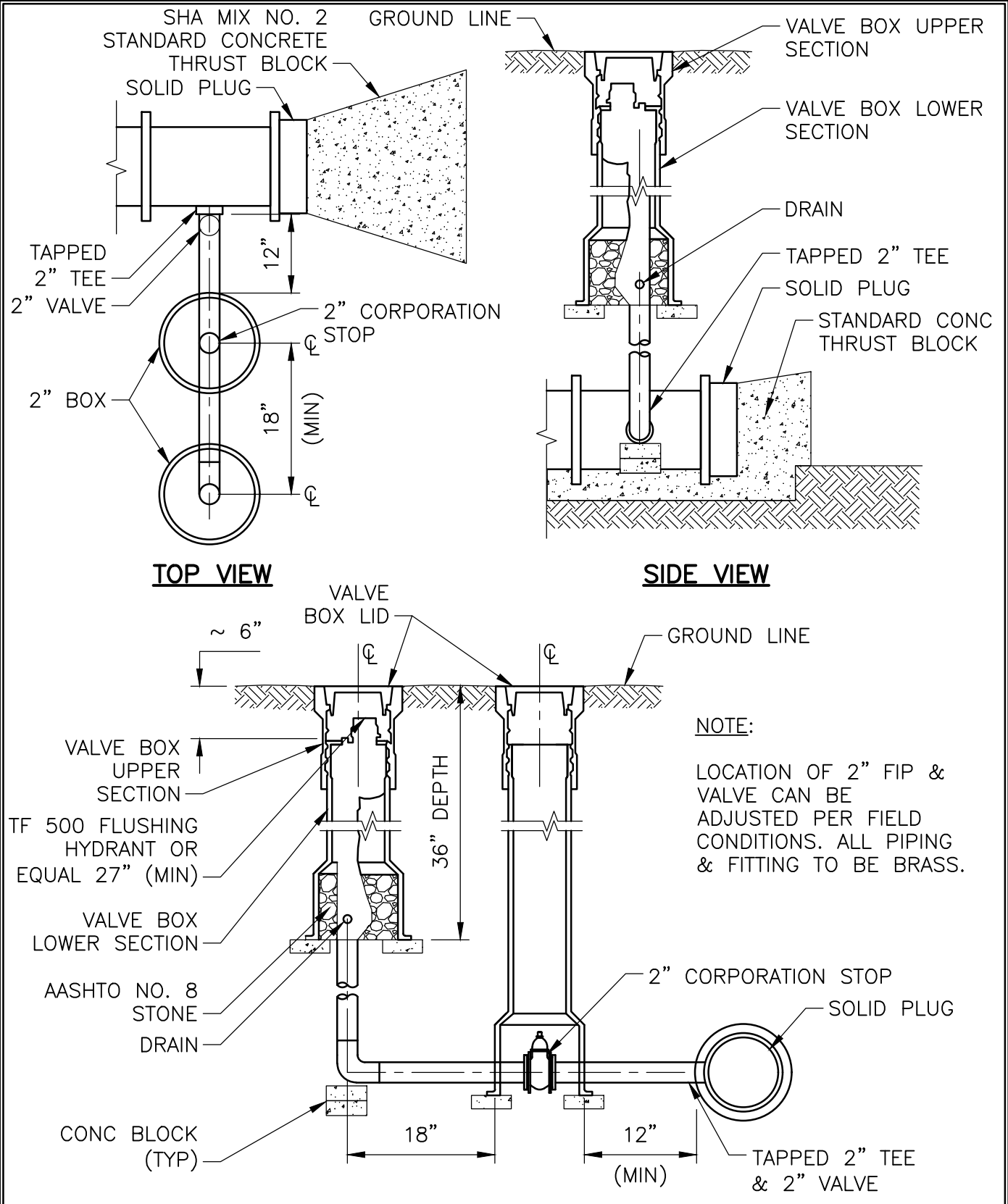
Andrew C Watcher
CHIEF

CAP AND BLOW-OFF

STANDARD
DETAIL

W-5A

Revised 03/2022



CARROLL CNTY DEPT. OF PUBLIC WORKS
BUREAU OF UTILITIES

July 11, 2022
DATE

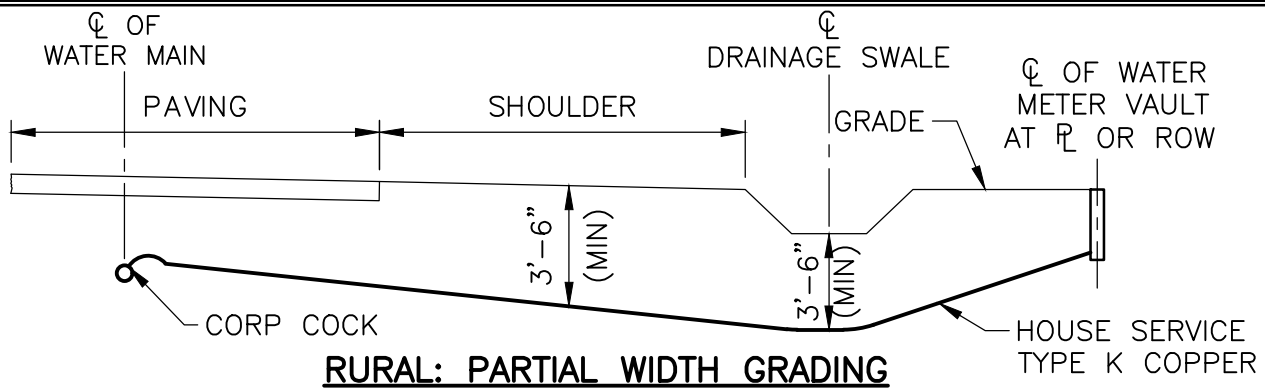
Andrew C Watcher
CHIEF

BLOW-OFF FLUSHING HYDRANT

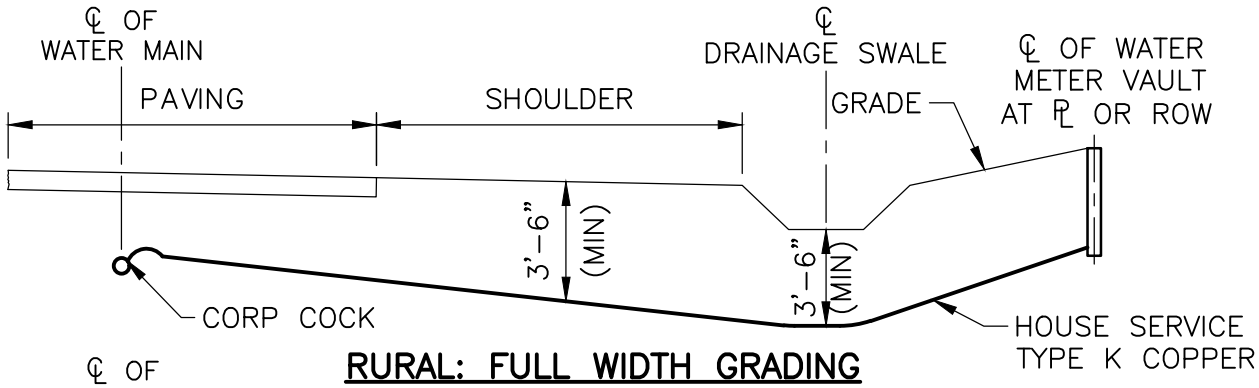
STANDARD DETAIL

W-5B

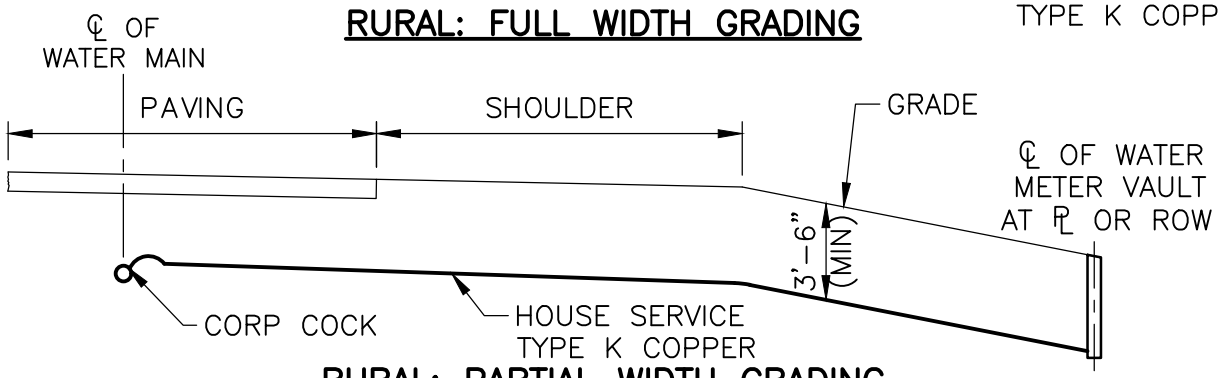
Revised 03/2022



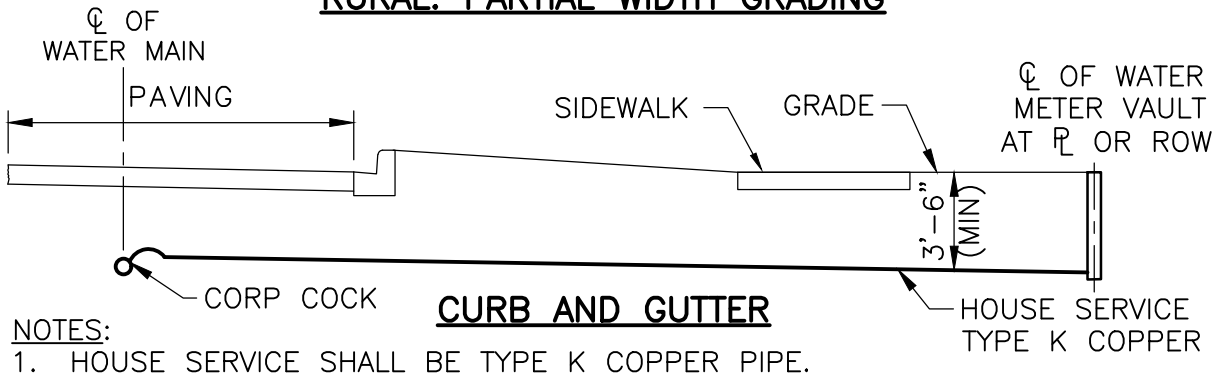
RURAL: PARTIAL WIDTH GRADING



RURAL: FULL WIDTH GRADING



RURAL: PARTIAL WIDTH GRADING

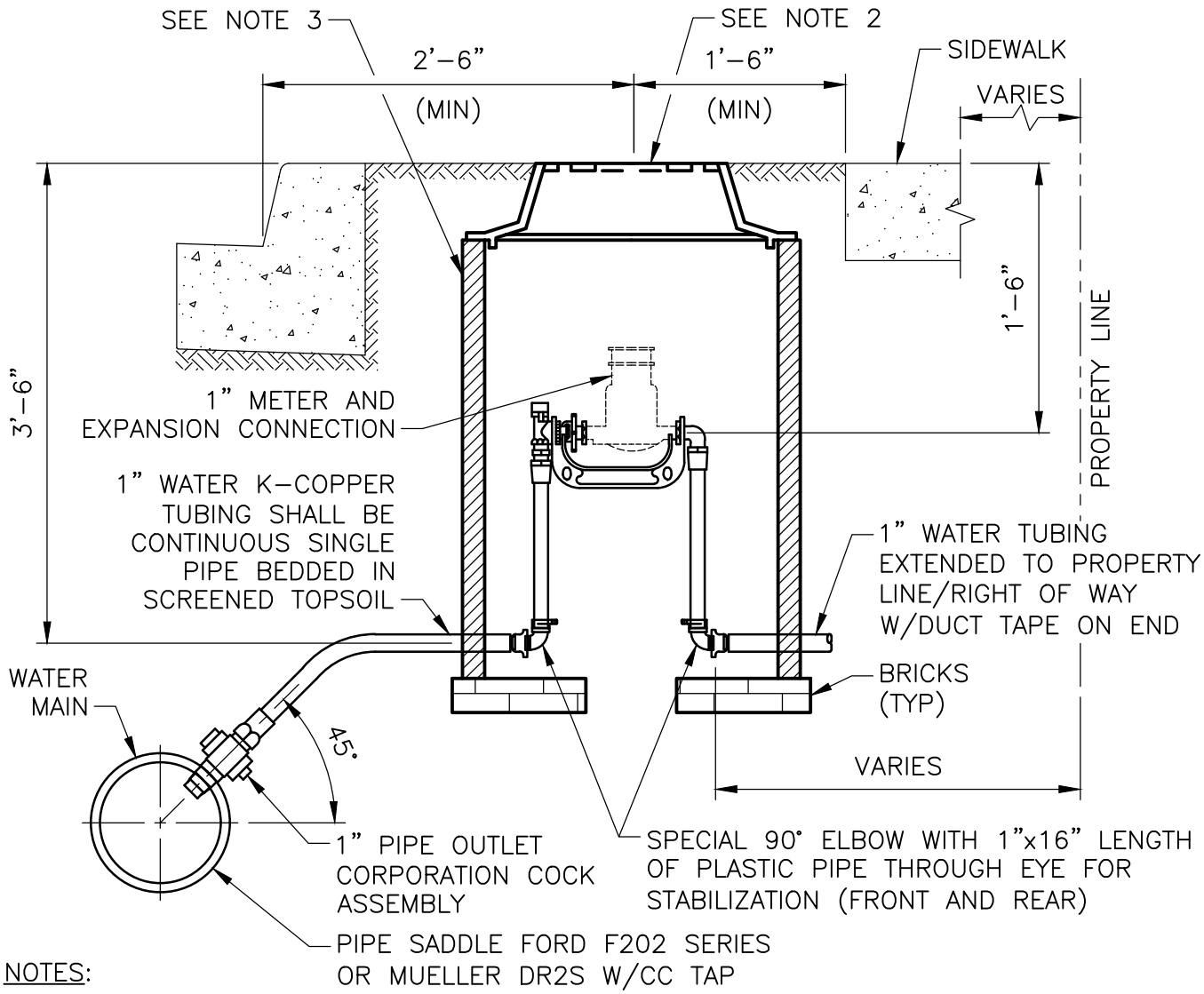


CURB AND GUTTER

NOTES:

1. HOUSE SERVICE SHALL BE TYPE K COPPER PIPE.
2. METER VAULT SHALL BE PROVIDED WITH A PLUG OR CAP UNLESS HOUSE IS CONNECTED IMMEDIATELY.
3. 1½" & 2" LINES REQUIRE TAPPED TEE AT MAIN LINE.
4. METER SHALL BE LOCATED AT THE PL OR RIGHT OF WAY.

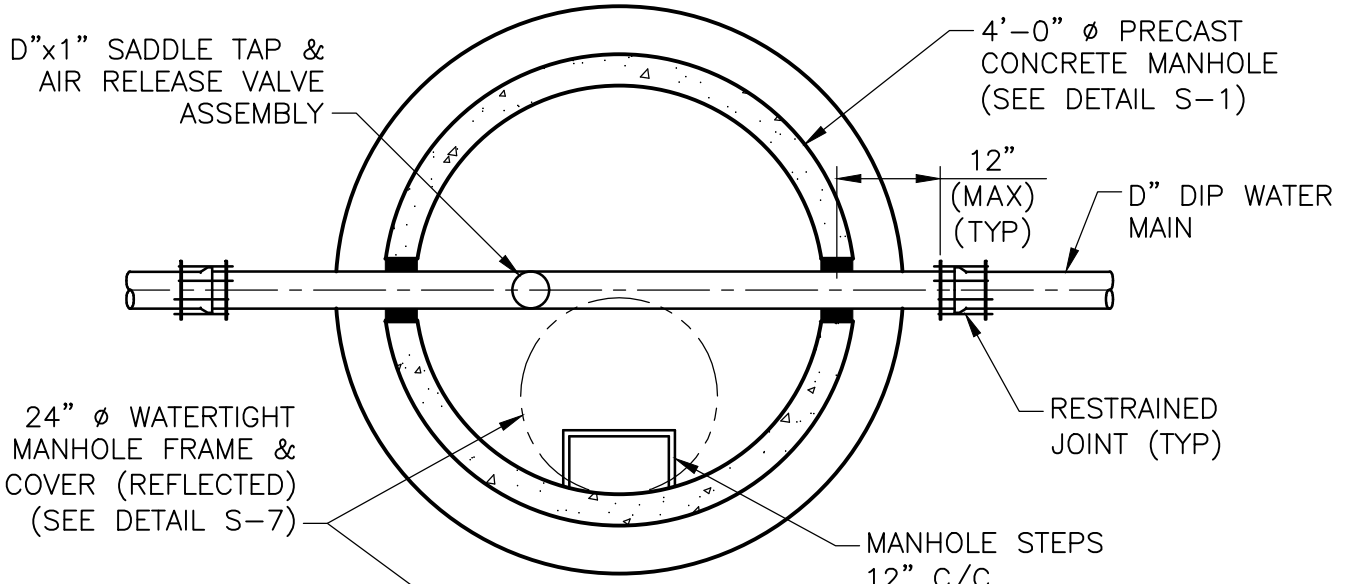
CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	METER VAULT LOCATIONS	STANDARD DETAIL W-6
July 11, 2022 DATE Andrew C Watcher CHIEF		Revised 03/2022



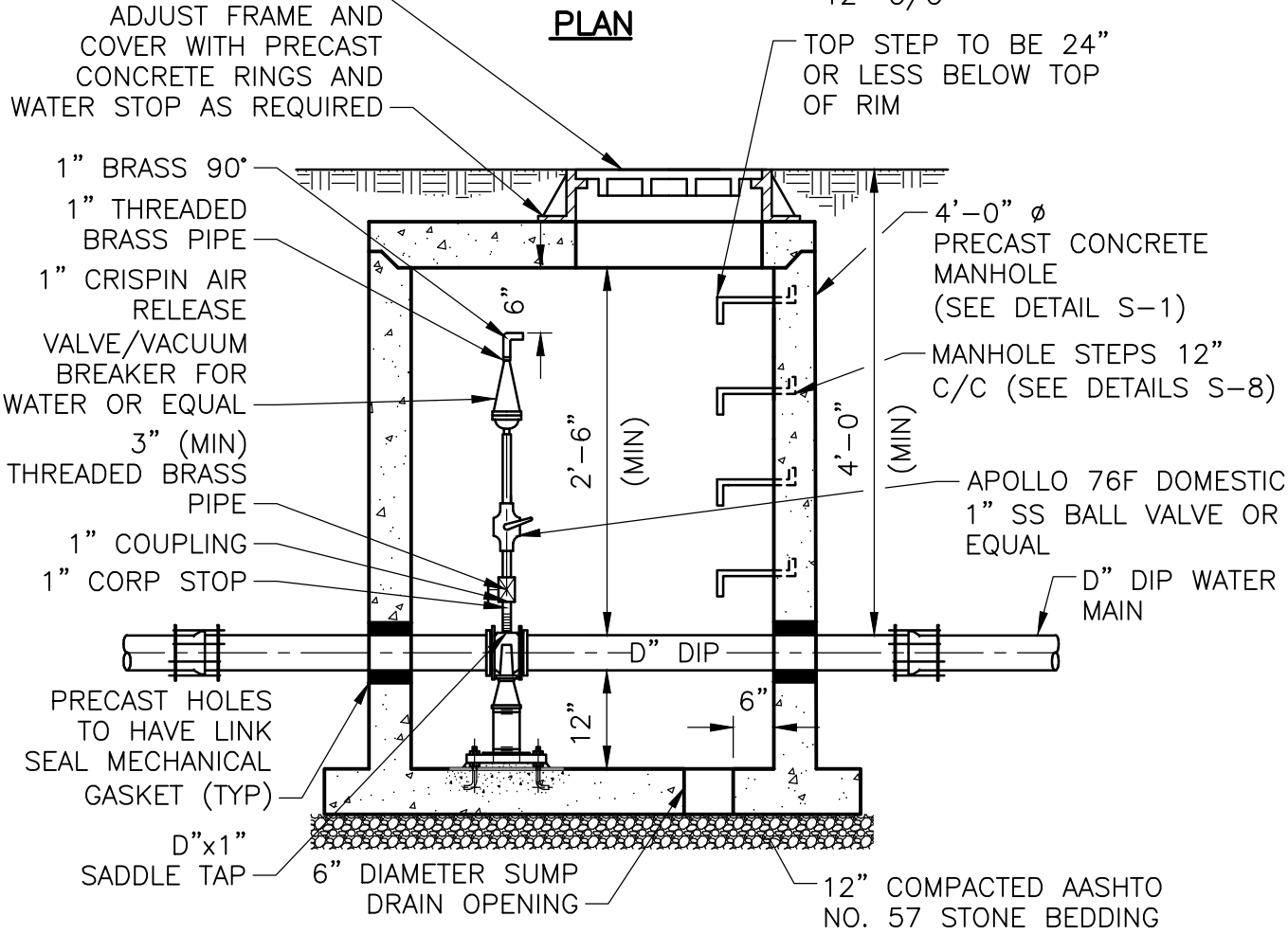
NOTES:

1. METER AND EXPANSION CONNECTION SHALL BE FURNISHED AND INSTALLED BY THE COUNTY.
2. FRAME AND LID TO BE FORD MONITOR FRAME AND LID A53T WITH WORM LOCK ASSEMBLY. IN TRAFFIC AREAS USE FORD ASSEMBLY C3HT.
3. METER VAULT TO BE SIGMA RAVEN HDPE PRODUCTS 18" ROUND METER PIT SERIES RMP 1830–W, BINGHAM AND TAYLOR MMP240, OR APPROVED EQUAL.
4. SINGLE METER SETTING (FORD NO. B–95141–09) (FACTORY ASSEMBLED): Y–504, AV91–445, HHCA91–444TD ON TOP OF RISER; MUELLER 013C5041–6DN; OR APPROVED EQUAL.
5. TWIN METER SETTING (MODEL NO. CS–B95141–D10) 9FACTORY ASSEMBLED):1" CCUSTOM–SETTER TEES WITH 3–1–1/2" RISER, 25" HIGH, WITH SPECIAL U18–64–9 COPPER U–BRNCH ON INLET RISER AND WITH TWO Y–504 WITH ONE TIE ROD, TWO AV91–44W AND TWO HHCA91–444TD ON OUTLET RISERS MUELLER 013C5041–6DN OR APPROVED EQUAL.

CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	INSTALLATION OF 1" METERED WATER SUPPLY SERVICE - DOMESTIC 1" METERS	STANDARD DETAIL W-7
July 11, 2022 DATE *Andrew C Watcher* CHIEF		Revised 03/2022



PLAN



SECTIONAL ELEVATION

CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	AIR RELEASE VALVE VAULT	STANDARD DETAIL W-8
July 11, 2022 DATE Andrew C Watcher CHIEF		Revised 03/2022

METERS	CIRCULAR VAULT	SMALL PRECAST VAULT	LARGE PRECAST VAULT	VAULT BUILT IN PLACE
3/4" SUPPLY SERVICE, 5/8" METER (SINGLE)	18"			
3/4" SUPPLY SERVICE, TWIN 5/8" METERS	18"			
1" SUPPLY SERVICE, 3/4" METER (SINGLE)	18"			
1–1/2" SUPPLY SERVICE, 1" METER (SINGLE)	24"			
1–1/2" SUPPLY SERVICE, 3/4" METER (SINGLE)	24"			
2" SUPPLY SERVICE, 1–1/2" METER (SINGLE)		●		
2" SUPPLY SERVICE, 2" METER (SINGLE)		●		
4" SUPPLY SERVICE, 3" METER				●▲
4", 6", 8", 10" AND 12" FM METERS				●▲
4", 6", 8", 10" AND 12" FM METERS WITH SMALL DOMESTIC METER (5/8" – 2"), OUTSIDE FIRE HYDRANTS ALLOWED.				●
1" SUPPLY SERVICE, TWIN 3/4" METERS	24"			
1–1/2" SUPPLY SERVICE, TWIN 3/4" METERS	24"			
1–1/2" SUPPLY SERVICE, TWIN 1" METERS	24"			
4", 6", 8" & 10" FIRE SUPPLY SERVICE (TYPE DETECTOR CHECK) WITH SMALL DOMESTIC METER (5/8" – 2"), NO OUTSIDE FIRE HYDRANTS.			●	
4", 6", 8", 10" & 12" FIRE SUPPLY SERVICE (TYPE DETECTOR CHECK) WITH REDUCED SIZE LARGE OR LARGE DOMESTIC METER (3" – 6"), NO OUTSIDE FIRE HYDRANTS.				●
4", 6", 8", 10" & 12" FIRE SUPPLY SERVICE (TYPE F.M.) WITH REDUCED SIZE LARGE OR LARGE DOMESTIC METER (3" – 6"), OUTSIDE FIRE HYDRANTS ALLOWED.				●

VALVES	PRECAST MANHOLE	SMALL PRECAST VAULT	LARGE PRECAST VAULT	VAULT BUILT IN PLACE
MAINS 8"Ø AND SMALLER		●		
MAINS 10"Ø AND 12"Ø			●	
MAINS 16"Ø , 20"Ø , 24"Ø AND 30"Ø			*	●▲
DEWATERING VALVE & VAULT	■			
FIRE HYDRANT LEADS 6"Ø	■	●▲		
BLOW OFF INSTALLATION		●		
AIR RELEASE INSTALLATION, 16"Ø MAIN & SMALLER			● (F TOP)	
AIR RELEASE INSTALLATION, 20"Ø MAIN & LARGER				●▲
TAPPING SLEEVE AND VALVE 8"Ø AND SMALLER	■	●▲		
TAPPING SLEEVE AND VALVE 10"Ø AND 12"Ø	■		● (F TOP)	
TAPPING SLEEVE AND VALVE 16"Ø AND LARGER				●
COMFORT STATION DEWATERING VALVE AND VAULT	■			

* OR DUCTILE IRON PIPE INSTALLATIONS WITH VERTICAL VALVES, 16" RESILIENT SEATED VALVES (NON–TAPPING AND WITHOUT BYPASS) MAY BE INSTALLED IN A LARGE PRECAST SECTIONAL VAULT.

■ PRECAST MANHOLE MAY BE UTILIZED WHERE INDICATED. SEE APPROPRIATE STANDARD DETAIL AS REFERENCED.

▲ PRECAST VAULT MAY BE SUBSTITUTED WHERE INDICATED, SUBJECT TO APPROVAL BY THE COUNTY. SEE APPROPRIATE STANDARD DETAIL.

CARROLL CNTY DEPT. OF PUBLIC WORKS
BUREAU OF UTILITIES

July 11, 2022
DATE

Andrew C Watcher
CHIEF

TYPES OF HOUSING FOR METERS

STANDARD DETAIL

W-9A

Revised 03/2022

PRECAST VAULTS

4" VALVE (SMALL VAULT)

COVER ON MAIN	STD. CONCRETE SECTIONS					FRAME & COVER
	A	B	C	D	E	
1'-6" to 1'-9"	2	2	0	2	1	1
1'-10" to 2'-3"	2	2	2	0	1	1
2'-4" to 2'-9"	2	2	2	2	1	1
2'-10" to 3'-3"	2	2	2	4	1	1
3'-4" to 3'-9"	2	2	4	2	1	1
3'-10" to 4'-3"	2	2	4	4	1	1
4'-4" to 4'-9"	2	2	4	6	1	1

6" VALVE (SMALL VAULT)

COVER ON MAIN	STD. CONCRETE SECTIONS					FRAME & COVER
	A	B	C	D	E	
2'-0" to 2'-1"	2	2	2	0	1	1
2'-4" to 2'-7"	2	2	2	2	1	1
2'-10" to 3'-1"	2	2	2	4	1	1
3'-4" to 3'-7"	2	2	4	2	1	1
3'-10" to 4'-1"	2	2	4	4	1	1
4'-4" to 4'-7"	2	2	4	6	1	1
4'-10" to 5'-1"	2	2	6	4	1	1

8" VALVE (SMALL VAULT)

COVER ON MAIN	STD. CONCRETE SECTIONS					FRAME & COVER
	A	B	C	D	E	
1'-11"	2	2	2	0	1	1
2'-3" to 2'-5"	2	2	2	2	1	1
2'-9" to 2'-11"	2	2	2	4	1	1
3'-3" to 3'-5"	2	2	4	2	1	1
3'-9" to 3'-11"	2	2	4	4	1	1
4'-3" to 4'-5"	2	2	4	6	1	1
4'-9" to 4'-11"	2	2	6	4	1	1

10" VALVE (LARGE VAULT)

COVER ON MAIN	STD. CONCRETE SECTIONS					FRAME & COVER
	A	B	C	D	E	
2'-3" to 2'-9"	4	2	2	2	2*	1
2'-9" to 3'-3"	4	2	2	4	2*	1
3'-3" to 3'-9"	4	2	2	6	2*	1
3'-9" to 4'-3"	4	2	4	4	2*	1
4'-3" to 4'-9"	4	2	4	6	2*	1
4'-9" to 5'-3"	4	2	4	8	2*	1
5'-3" to 5'-9"	4	2	6	6	2*	1

12" VALVE (LARGE VAULT)

COVER ON MAIN	STD. CONCRETE SECTIONS					FRAME & COVER
	A	B	C	D	E	
2'-6" to 2'-7"	4	2	2	2	2*	1
2'-9" to 3'-1"	4	2	2	4	2*	1
3'-3" to 3'-7"	4	2	2	6	2*	1
3'-9" to 4'-1"	4	2	4	4	2*	1
4'-3" to 4'-7"	4	2	4	6	2*	1
4'-9" to 5'-1"	4	2	4	8	2*	1
5'-3" to 5'-7"	4	2	6	6	2*	1

* FOR 10" AND 12" TAPPING SLEEVE AND VALVE, F SECTIONS SHALL BE SUBSTITUTED FOR E SECTIONS.

CARROLL CNTY DEPT. OF PUBLIC WORKS
BUREAU OF UTILITIES

July 11, 2022
DATE

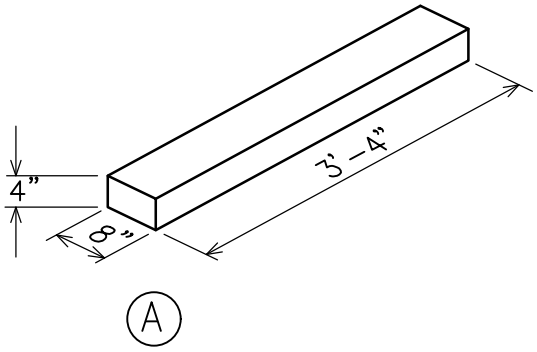
Andrew C Watcher
CHIEF

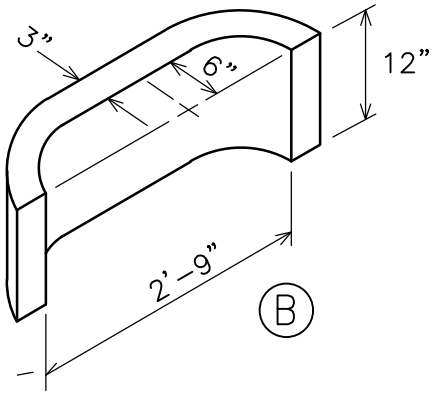
TABLE OF SECTIONS REQUIRED FOR
CONCRETE VALVE VAULTS

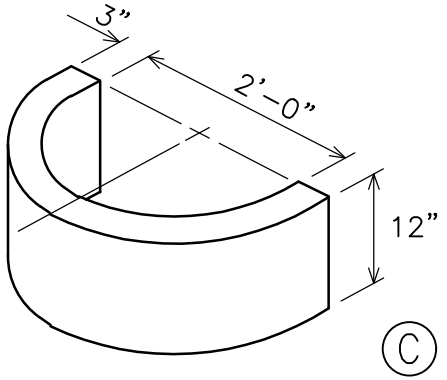
STANDARD DETAIL

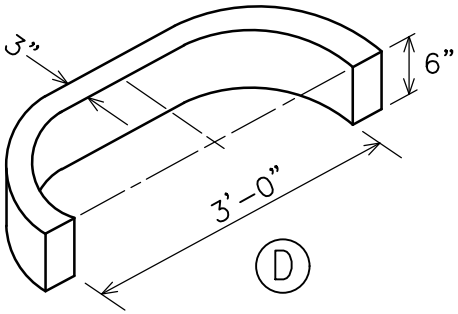
W-9B

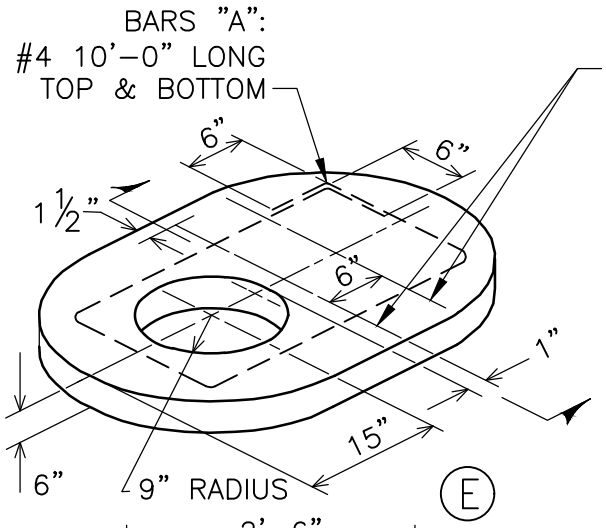
Revised 03/2022

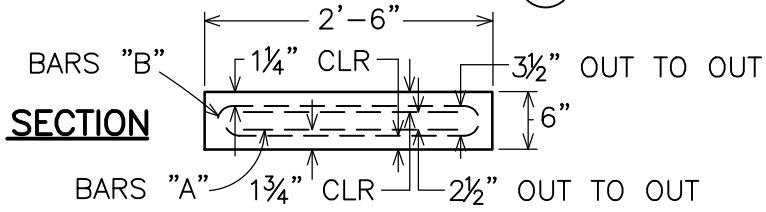












SECTION

NOTES:

1. ALL SECTIONS TO HAVE 4"x4" W4 x W4 WIRE MESH REINFORCING EXCEPT AS INDICATED ON SECTION E. WWF TO HAVE 3/4" COVER.
2. ALL CONCRETE TO BE SHA MIX NO. 3.
3. TAPPING VALVE VAULT TO BE PLACED ON 6" CONCRETE SLAB REINFORCED WITH NO. 4 BARS AT 12" E. W. ON CENTER LINE OF SLAB.
4. SECTION JOINTS SHALL BE MORTARED.

CARROLL CNTY DEPT. OF PUBLIC WORKS
BUREAU OF UTILITIES

July 11, 2022
DATE

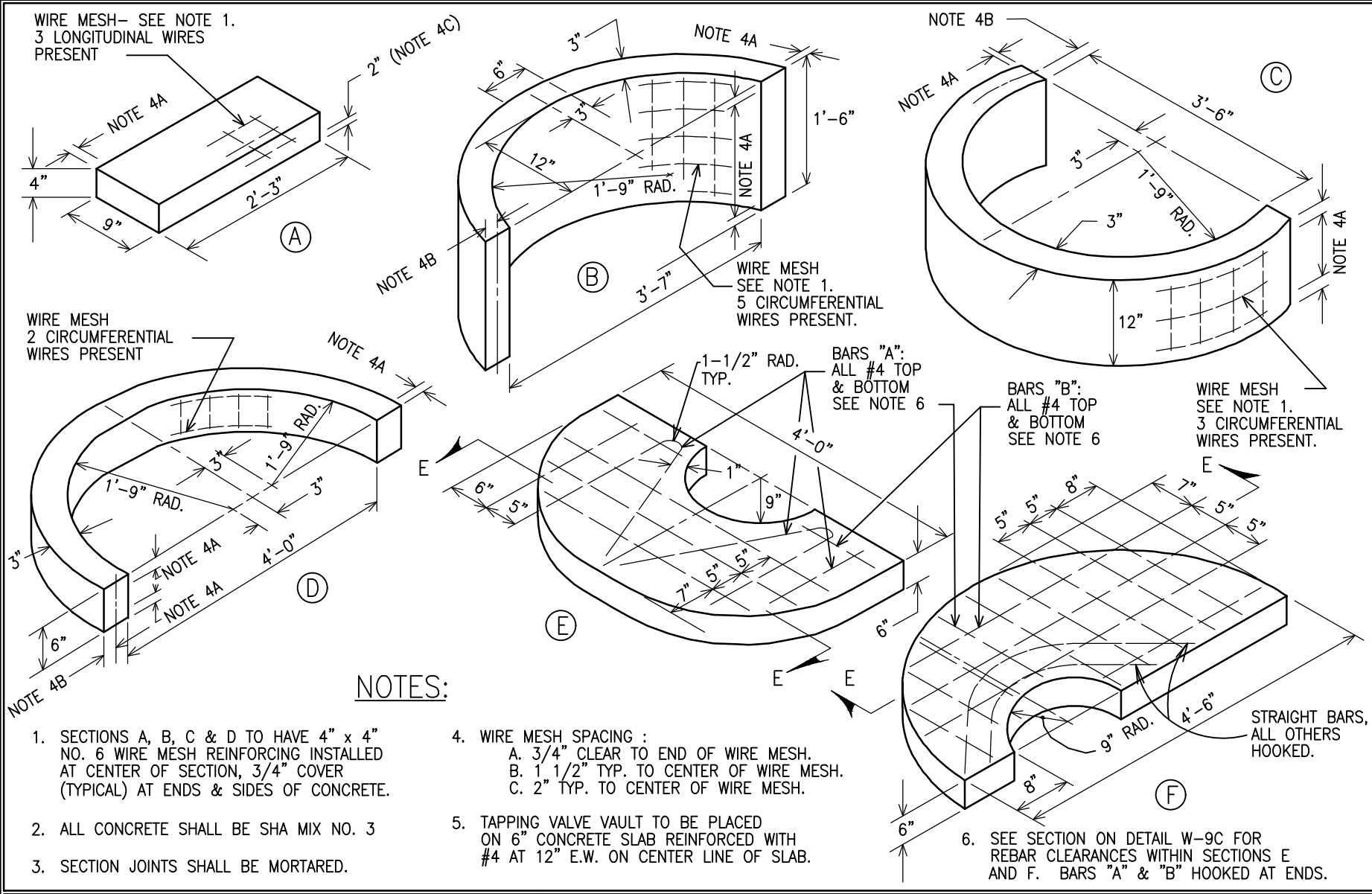
Andrew C Watcher
CHIEF

SECTIONS FOR SMALL CONCRETE VAULTS

STANDARD DETAIL

W-9C

Revised 03/2022



NOTES:

1. SECTIONS A, B, C & D TO HAVE 4" x 4" NO. 6 WIRE MESH REINFORCING INSTALLED AT CENTER OF SECTION, 3/4" COVER (TYPICAL) AT ENDS & SIDES OF CONCRETE.
2. ALL CONCRETE SHALL BE SHA MIX NO. 3
3. SECTION JOINTS SHALL BE MORTARED.
4. WIRE MESH SPACING :
   A. 3/4" CLEAR TO END OF WIRE MESH.
   B. 1 1/2" TYP. TO CENTER OF WIRE MESH.
   C. 2" TYP. TO CENTER OF WIRE MESH.
5. TAPPING VALVE VAULT TO BE PLACED ON 6" CONCRETE SLAB REINFORCED WITH #4 AT 12" E.W. ON CENTER LINE OF SLAB.
6. SEE SECTION ON DETAIL W–9C FOR REBAR CLEARANCES WITHIN SECTIONS E AND F. BARS "A" & "B" HOOKED AT ENDS.

CARROLL CNTY DEPT. OF PUBLIC WORKS
BUREAU OF UTILITIES

July 11, 2022
DATE

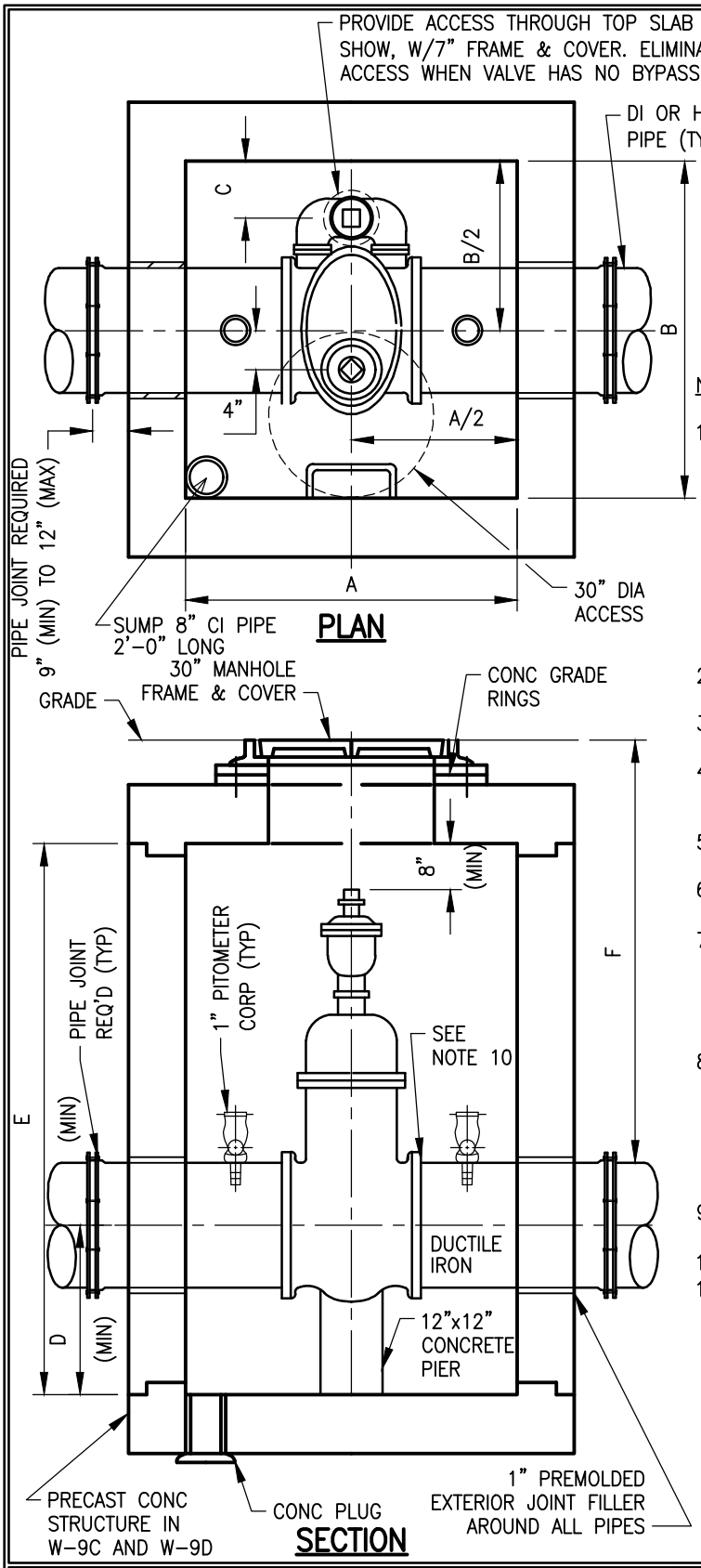
Andrew C Watcher
CHIEF

SECTIONS FOR LARGE CONCRETE VAULTS

STANDARD DETAIL

W-9D

Revised 03/2022



VALVE SIZE	16"*	20"	24"	30"**
A	5'-0"	5'-0"	5'-6"	6'-0"
B	5'-0"	5'-0"	5'-6"	6'-0"
C	11.50"	11.50"	12"	12"
D	2'-3"	2'-6"	2'-8"	2'-11"
E	7'-1"	8'-4"	9'-2"	10'-5"
F	5'-11"	6'-3"	6'-5"	7'-0"

* SEE NOTE 8 ** SEE NOTE 11

NOTES:

1. VAULTS SHALL BE DESIGNED TO MATCH SUPPLIED VALVES. SHOP DRAWINGS SHALL BE SUBMITTED & APPROVED FOR EACH VAULT. SHOP DRAWINGS SHALL BE SIGNED & SEALED BY A MARYLAND REGISTERED PROFESSIONAL ENGINEER.
   LOADS: L.L. = MdSHA HS-27 (135% OF AASHTO S20-44 LOADING)
   D.L. = EARTH AT 110 Lbs. PER CU. FT. & 42 Lbs. PER CU. FT. EQUIVALENT FLUID PRESSURE.
2. CONCRETE & REINFORCING SHALL CONFORM TO THE STANDARD CARROLL COUNTY SPECIFICATION.
3. CAST-IN-PLACE CONCRETE SHALL BE SHA MIX NO. 3 PRECAST CON-CRETE SHALL BE 4500 PSI.
4. TOP SLAB MUST BE SEPARATE AND REMOVABLE FROM VAULT. TOP SLAB OPENINGS MUST ALIGN WITH VALVE CONTROLS AS INSTALLED.
5. VAULT FLOTATION TO BE ADDRESSED BY CERTIFYING ENGINEER TO THE SATISFACTION OF THE COUNTY.
6. 1 INCH PITOMETER CORPORATION TO BE INSTALLED ON EACH SIDE OF THE VALVE.
7. FOR DUCTILE IRON PIPE INSTALLATIONS (DUCTILE IRON PIPE ON EACH SIDE OF PIPE JOINTS), 16 INCH RESILIENT-SEATED VALVES WITHOUT BYPASS MAY BE INSTALLED IN A LARGE SECTIONAL VAULT. PITOMETER CORPORATIONS ARE REQUIRED.
8. FOR HDPE PIPE INSTALLATIONS, TRANSITION TO DUCTILE IRON PIPE OUTSIDE OF VAULT (AT PIPE JOINTS) USING BUTT FUSION WELDED MECHANICAL JOINT ADAPTER WITH METAL INSERT, METAL GLAND AND ATTACHMENT BOLTS & NUTS. PIPE BETWEEN JOINTS SHOWN SHALL BE DUCTILE IRON ONLY.
9. CONNECT DUCTILE IRON PIPE (EACH SIDE) TO VALVE USING RESTRAINED JOINTS APPROVED BY THE COUNTY.
10. FOR 30" VALVE, CONSULT THE COUNTY.
11. FOR PRECAST VAULTS (NOT SHOWN), PROVIDE & MAINTAIN A 2" GAP BETWEEN PIPE & "DOGHOUSE" OPENINGS. OPENINGS ABOVE PIPE CENTERLINE SHALL BE FILLED WITH PRE-MOLDED EXPANSION JOINT FILLER. BLOCK OPENINGS BELOW PIPE CENTERLINE WITH BRICK AND MORTAR INSTALLED ON THE OUTSIDE OF THE VAULT WALL. CONTINUE BRICK AND MORTAR TO ONE COURSE ABOVE THE PIPE CENTERLINE.

CARROLL CNTY DEPT. OF PUBLIC WORKS
BUREAU OF UTILITIES

July 11, 2022
DATE

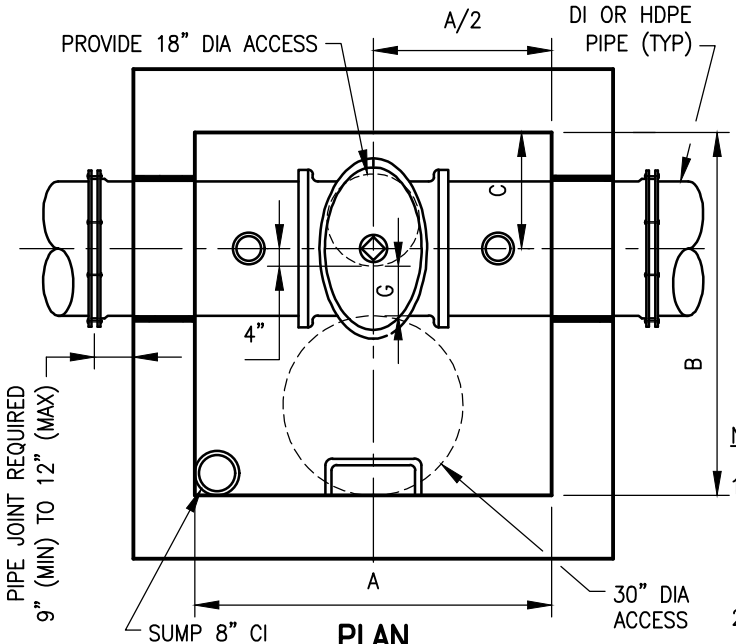
Andrew C Watcher
CHIEF

VAULT FOR VERTICAL VALVES WITH GEARING

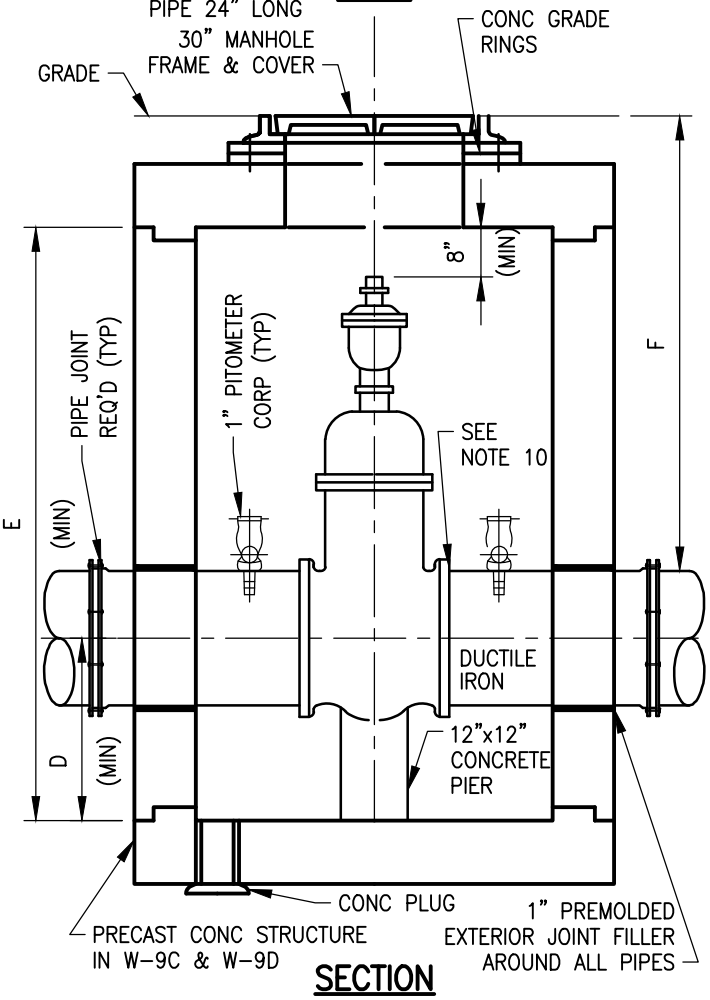
STANDARD DETAIL

W-10A

Revised 03/2022



PLAN



SECTION

VALVE SIZE	16"	20"	24"
A	5'-0"	5'-0"	5'-6"
B	5'-0"	5'-6"	6'-0"
C	1'-6"	2'-0"	2'-4"
D	2'-3"	2'-6"	2'-8"
E	7'-1"	8'-4"	9'-2"
F	5'-11"	6'-3"	6'-5"
G	8"	8"	10"

NOTES:

1. VAULTS SHALL BE DESIGNED TO MATCH SUPPLIED VALVES. SHOP DRAWINGS SHALL BE SUBMITTED & APPROVED FOR EACH VAULT. SHOP DRAWINGS SHALL BE SIGNED & SEALED BY A MARYLAND REGISTERED PROFESSIONAL ENGINEER.
2. LOADS: L.L. = MdSHA HS-27 (135% OF AASHTO S20-44 LOADING)
   D.L. = EARTH AT 110 Lbs. PER CU. FT. & 42 Lbs. PER CU. FT. EQUIVALENT FLUID PRESSURE.
3. CONCRETE & REINFORCING SHALL CONFORM TO THE STANDARD CARROLL COUNTY SPECIFICATION.
4. CAST-IN-PLACE CONCRETE SHALL BE SHA MIX NO. 3. PRECAST CON-CRETE SHALL BE 4500 PSI.
5. TOP SLAB MUST BE SEPARATE AND REMOVABLE FROM VAULT. TOP SLAB OPENINGS MUST ALIGN WITH VALVE CONTROLS AS INSTALLED.
6. VAULT FLOTATION TO BE ADDRESSED BY CERTIFYING ENGINEER TO THE SATISFACTION OF THE COUNTY.
7. 1 INCH PITOMETER CORPORATION TO BE INSTALLED ON EACH SIDE OF THE VALVE.
8. FOR DUCTILE IRON PIPE INSTALLATIONS (DUCTILE IRON PIPE ON EACH SIDE OF PIPE JOINTS), 16 INCH RESILIENT-SEATED VALVES WITHOUT BYPASS MAY BE INSTALLED IN A LARGE SECTIONAL VAULT. PITOMETER CORPORATIONS ARE REQUIRED.
9. FOR HDPE PIPE INSTALLATIONS, TRANSITION TO DUCTILE IRON PIPE OUTSIDE OF VAULT (AT PIPE JOINTS) USING BUTT FUSION WELDED MECHANICAL JOINT ADAPTER WITH METAL INSERT, METAL GLAND AND ATTACHMENT BOLTS & NUTS. PIPE BETWEEN JOINTS SHOWN SHALL BE DUCTILE IRON ONLY.
10. CONNECT DUCTILE IRON PIPE (EACH SIDE) TO VALVE USING RESTRAINED JOINTS APPROVED BY THE COUNTY.
11. FOR PRECAST VAULTS (NOT SHOWN), PROVIDE & MAINTAIN A 2" GAP BETWEEN PIPE & "DOGHOUSE" OPENINGS. OPENINGS ABOVE PIPE CENTERLINE SHALL BE FILLED WITH PRE-MOLDED EXPANSION JOINT FILLER. BLOCK OPENINGS BELOW PIPE CENTERLINE WITH BRICK AND MORTAR INSTALLED ON THE OUTSIDE OF THE VAULT WALL. CONTINUE BRICK AND MORTAR TO ONE COURSE ABOVE THE PIPE CENTERLINE.

CARROLL CNTY DEPT. OF PUBLIC WORKS
BUREAU OF UTILITIES

July 11, 2022
DATE

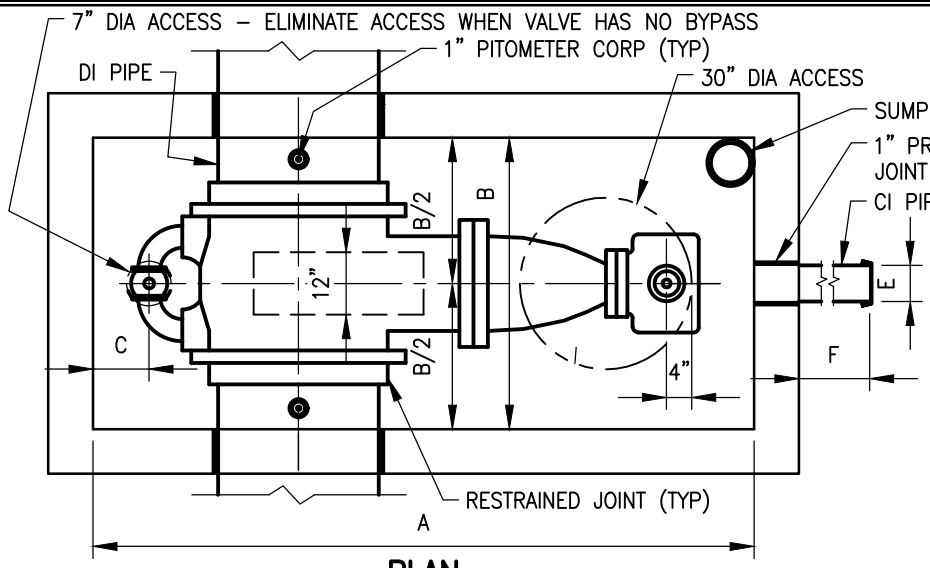
Andrew C Watcher
CHIEF

VAULT FOR VERTICAL VALVES WITHOUT GEARING

STANDARD DETAIL

W-10B

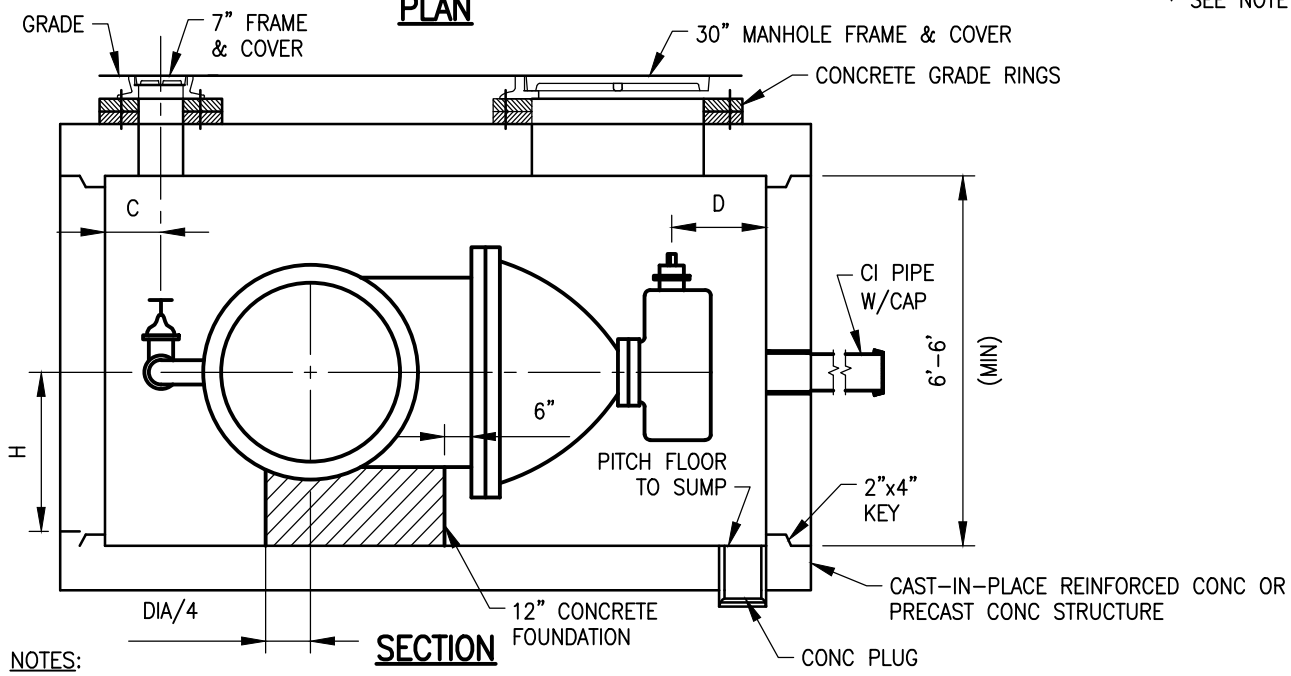
Revised 03/2022



PLAN

VALVE SIZE	16"	20"	24"	30"*
A	8'–0"	8'–6"	10'–0"	11'–3"
B	4'–6"	5'–0"	5'–6"	6'–0"
C	1'–0"	1'–0"	1'–0"	1'–0"
D	2'–5"	2'–2"	2'–8"	2'–9"
E	6"	6"	6"	8"
F	1'–6"	1'–6"	1'–6"	2'–0"
H	2'–1"	2'–3"	2'–6"	2'–10"

* SEE NOTE 8



SECTION

NOTES:

1. VAULTS SHALL BE DESIGNED TO MATCH SUPPLIED VALVES. SHOP DRAWINGS SHALL BE SUBMITTED & APPROVED FOR EACH VAULT. SHOP DRAWINGS SHALL BE SIGNED & SEALED BY A MARYLAND REGISTERED PROFESSIONAL ENGINEER.
2. LOADS: L.L. = MdSHA HS–27 (135% OF AASHTO S20–44 LOADING)
   D.L. = EARTH AT 110 Lbs. PER CU. FT. & 42 Lbs. PER CU. FT. EQUIVALENT FLUID PRESSURE.
3. CONCRETE & REINFORCING SHALL CONFORM TO THE STANDARD CARROLL COUNTY SPECIFICATION.
4. CAST–IN–PLACE CONCRETE SHALL BE SHA MIX NO. 3 PRECAST CONCRETE SHALL BE 4500 PSI.
5. TOP SLAB MUST BE SEPARATE AND REMOVABLE FROM VAULT. TOP SLAB OPENINGS MUST ALIGN WITH VALVE CONTROLS AS INSTALLED.
6. VAULT FLOTATION TO BE ADDRESSED BY CERTIFYING ENGINEER TO THE SATISFACTION OF THE COUNTY.
7. 1 INCH CORPORATION TO BE INSTALLED ON EACH SIDE OF THE VALVE.
8. FOR 30" VALVE, CONSULT THE BUREAU OF UTILITIES.

CARROLL CNTY DEPT. OF PUBLIC WORKS
BUREAU OF UTILITIES

July 11, 2022
DATE

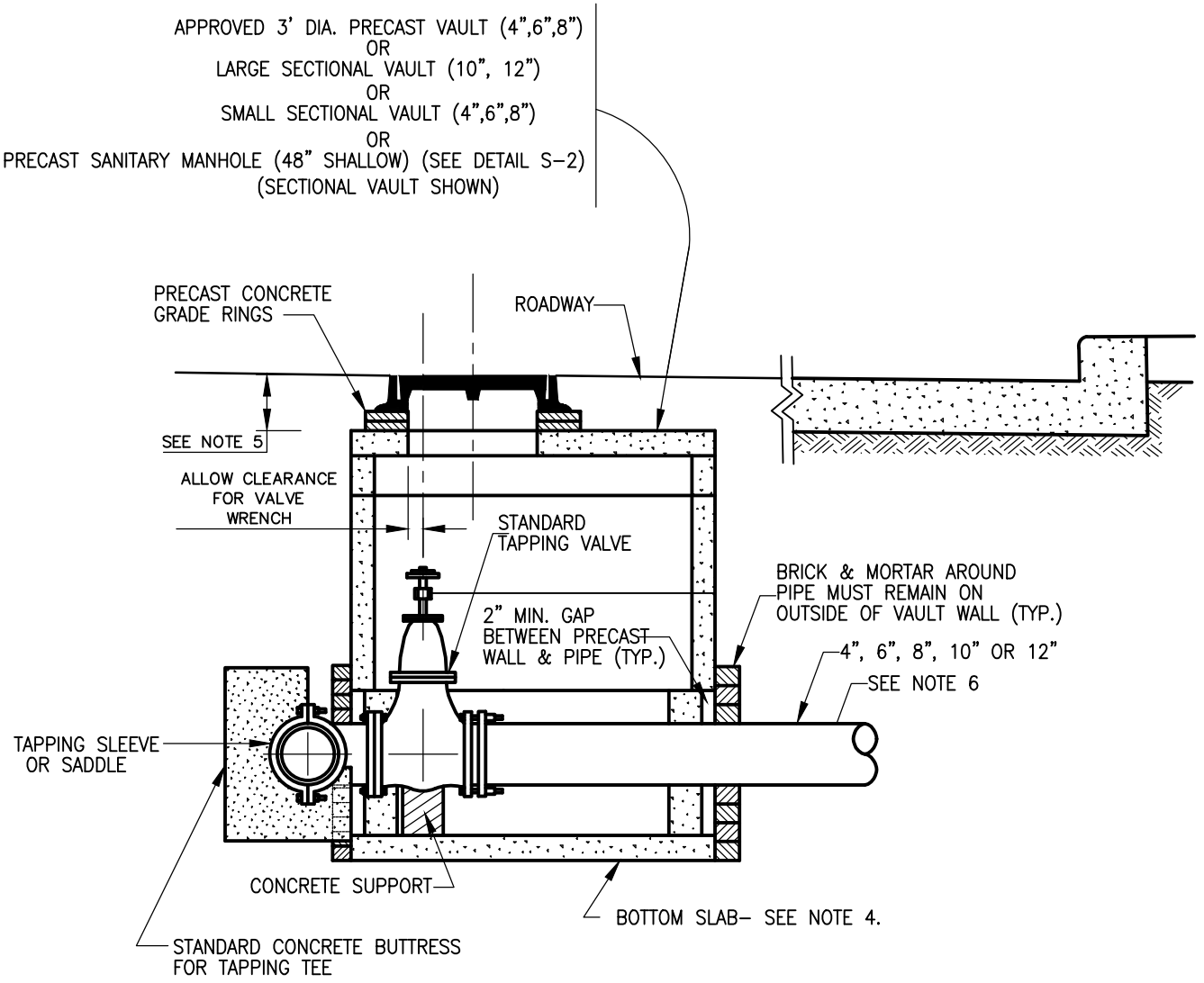
Andrew C Watcher
CHIEF

VAULT FOR HORIZONTAL VALVES

STANDARD DETAIL

W-10C

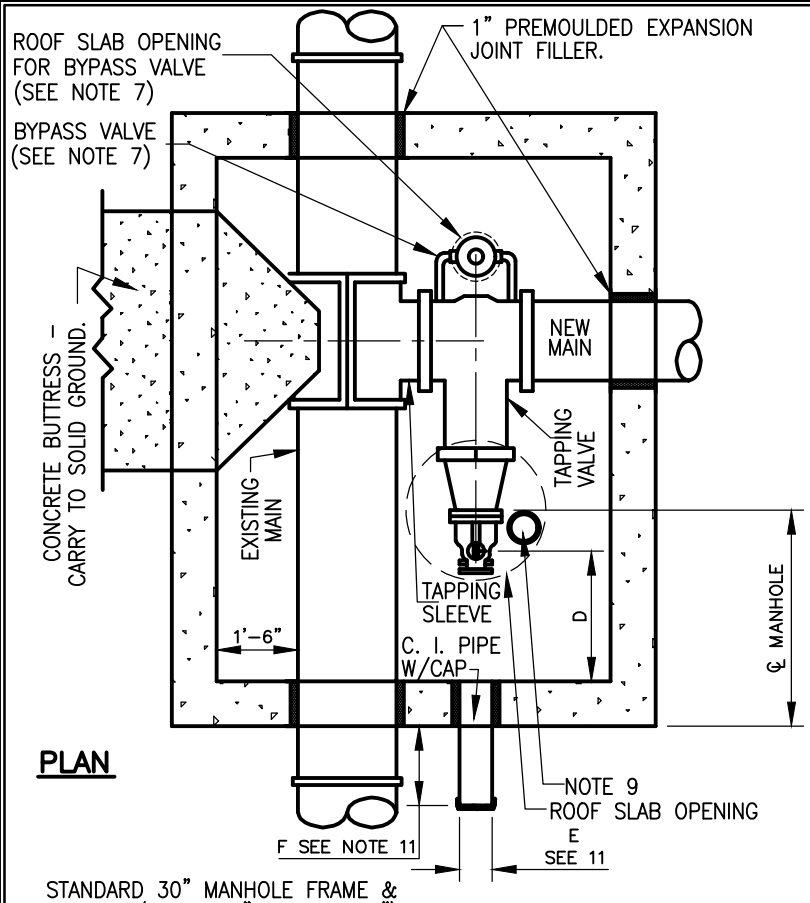
Revised 03/2022

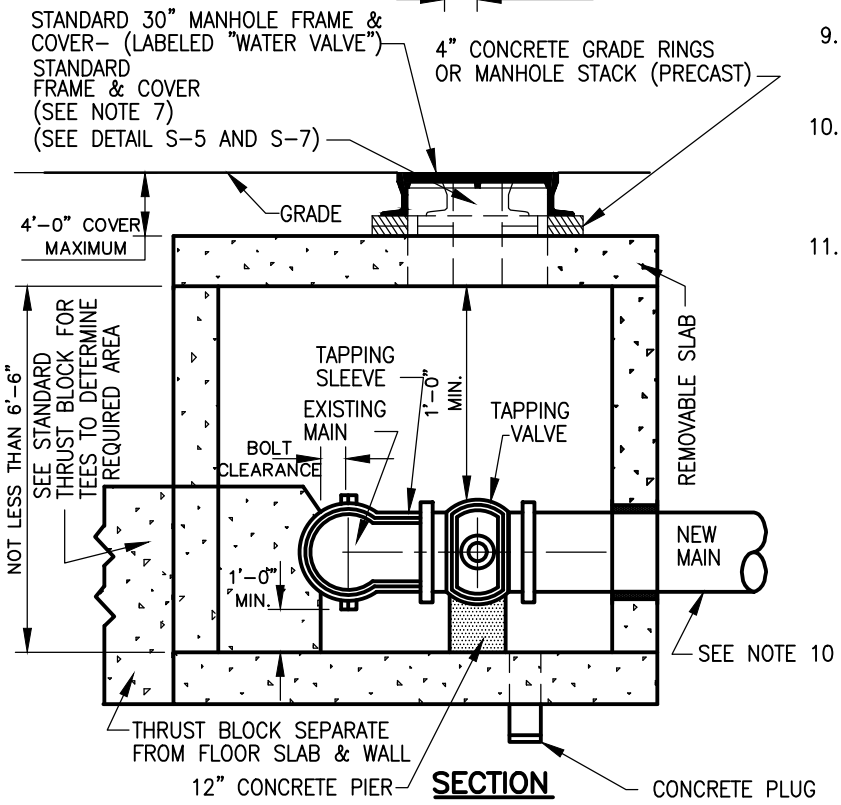


NOTES:

1. SEE DETAIL PLATE S-8 FOR MANHOLE STEP SPECIFICATIONS, PLACEMENT AND SPACING. LOCATE STEPS AS SHOWN (PRECAST SHALLOW MANHOLE ONLY).
2. MANHOLE CONSTRUCTION SHALL BE IN ACCORDANCE WITH ALL APPLICABLE REQUIREMENTS INDICATED FOR PRECAST SHALLOW MANHOLE. (SEE DETAIL S-2).
3. IF PRECAST "DOGHOUSE" MANHOLE RISER IS USED, PROVIDE AND MAINTAIN A 2" GAP BETWEEN PIPE AND RISER.
4. BOTTOM SLAB :
   SECTIONAL VAULTS- 6" THICK 3500 psi CONCRETE SLAB; #4 BARS @ 12" C/C E.W. AT ℄ OF SLAB.
   PRECAST MANHOLE- SEE STD. DETAIL S-1 AND S-2 AS APPLICABLE.
5. SECTIONAL VAULT- 12" MINIMUM, 18" MAXIMUM.
   PRECAST MANHOLE- SEE STD. DETAIL PLATE S-1.
6. IF TAPPING VALVE FUNCTIONS AS A SERVICE VALVE TO A LARGE METER (3" OR GREATER), PIPE BETWEEN TAPPING VALVE & METER SHALL BE DIP ONLY.

CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	TAPPING SLEEVE AND VALVE	STANDARD DETAIL W-11A
July 11, 2022 DATE Andrew C Watcher CHIEF		Revised 03/2022





NOTES:

1. VAULTS SHALL BE DESIGNED TO MATCH SUPPLIED VALVES. SHOP DRAWINGS SHALL BE SUBMITTED & APPROVED FOR EACH VAULT. SHOP DRAWINGS SHALL BE SIGNED & SEALED BY A MARYLAND REGISTERED PROFESSIONAL ENGINEER.
2. LOADS: L.L. = MdSHA HS-27 (135% OF AASHTO HS20-44 LOADING)
   D.L. = EARTH AT 110 Lbs. PER CU. FT. & 42 Lbs. PER CU. FT. EQUIVALENT FLUID PRESSURE.
3. CONCRETE & REINFORCING SHALL CONFORM TO THE STANDARD CARROLL COUNTY SPECIFICATION.
4. CAST-IN-PLACE CONCRETE SHALL BE SHA MIX NO. 3.
5. TOP SLAB MUST BE SEPARATE AND REMOV-ABLE FROM VAULT. TOP SLAB OPENINGS MUST ALIGN WITH VALVE CONTROLS AS INSTALLED.
6. VAULT FLOTATION TO BE ADDRESSED BY CERTIFYING ENGINEER TO SATISFACTION OF BUREAU OF UTILITIES.
7. VALVES 24 INCHES IN DIAMETER OR LESS SHALL BE OF RESILIENT SEAT DESIGN WITHOUT BYPASS VALVE & WITHOUT FRAME & COVER.
8. FOR VALVES 30 INCHES IN DIAMETER OR LARGER, CONSULT WITH THE COUNTY.
9. SUMP- 8" PIPE, 2' LONG, PITCH FLOOR TO SUMP. ADJUST LOCATION AS NECESSARY TO BE UNDER ROOF SLAB OPENING.
10. IF TAPPING VALVE FUNCTIONS AS A SERVICE VALVE TO A LARGE METER (3" OR GREATER), PIPE BET-WEEN TAPPING VALVE AND METER SHALL BE D.I.P. ONLY.
11. FOR VALVES 16" TO 24", USE F=18" AND E=6". FOR 30" VALVES, USE F=24" AND E=8".

CARROLL CNTY DEPT. OF PUBLIC WORKS
BUREAU OF UTILITIES

July 11, 2022
DATE

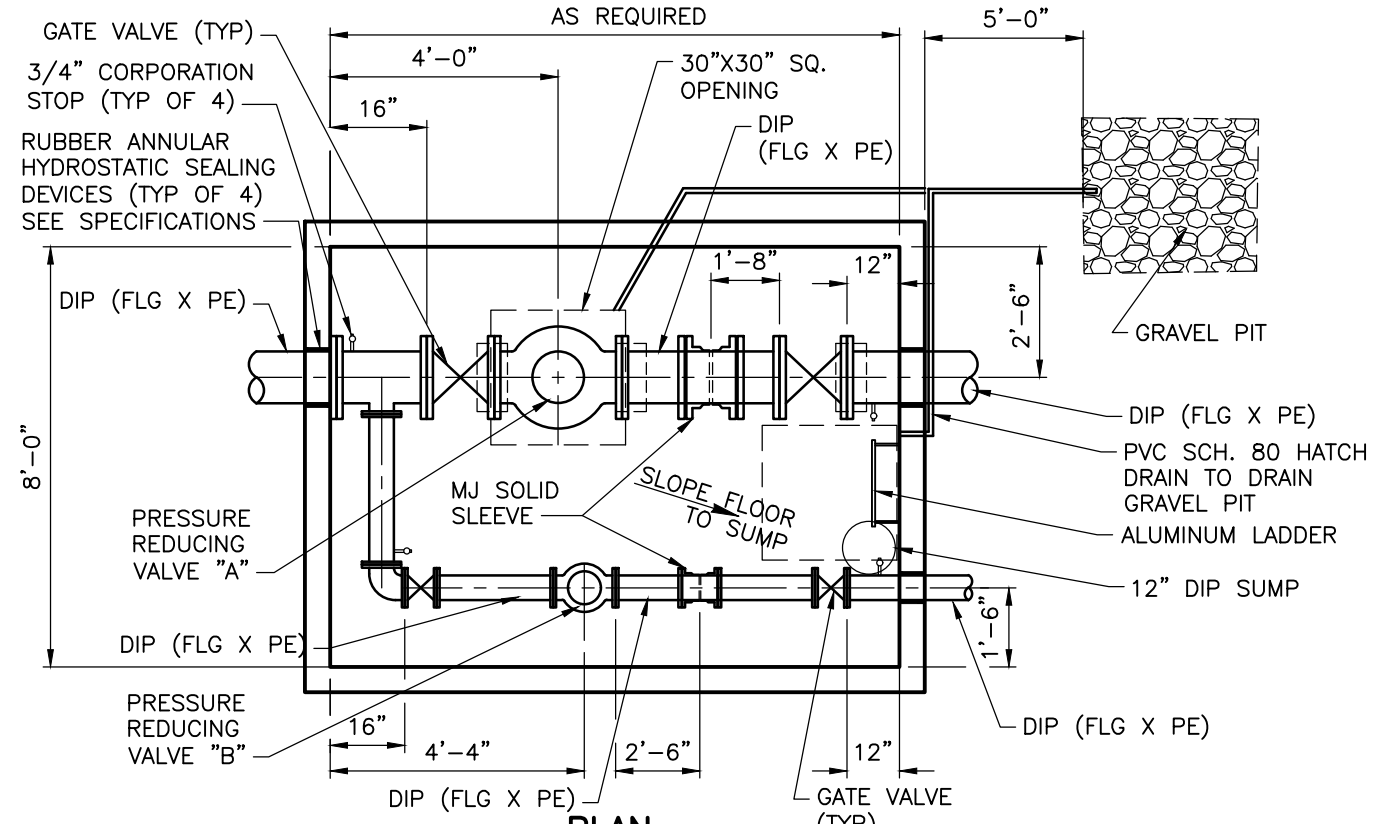
Andrew C Watcher
CHIEF

STANDARD INSTALLATION OF TAPPING SLEEVE AND HOR. VALVE

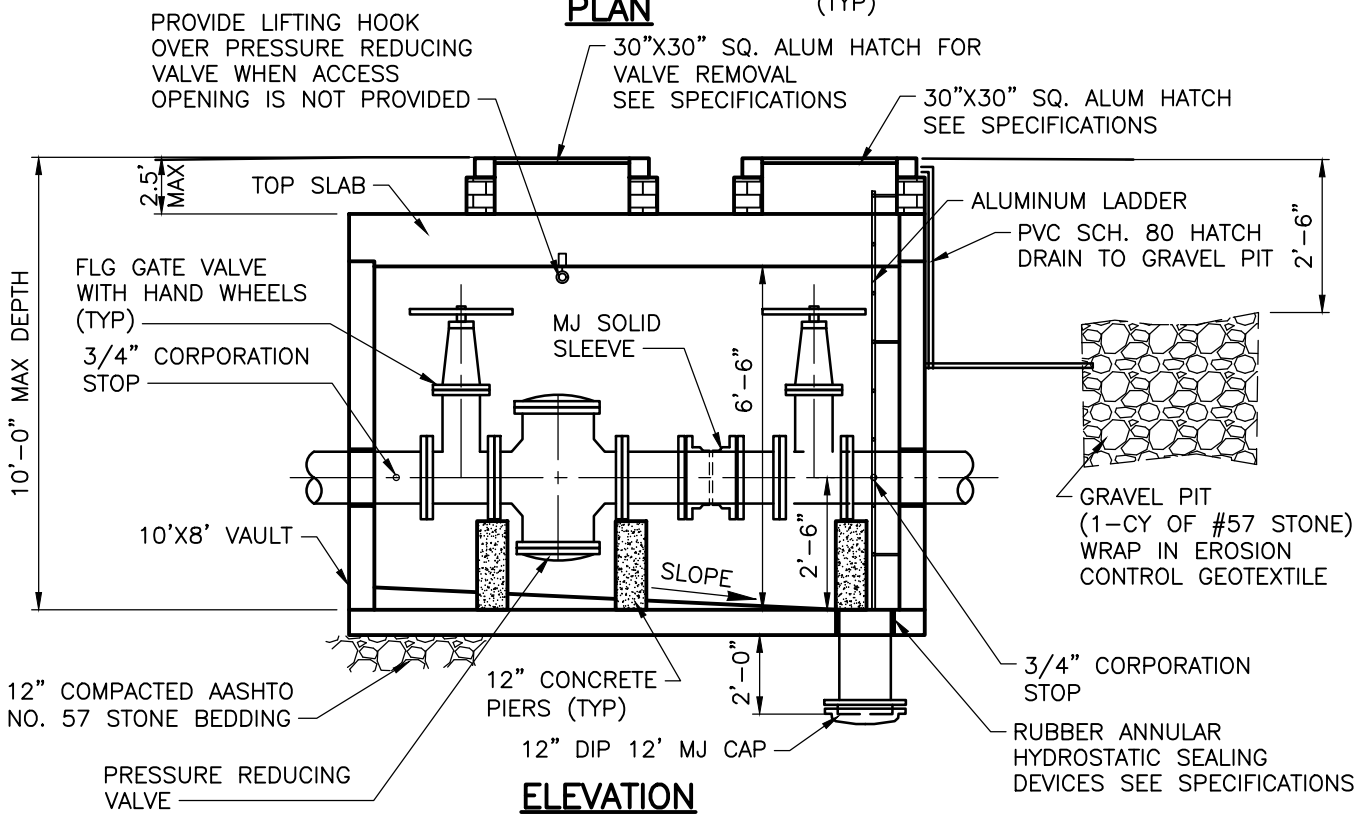
STANDARD DETAIL

W-11B

Revised 03/2022



PLAN



ELEVATION

CARROLL CNTY DEPT. OF PUBLIC WORKS
BUREAU OF UTILITIES

July 11, 2022
DATE

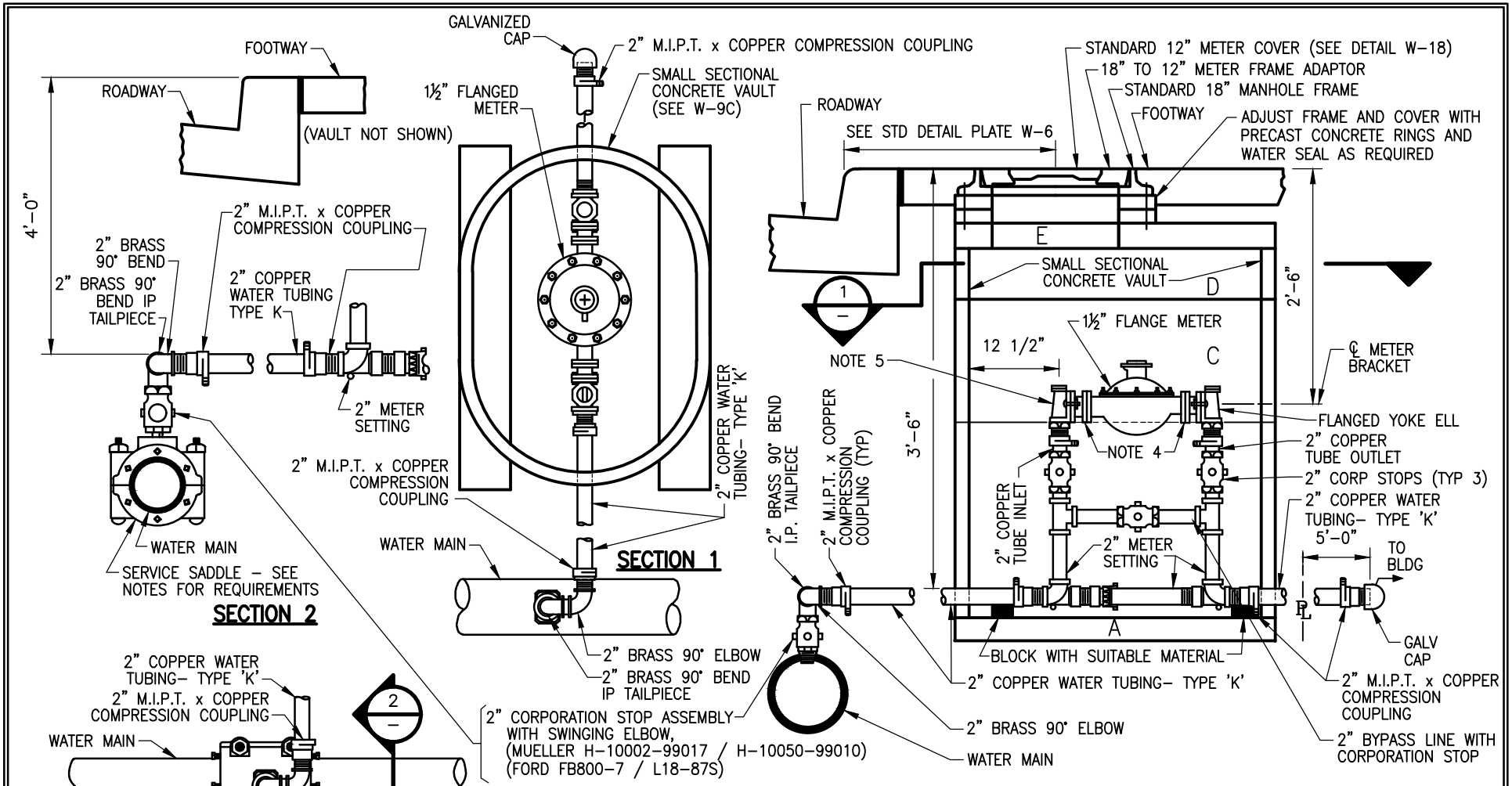
Andrew C Watcher
CHIEF

PRESSURE REDUCING VALVE VAULT

STANDARD DETAIL

W-12

Revised 03/2022



NOTES:

1. ON 4" – 10" DUCTILE IRON PIPE, USE SERVICE SADDLE (FORD FC202 OR SMITH-BLAIR 317)
2. FOR 12" AND LARGER DIP, CONTRACTOR MAY INSTALL CORPORATION USING SERVICE SADDLE LISTED IN NOTE 1.
3. ON 4" – 24" HDPE, USE APPROVED ELECTROFUSION TAPPING SADDLE.
4. 1 PAIR OF FLANGE x FLANGE METER ADAPTER. FORD #A-67
5. 2" FLANGED ANGLE METER VALVE WITH "O" RING TYPE FLANGE METER SUPPORT BRACKETS DRILLED FOR 1-1/2" METER (EACH SIDE OF METER)

CARROLL CNTY DEPT. OF PUBLIC WORKS
BUREAU OF UTILITIES

July 11, 2022
DATE

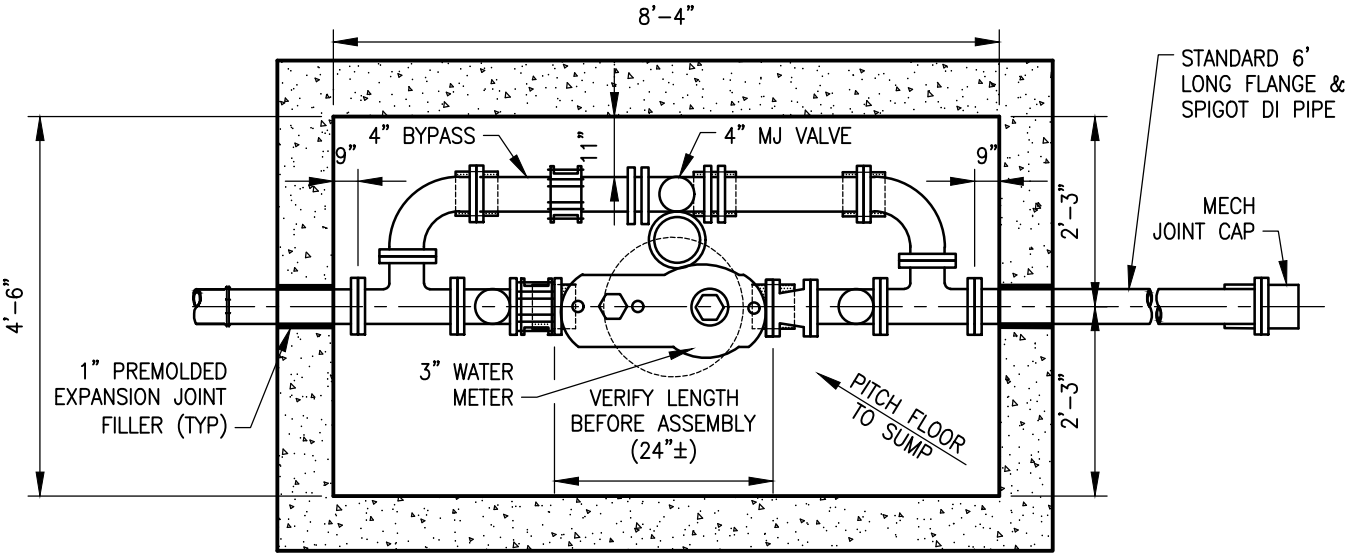
Andrew C Watcher
CHIEF

INSTALLATION OF
1-1/2" & 2" METERED WATER SUPPLY SERVICE
(1-1/2" & 2" METER)

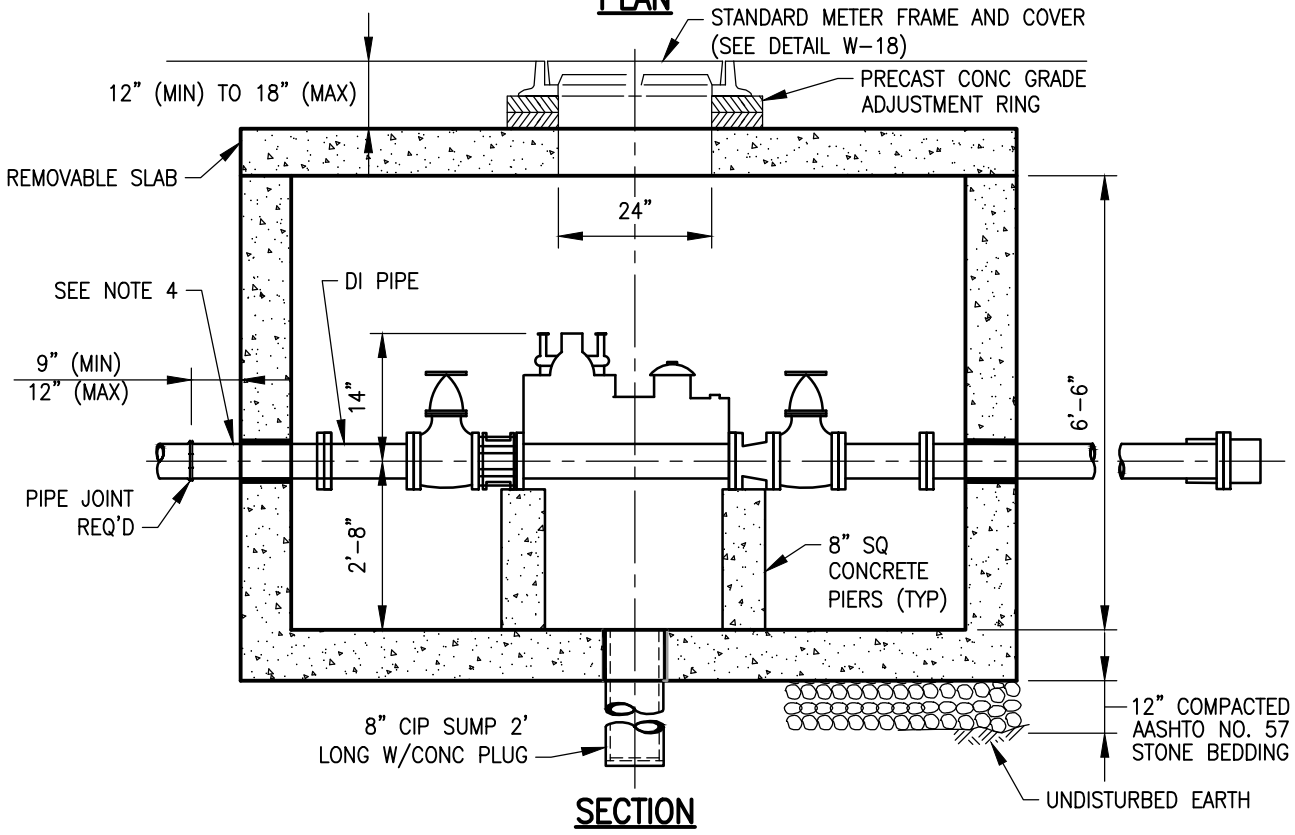
STANDARD DETAIL

W-13

Revised 03/2022



PLAN

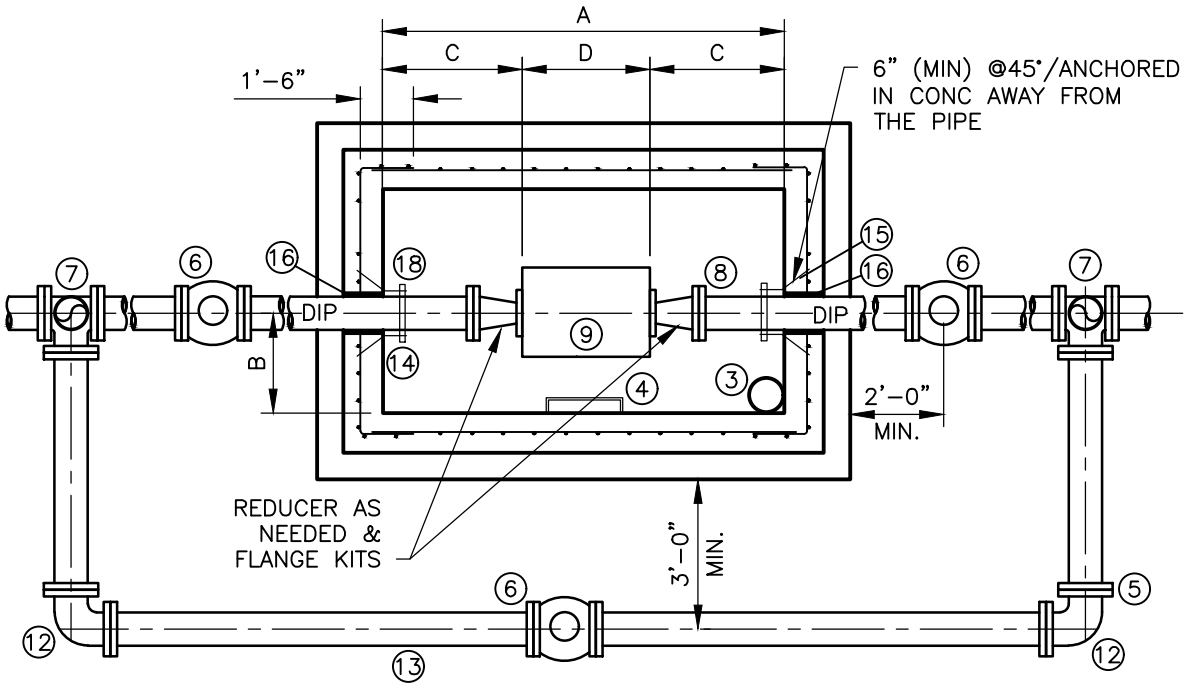


SECTION

NOTES:

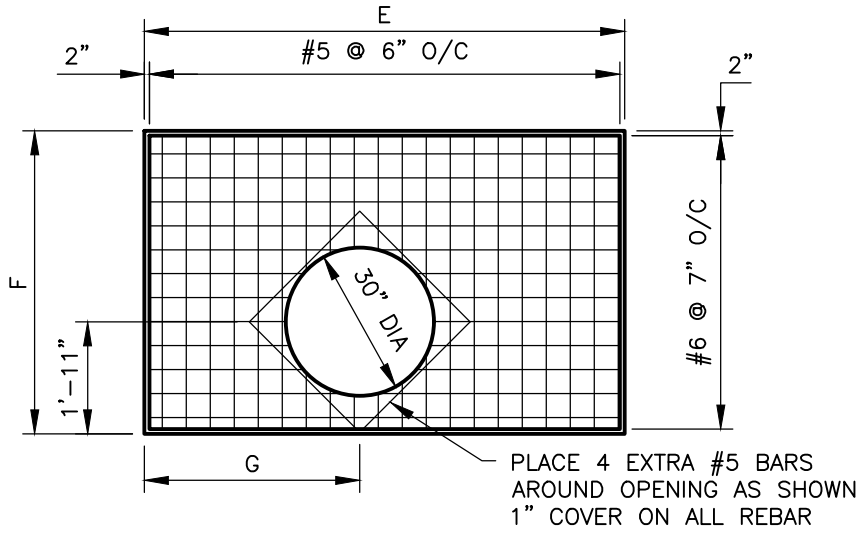
1. ALL VALVES AND FITTINGS TO BE FLANGED. VALVES SHALL HAVE HANDWHEELS.
2. BYPASS SHALL BE SIZED FOR NON-FIRE DEMAND ONLY.
3. VAULT CONSTRUCTION SHALL BE IN ACCORDANCE WITH INTERIOR DIMENSIONS SHOWN, AND WITH NOTES ON STANDARD DETAIL PLATE W-9D.
4. PIPES BETWEEN SERVICE VALVE (NOT SHOWN) AND METER VAULT SHALL BE DUCTILE IRON PIPE, REGARDLESS OF TYPE OF PIPE USED ELSEWHERE.
5. CAST-IN-PLACE CONCRETE TO BE SHA MIX NO. 3.

CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	INSTALLATION OF 4" WATER SUPPLY SERVICE WITH 3" METER	STANDARD DETAIL W-14
July 11, 2022 DATE Andrew C Watcher CHIEF		Revised 03/2022



NOTE:
SEE PROFILE DETAIL W–15B
FOR COMPONENT IDENTIFICATION

PLAN



PLAN OF SLAB REINFORCED

	SIZE	A	B	C	D	E	F	G
4" FM	4"	8"	4"	2'–7 1/2"	2'–9"	9'–4"	5'–4"	4'–8"
6" FM	6"	8"	4"	2'–1"	3'–10"	9'–4"	5'–4"	4'–8"
8" FM	8"	8"	4"	1'–9"	4'–6"	9'–4"	5'–4"	4'–8"

CARROLL CNTY DEPT. OF PUBLIC WORKS
BUREAU OF UTILITIES

July 11, 2022
DATE

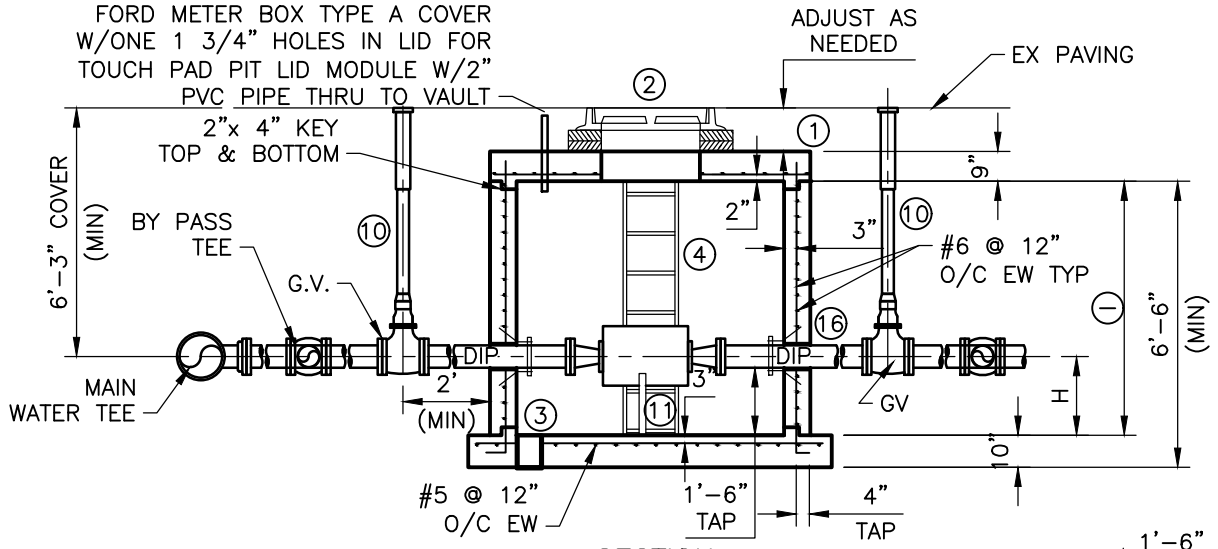
Andrew C Watcher
CHIEF

FIRE & DOMESTIC
METER VAULT ASSEMBLY
STANDARD VAULT FOR
4", 6" & 8" FIRE METERS

STANDARD
DETAIL

W-15A

Revised 03/2022



VAULT MATERIAL

1. 8'–0"L x 4'–0"W PRECAST VAULT /ROADWAY APPROVED.
2. 30' MANHOLE FRAME & COVER. 9SEE DETAIL S–5 EXCEPT LABELED "WATER")
3. SUMP/2" FLOOR DRAIN, ABOVE FLOOD PLAIN ONLY BELOW FLOOD PLAIN SEAL SUMP.
4. ALUMINUM LADDER W/SAFETY POST.

PIPE ASSEMBLY

5. (16) 4", 6" OR 8" UNI–FLANGE SERIES 1400 WEDGE RETINER/FORD OR EQUAL.
6. (3) 4",6" OR 8" MJ RESILIENT WEDGE NON RISING SHAFT OPEN–CC NSF–61 CERT/UL262 ANSI C509/FM 1120/1130 GATE VALVE/AMERICAN FLOW CONTROL OR EQUAL
7. (2) 4", 6" OR 8" MJ TEE AWWA CLASS 153/TYLER PIPE COMPANY OR EQUAL
8. (2) 4", 6" OR 8" FLANGE TAIL PIECE PLAIN END PIPE/CUSTOM FABRICATORS
9. (1) 4", 6" OR 8" COMPACT FIRE OMNI F2 METER/SENUS TECHNOLOGIES FIRELINE FIRE SERVICE ASSEM. W/TOUCH READ.
10. (3) BINGHAM & TAYLOR 3 PIECE VALVE BOXES OR EQUAL
11. (1) ANVIL INTERNATIONAL 264 ADJUSTABLE PIPE SADDLE SUPPORT OR EQUAL
12. (2) 4", 6" OR 8" DI MJ 90° ELBOW
13. 4", 6" OR 8" CLASS 52 DUCTILE IRON PIPE
14. (2) 4", 6" OR 8" UNDERGROUND PIPE CLAMPS W/TWO 3/4" CLAMP WASHERS
15. .75" S.S. ALL THREAD ROD OIL FINISHED FOR CLAMPS
16. WATER STOP/LINK SEAL
17. ALL HARDWARE TO BE 304 STAINLESS STEEL MIN.
18. 4", 6" OR 8" FORD OR DRESSER COUPLING

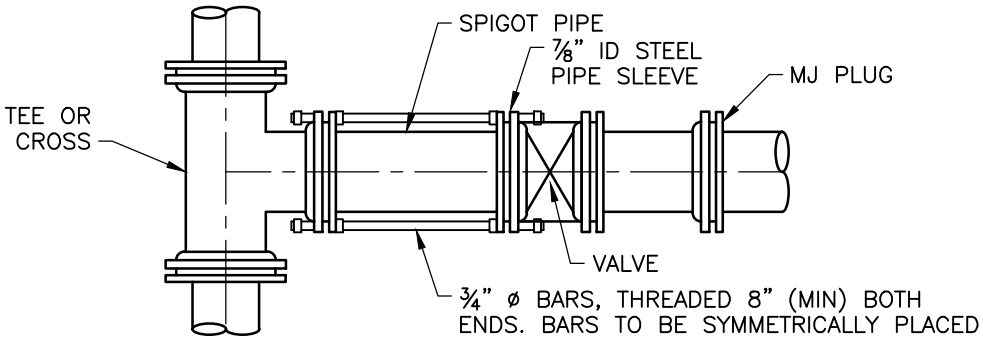
NOTES

(A) 8'–0" LENGTH OF VAULT/INSIDE
(C) THE DISTANCE FROM EACH END OF METER TO VAULT WALL IS 31.5" FOR 4" METER & 25' FOR 6" METER
(D) LENGTH F OMNI METERS/4" IS 33" & 6" IS 46"
(H) DISTANCE FROM VAULT FLOOR TO CENTER OF PIPE IS 2'–0"
(I) THE VAULT IS 6'–0" HIGH (INSIDE) MIN.

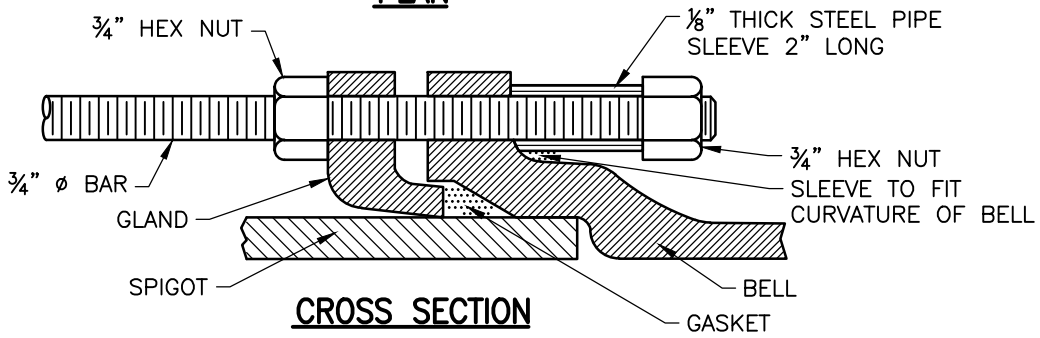
NOTES

1. CONCRETE MD SHA MIX NO. 3 SLAB THICKNESS 9". ALL SLAB BARS SHALL HAVE STANDARD HOOKS.
2. PRECAST VAULT WALLS SHALL BE 8" MIN. THICKNESS (ALL SIDES)
3. BY–PASS MAIN W/VALVES ARE REQUIRED AROUND METER OUTSIDE VAULT.
4. METER SIZE AND BY–PASS SIZE ARE TO BE SIZED BY DESIGN ENGINEER, BASED ON PROPOSED USAGE.
5. ALL METERS SHALL BE LOCATED IN A VAULT. IN AN EASEMENT OR R.O.W.
6. ALL BACK FLOW AND CROSS CONNECTION ISSUES ARE TO BE ADDRESSED AS REQUIRED BY THE CURRENT ADAPTED PLUMBING CODE FOR CARROLL COUNTY, MD.

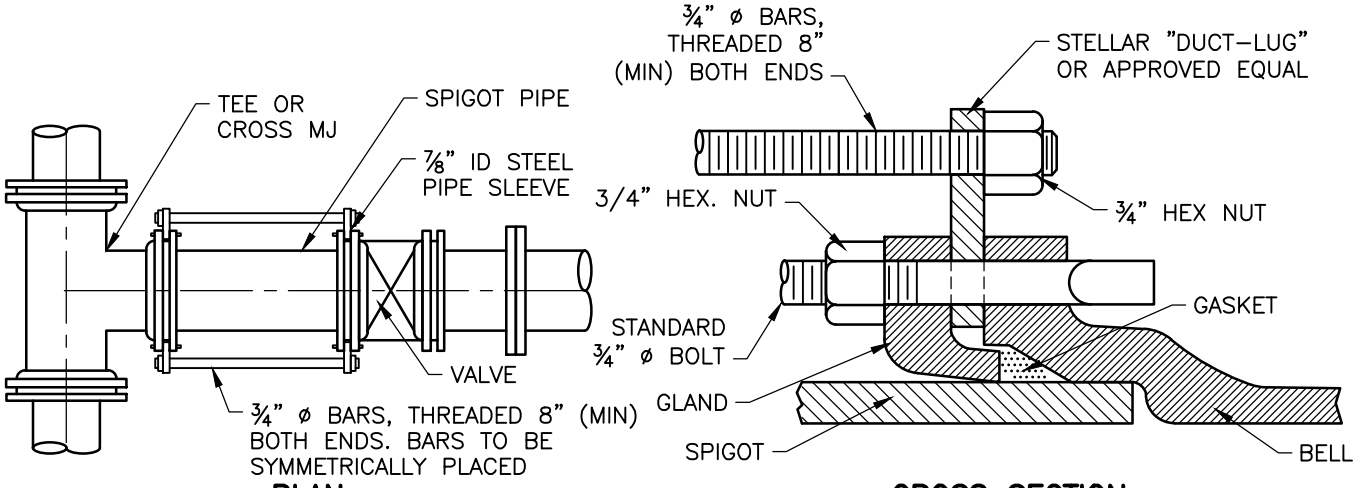
CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	FIRE & DOMESTIC METER VAULT ASSEMBLY STANDARD VAULT FOR 4", 6" & 8" FIRE METERS	STANDARD DETAIL W-15B
July 11, 2022 DATE Andrew C Watcher CHIEF		Revised 03/2022



PLAN



CROSS SECTION



PLAN

CROSS SECTION

VALVE SIZE	NUMBER OF BARS	MAX LENGTH OF SPIGOT PIPE
6"	2	27"
8"	2	27"
10"	4	27"
12"	6	27"
14"	8	36"
16"	8	36"
18"	10	36"
20"	12	36"
24"	16	36"

NOTES:
1. ALL RODS, NUTS, BOLTS, AND STRAPS SHALL BE 304 STAINLESS STEEL.
2. MEGALUG METHOD PRESENTED IN W-17 IS COUNTY'S PREFERRED MEANS TO STRAP VALVE TO MAIN.

CARROLL CNTY DEPT. OF PUBLIC WORKS
BUREAU OF UTILITIES

July 11, 2022
DATE

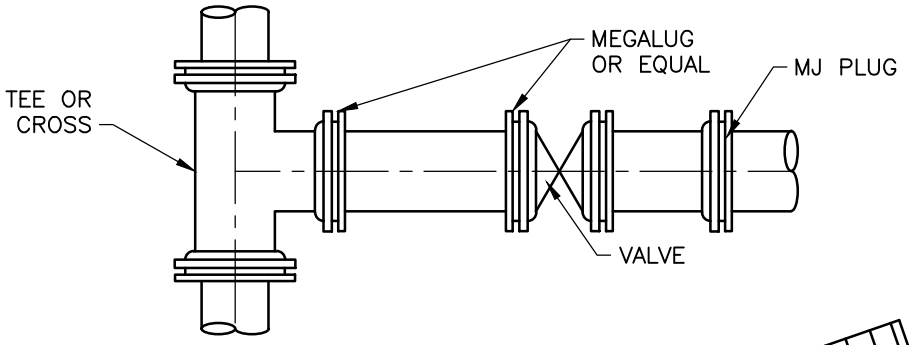
Andrew C Watcher
CHIEF

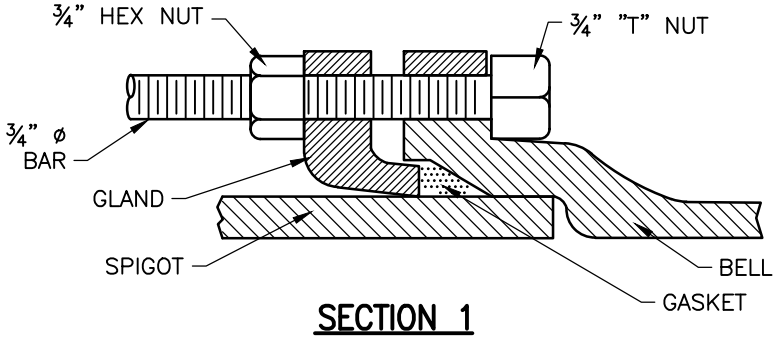
ROD METHOD OF STRAPPING VALVE TO MAIN

STANDARD DETAIL

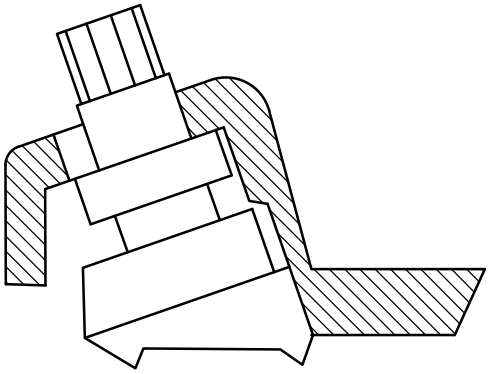
W-16

Revised 03/2022

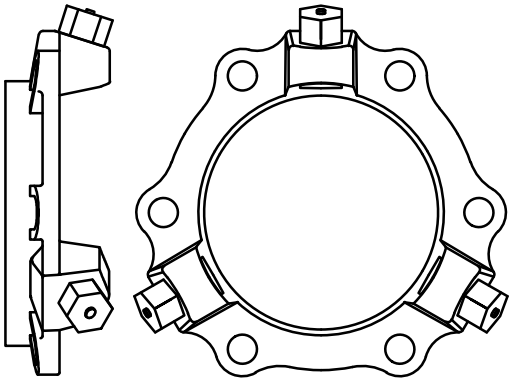




SECTION 1



SECTION 2



NOMINAL PIPE SIZE	WEDGE QTY	BOLT QTY
6	3	6
8	4	6
10	6	8
12	8	8
14	10	10
16	12	12
18	12	12
20	14	14
24	16	16

NOTES:
1. ALL MATERIALS SHALL BE 304 STAINLESS STEEL, OR FACTORY COATED TO PREVENT CORROSION.
2. RESTRAINT SHALL INCLUDE RETAINER GLAND SIMILAR DETAIL W–16.

CARROLL CNTY DEPT. OF PUBLIC WORKS
BUREAU OF UTILITIES

July 11, 2022
DATE

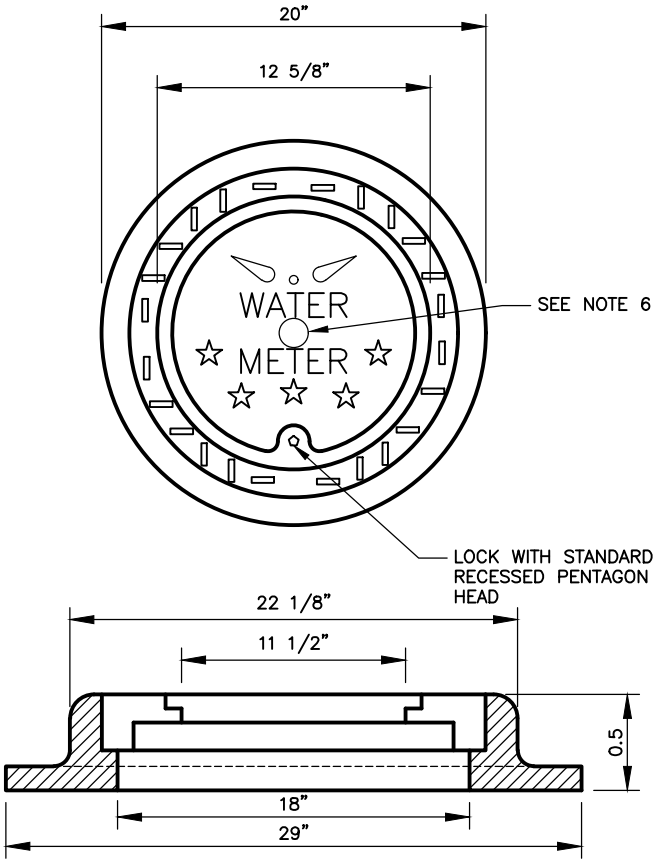
Andrew C Watcher
CHIEF

MEGALUG METHOD OF STRAPPING VALVE TO MAIN

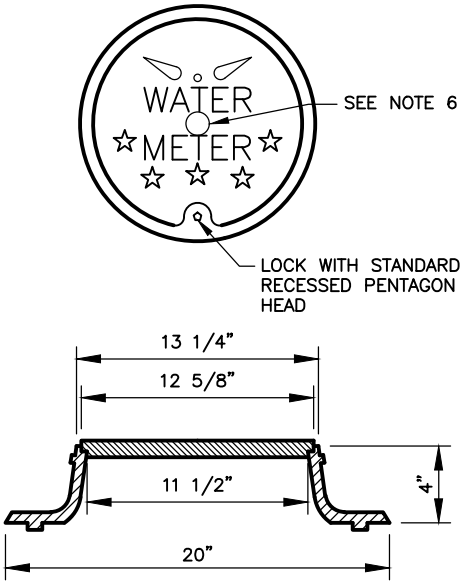
STANDARD DETAIL

W-17

Revised 03/2022



18"x12" METER FRAME AND COVER CAST IRON

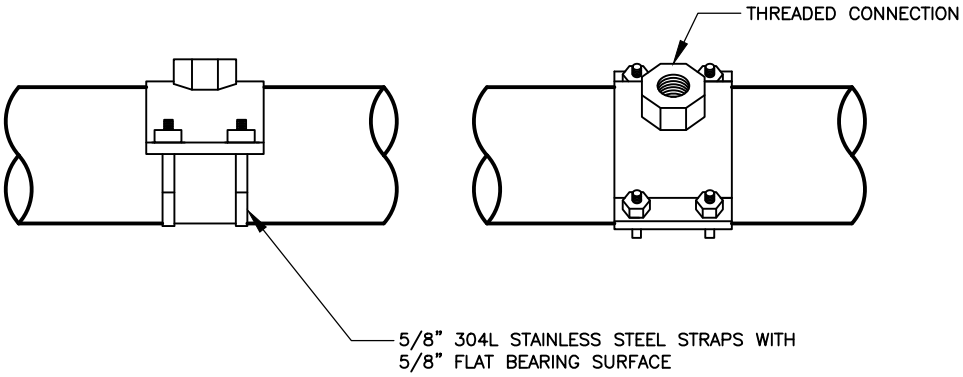


12" METER FRAME AND COVER CAST IRON

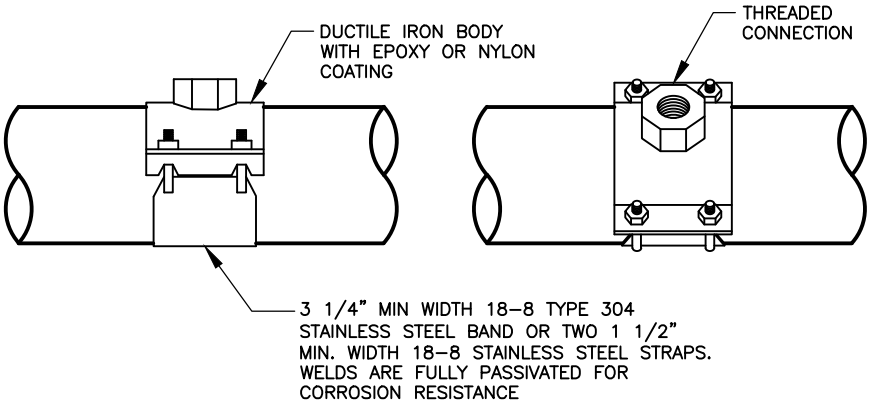
NOTES:

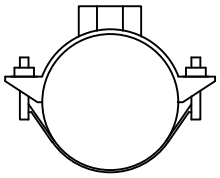
1. 12" METER FRAME AND COVER FOR USE WITH EXISTING WATER SERVICES FOR PURPOSE OF RELOCATION, TYPE "A" FRAME AND COVER (RECESSED).
2. 18"x12" METER FRAME AND COVER FOR USE WITH SECTIONAL CONCRETE VALVE VAULTS.
3. ALL STANDARD FRAME & COVER MATERIAL SHALL BE CAST IRON AND SHALL CONFORM TO ASTM A48, CLASS 30.
4. THE USE OF ADJUSTABLE FRAME AND COVER IS ALSO ACCEPTABLE.
5. EXTENSION RINGS FOR ADAPTING THE 12" METER FRAME TO THE VAULT SHALL BE USED.
6. SINGLE 2" DIAMETER HOLE FOR RADIO READ METERS WITH PLUG.

CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES July 11, 2022 DATE Andrew C Watcher CHIEF	WATER METER FRAME AND COVER	STANDARD DETAIL W-18 Revised 03/2022



METAL PIPE



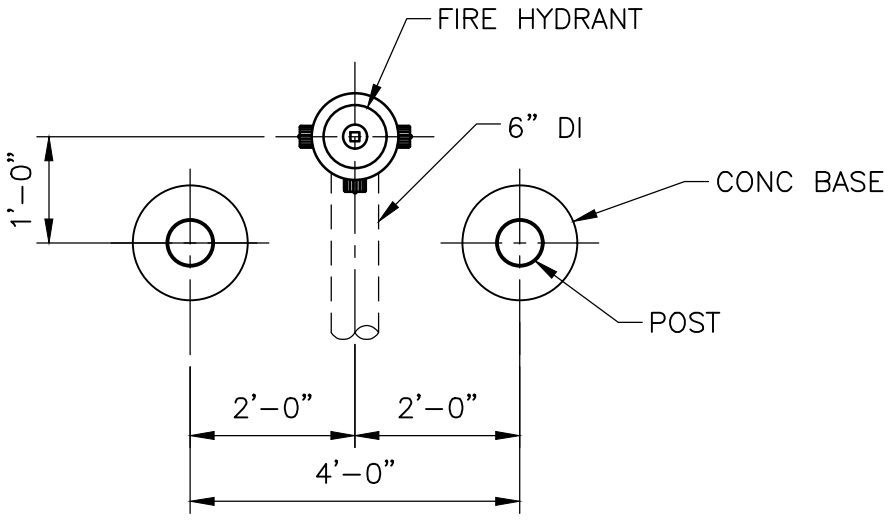


PLASTIC PIPE

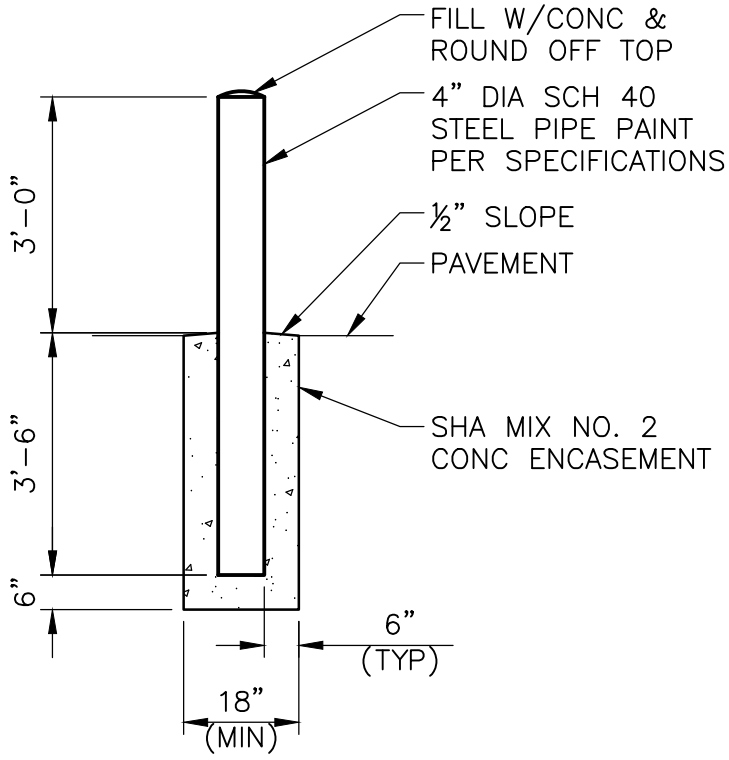
NOTES:

1. SADDLE SHALL CONFORM TO ANSI/NSF STANDARD 61.
2. PLASTIC PIPE SADDLE SHALL CONFORM TO THE RECOMMENDATION OF UNI-BELL HANDBOOK OF PVC PIPE AND AWWA MANUAL M23.
3. TIGHTEN SADDLE PER MANUFACTURER'S REQUIREMENTS.
4. NUTS SHALL BE 1/2" TO 5/8" HEAVY HEX NUTS AND WASHERS AND SHALL BE COATED TO PREVENT GALLING.
5. GASKETS SHALL BE RUBBER PER ASTM D2000.

CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES July 11, 2022 DATE Andrew C Watcher CHIEF	WATER METER WATER SERVICE SADDLE 3/4" THRU 2"	STANDARD DETAIL W-19 Revised 03/2022

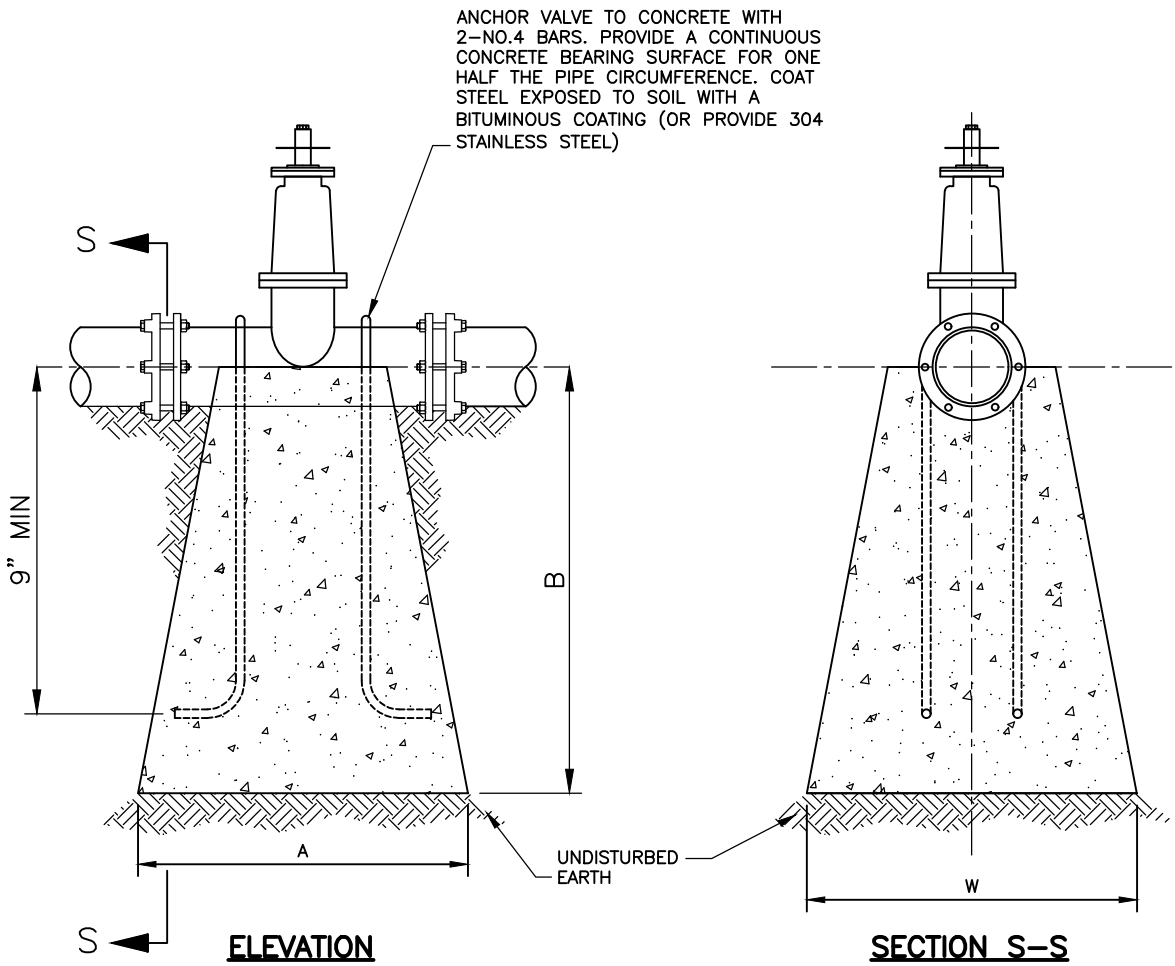


PLAN



SECTION

CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	METHOD OF PROTECTING FIRE HYDRANT	STANDARD DETAIL W-20
July 11, 2022 DATE Andrew C Watcher CHIEF		Revised 03/2022



NOTE:
CONCRETE TO BE MIX NO. 2.

PIPE SIZE	A	B	W
4"	10"	1'–0"	1'–6"
6"	1'–0"	1'–6"	1'–6"
8"	1'–6"	2'–0"	2'–0"
12"	2'–0"	2'–0"	3'–0"

CARROLL CNTY DEPT. OF PUBLIC WORKS
BUREAU OF UTILITIES

July 11, 2022
DATE

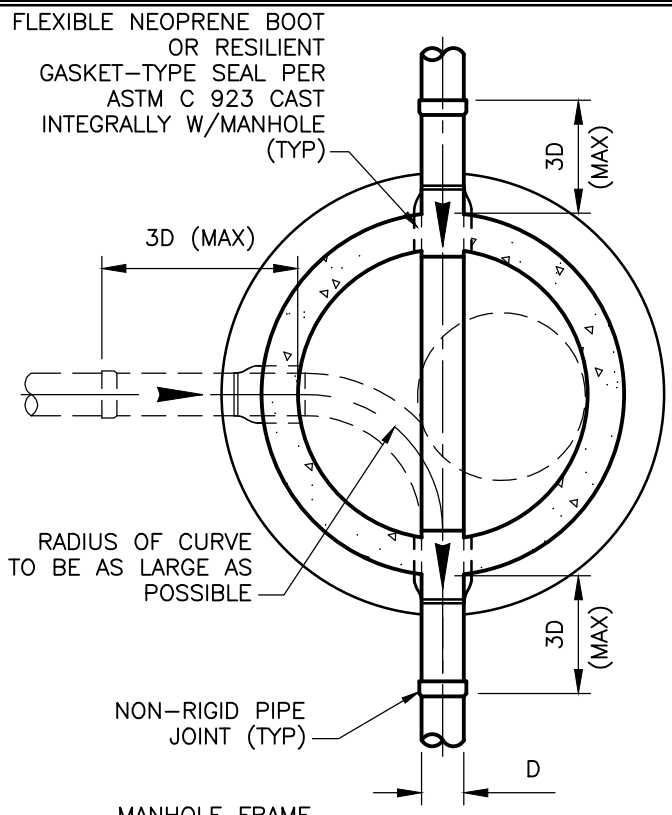
Andrew C Watcher
CHIEF

PVC WATER MAIN
VALVE ANCHORAGE

STANDARD DETAIL

W-21

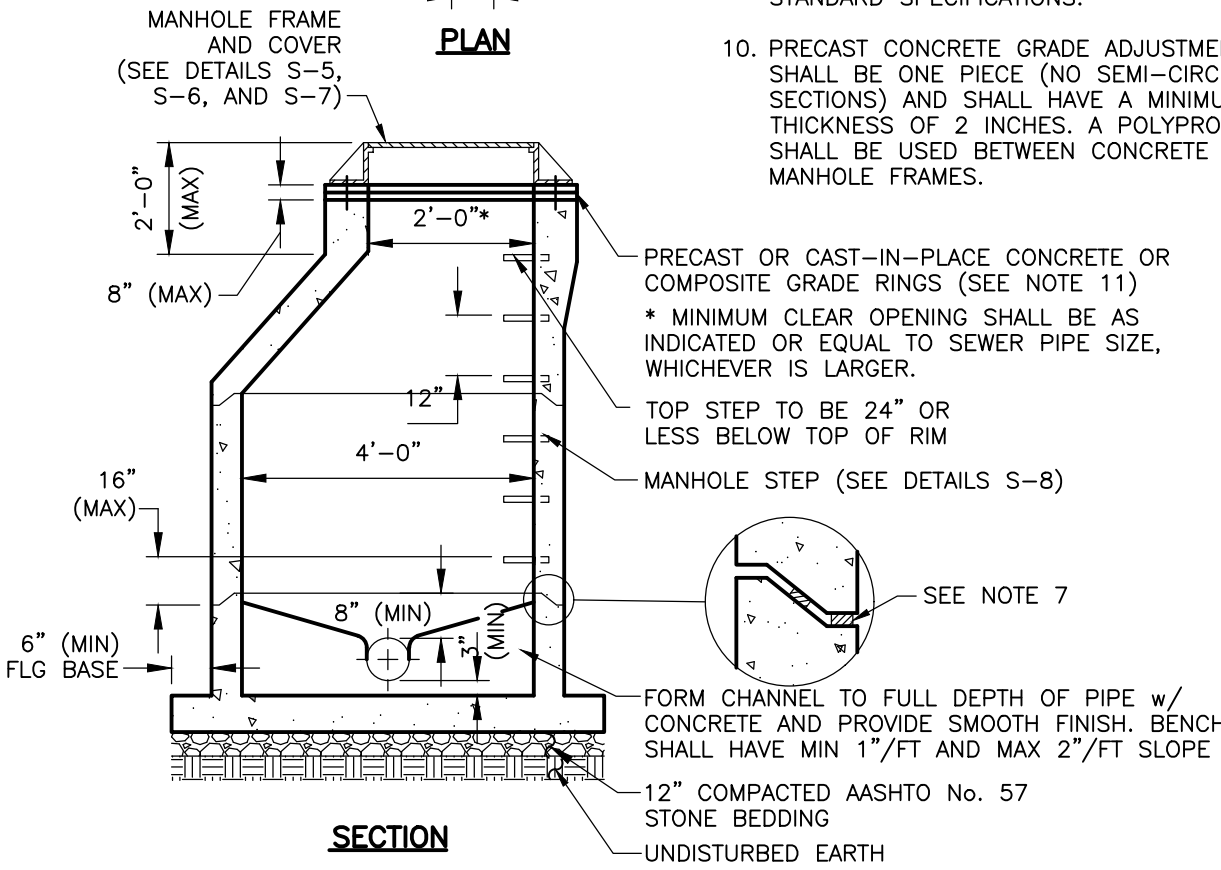
Revised 03/2022



PLAN

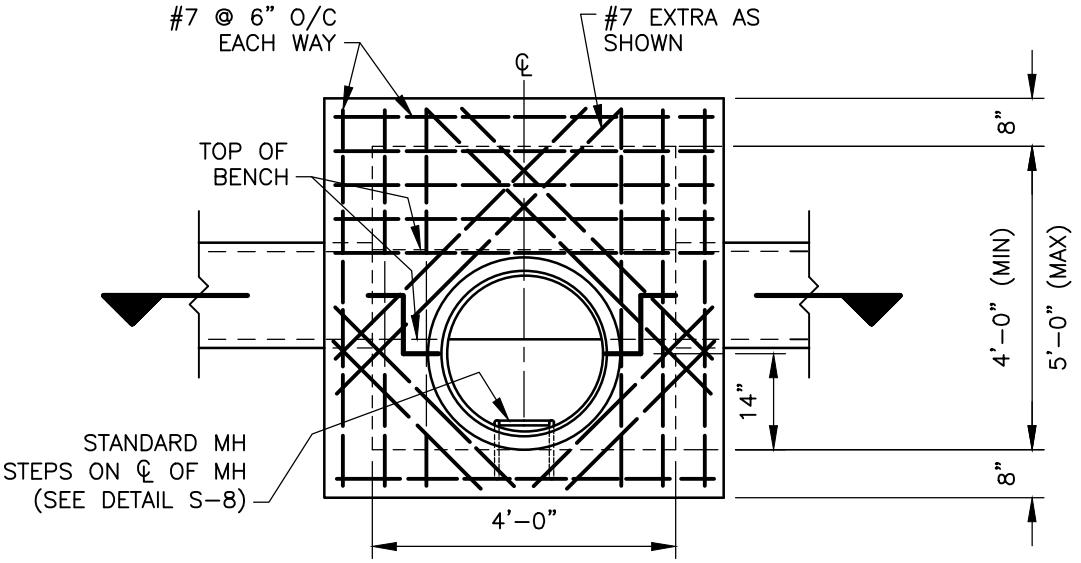
NOTES:

1. WHERE PIPE CROWN IS GREATER THAN 4'–6" DEEP UTILIZE STANDARD PRECAST CONCRETE MANHOLE.
2. ALL PRECAST REINFORCED CONCRETE MANHOLE SECTIONS SHALL COMPLY WITH STANDARD SPECIFICATIONS.
3. CEMENT SHALL BE TYPE II OR III, AIR ENTRAINED, WITH 4,000 psi AT 28 DAYS PER ASTM C476.
4. REINFORCEMENT SHALL BE GRADE 60 PER ASTM A–615.
5. FRAME TO BE BOLTED TO MANHOLE WITH 5/8" ANCHOR BOLTS.
6. GRADE RINGS TO BE SEALED TO MANHOLE WITH BUTYL RUBBER SEALANT ON BOTH MATING SURFACES.
7. ALL JOINTS SHALL BE SEALED WITH TWO RINGS OF BUTYL RUBBER SEALANT ON BOTH MATING SURFACES.
8. COAT MANHOLE EXTERIOR WITH DAMP PROOFING.
9. COAT MANHOLE INTERIOR AS DETERMINED IN STANDARD SPECIFICATIONS.
10. PRECAST CONCRETE GRADE ADJUSTMENT RINGS SHALL BE ONE PIECE (NO SEMI–CIRCULAR SECTIONS) AND SHALL HAVE A MINIMUM THICKNESS OF 2 INCHES. A POLYPROPYLENE RING SHALL BE USED BETWEEN CONCRETE AND MANHOLE FRAMES.

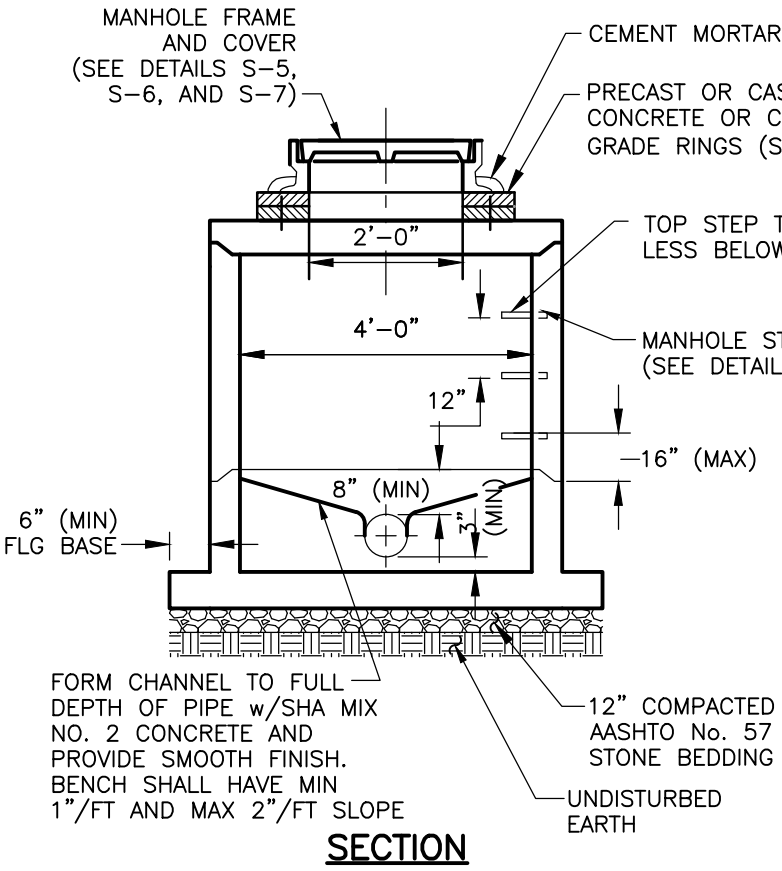


SECTION

CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	STANDARD PRECAST CONCRETE MANHOLE	STANDARD DETAIL S-1
July 11, 2022 DATE Andrew C Watcher CHIEF		Revised 03/2022



PLAN

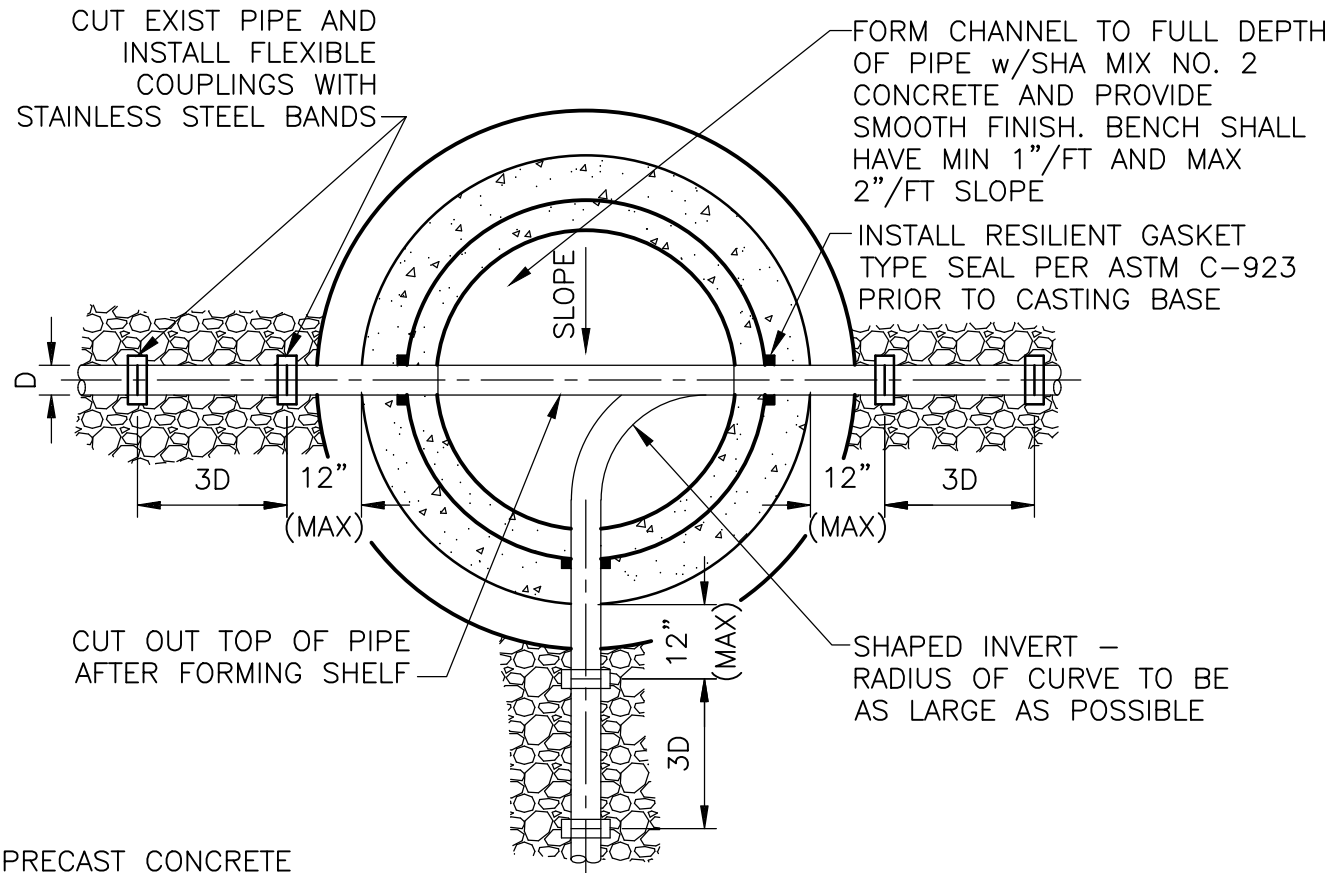


SECTION

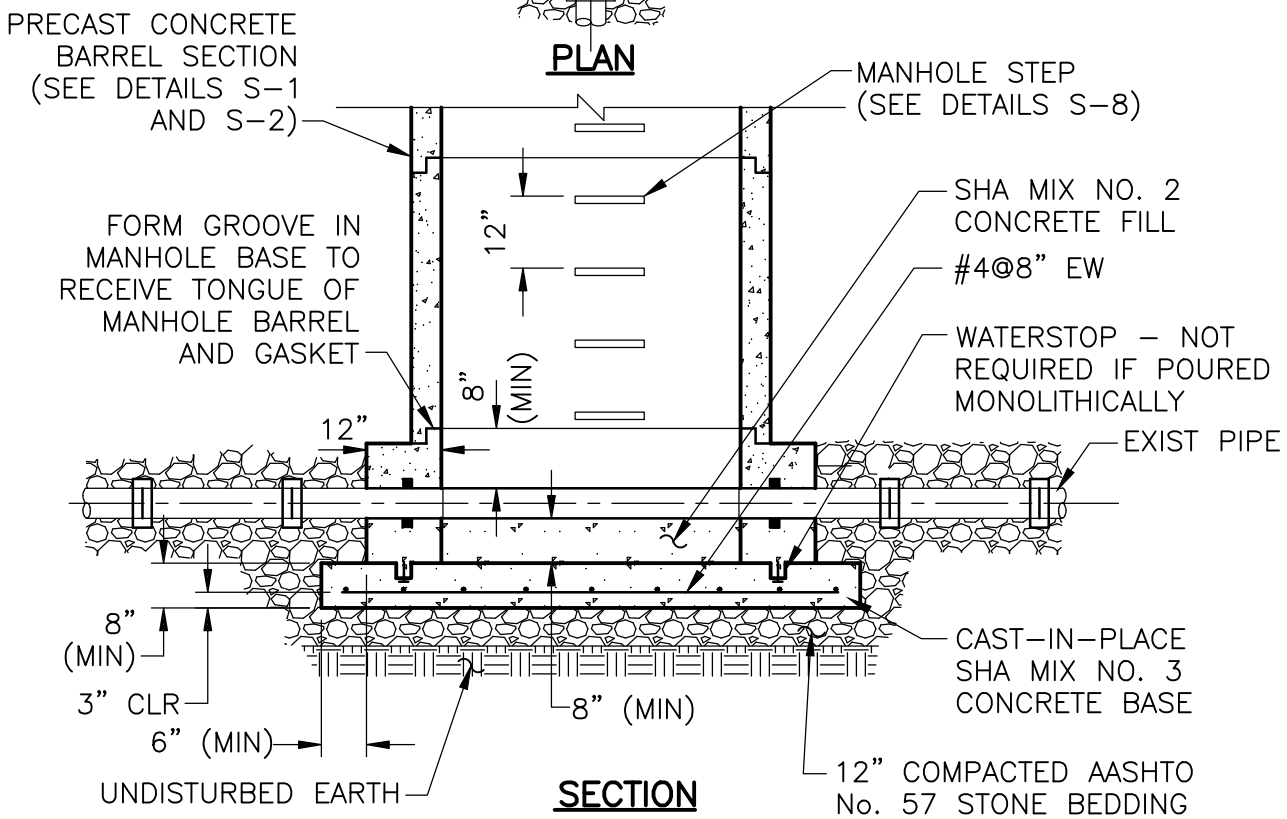
NOTES:

1. WHERE PIPE CROWN IS LESS THAN 4'-6" DEEP UTILIZE SHALLOW PRECAST CONCRETE MANHOLE.
2. PRECAST BARREL AND BASE MANHOLE SECTIONS TO CONFORM WITH STANDARD PRECAST MANHOLE REQUIREMENTS.
3. PRECAST CONCRETE GRADE ADJUSTMENT RINGS SHALL BE ONE PIECE (NO-SEMI-CIRCULAR SECTIONS) AND SHALL HAVE A MINIMUM THICKNESS OF 2 INCHES. A POLYPROPYLENE RING SHALL BE USED BETWEEN CONCRETE AND MANHOLE FRAMES.

CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	PRECAST SHALLOW MANHOLE	STANDARD DETAIL S-2
July 11, 2022 DATE Andrew C Watcher CHIEF		Revised 03/2022

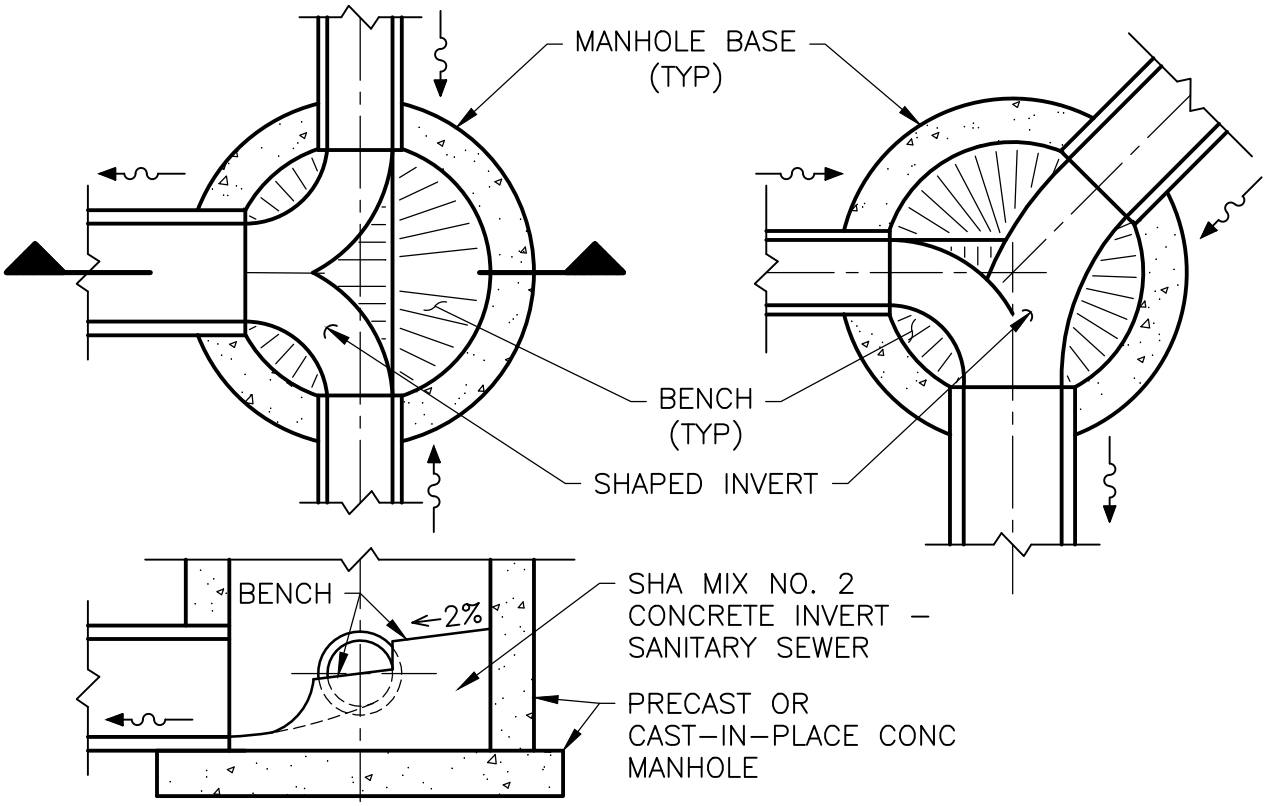


PLAN

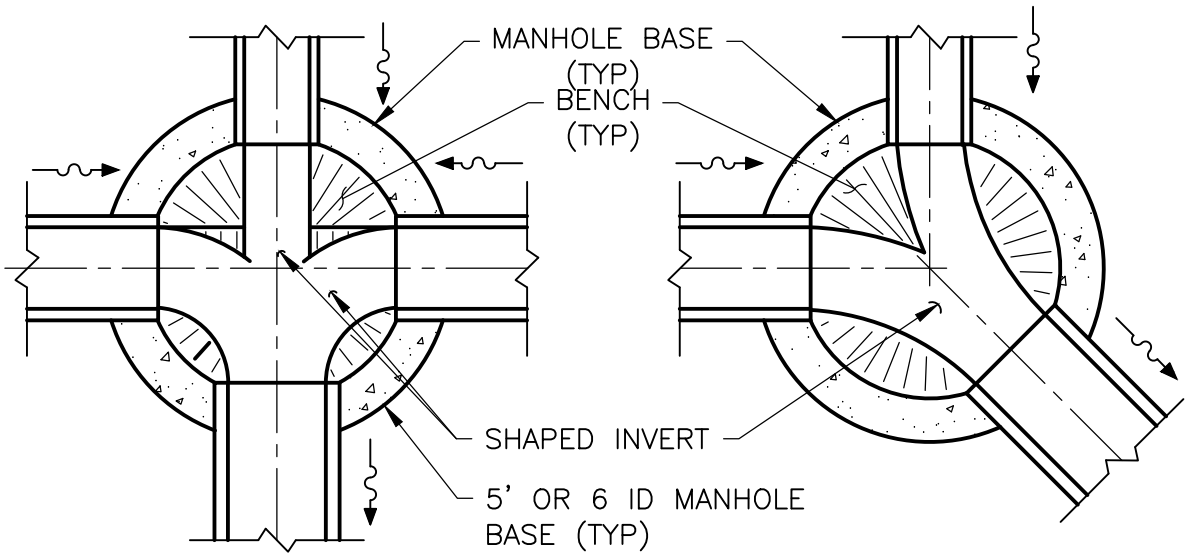


SECTION

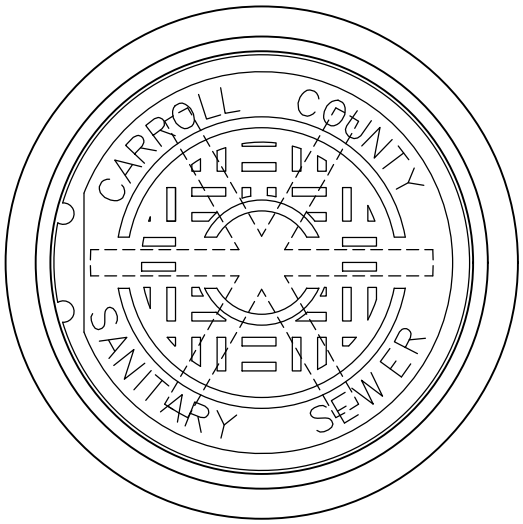
CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	DOGHOUSE MANHOLE	STANDARD DETAIL S-3
July 11, 2022 DATE *Andrew C Watcher* CHIEF		Revised 03/2022



SECTION



CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	MANHOLE CHANNEL ALIGNMENTS	STANDARD DETAIL S-4
July 11, 2022 DATE *Andrew C Watcher* CHIEF		Revised 03/2022



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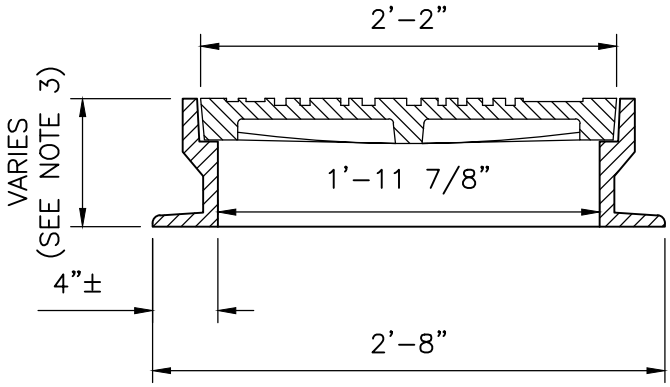
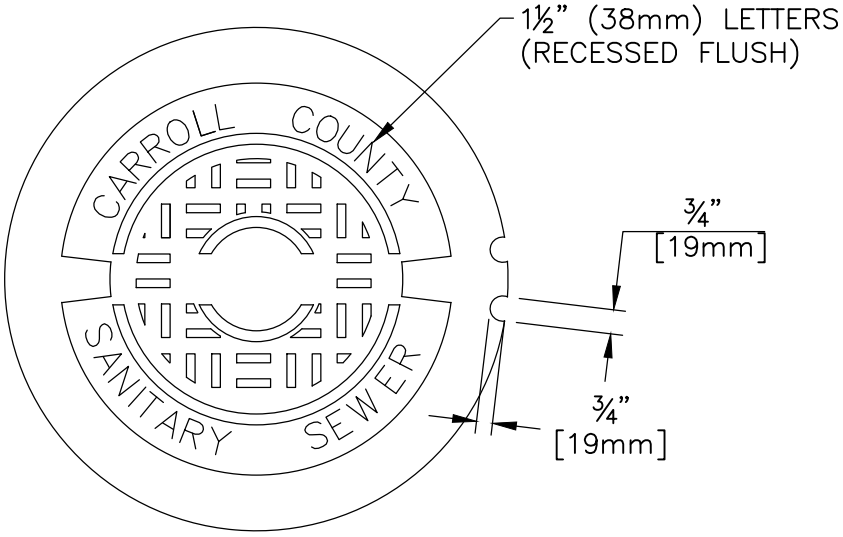
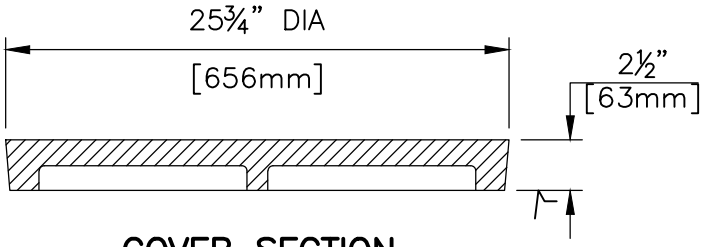


SECTION

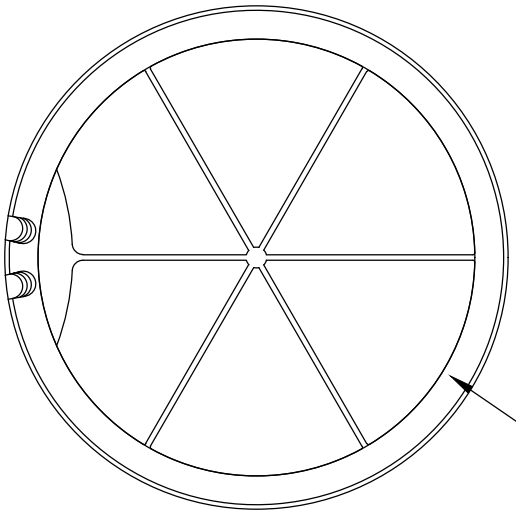
NOTES:
1. MANHOLE COVERS TO BE FURNISHED WITHOUT VENT HOLES.
2. TOTAL AVERAGE WEIGHT 400 LBS.
3. VARIOUS FRAME HEIGHTS ACCEPTABLE SO LONG AS OTHER SPECIFICATION REQUIREMENTS ARE MET.
4. MATERIAL USED WILL BE SIMILAR TO ASTM SPEC. A–48, CLASS 30 CAST IRON.

CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	HEAVY TRAFFIC MANHOLE FRAME	STANDARD DETAIL S-5
July 11, 2022 DATE Andrew C Watcher CHIEF		Revised 03/2022

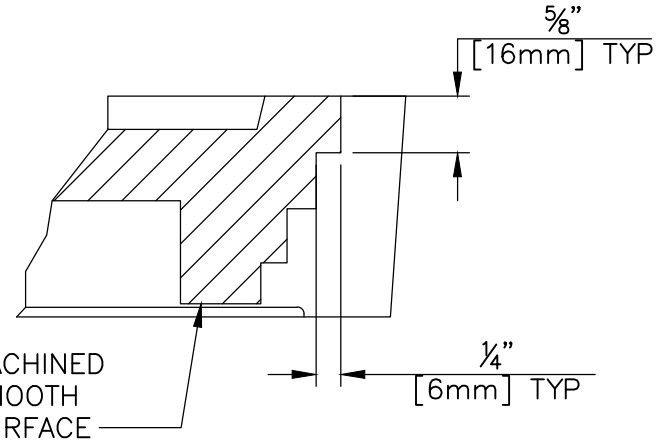




COVER SECTION

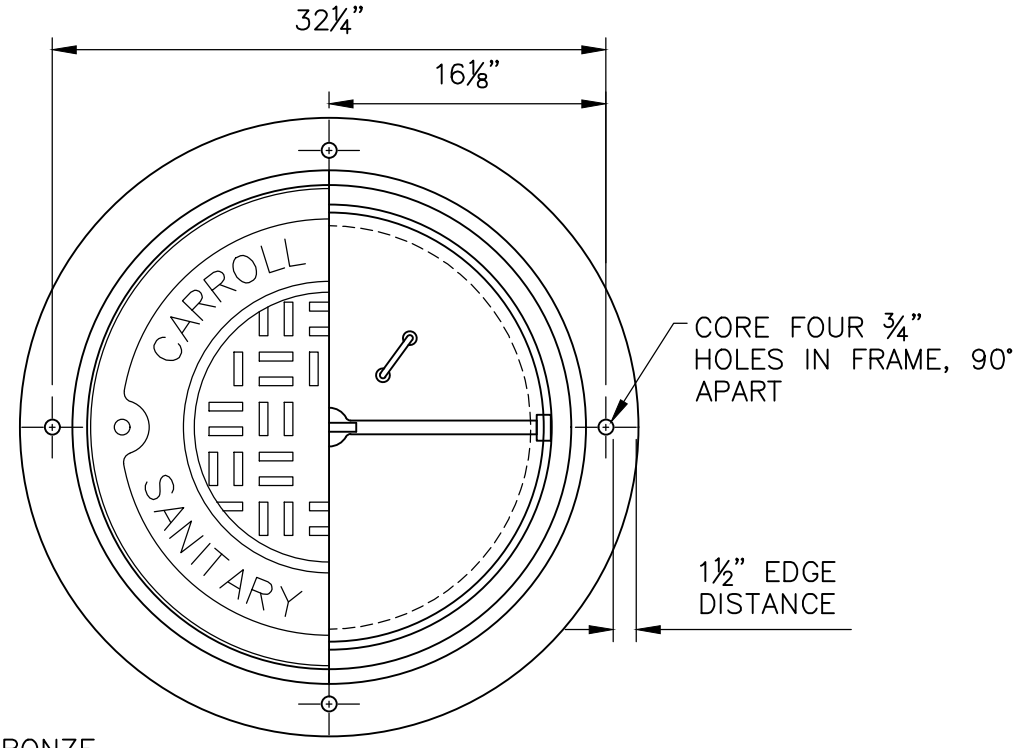


BOTTOM VIEW OF COVER

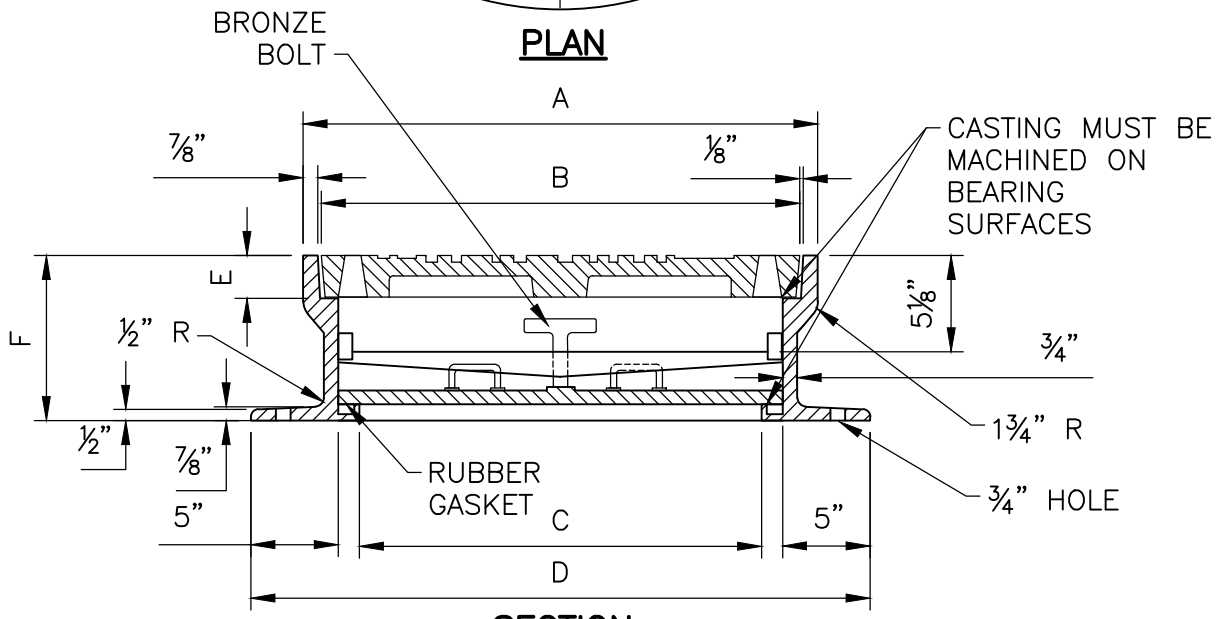


DETAIL OF PICKHOLE

CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES July 11, 2022 DATE Andrew C Watcher CHIEF	HEAVY DUTY MANHOLE COVER	STANDARD DETAIL S-6 Revised 03/2022



PLAN

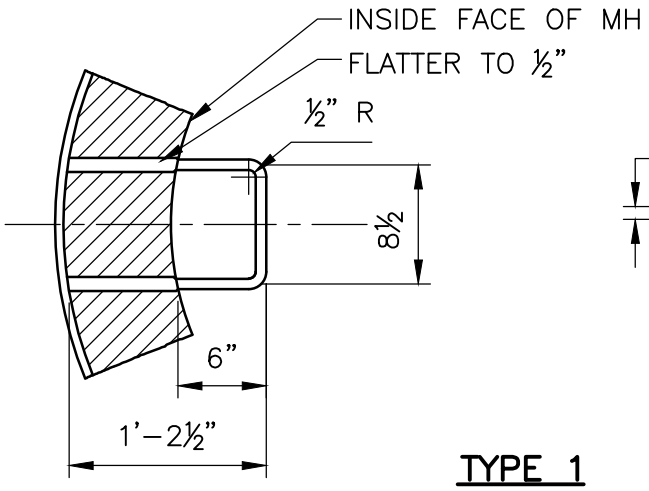


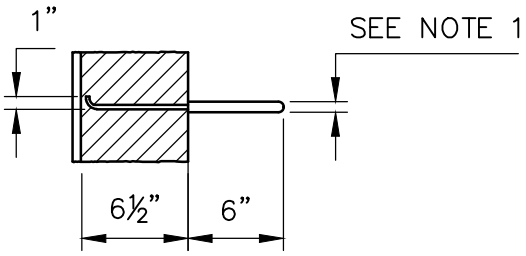
SECTION

A	B	C	D	E	F	WEIGHT
29⅞"	27⅞"	24"	36"	2½"	VARIES	575 LBS

NOTES:
1. MATERIAL USED WILL BE SIMILAR TO ASTM SPEC. A–48, CLASS 30 CAST IRON.
2. VARIOUS FRAME HEIGHTS ACCEPTABLE SO LONG AS OTHER SPECIFICATION REQUIREMENTS ARE MET.

CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	WATERTIGHT MANHOLE FRAME & COVER	STANDARD DETAIL S-7
July 11, 2022 DATE Andrew C Watcher CHIEF		Revised 03/2022





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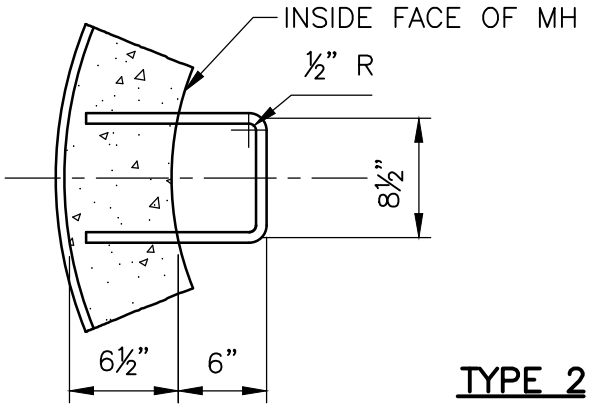
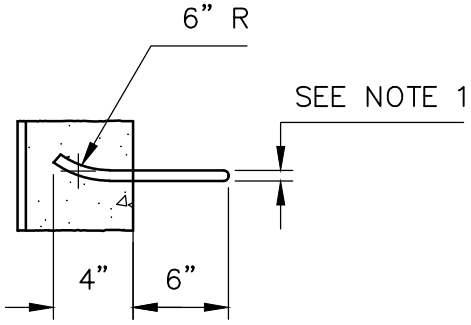
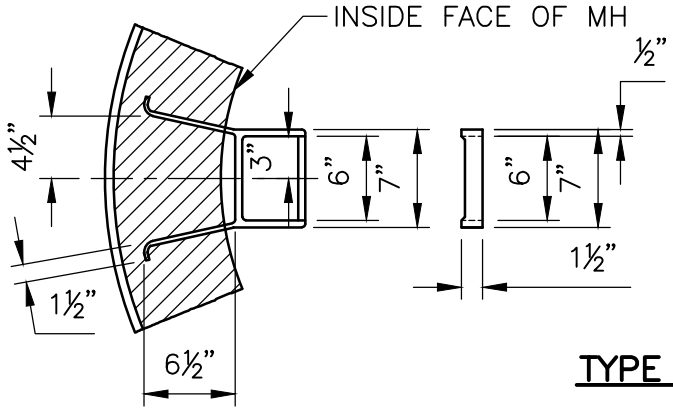
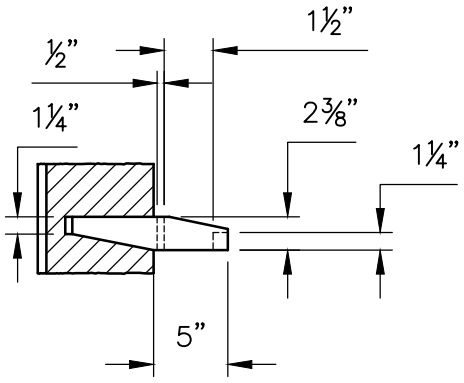




TYPE 2

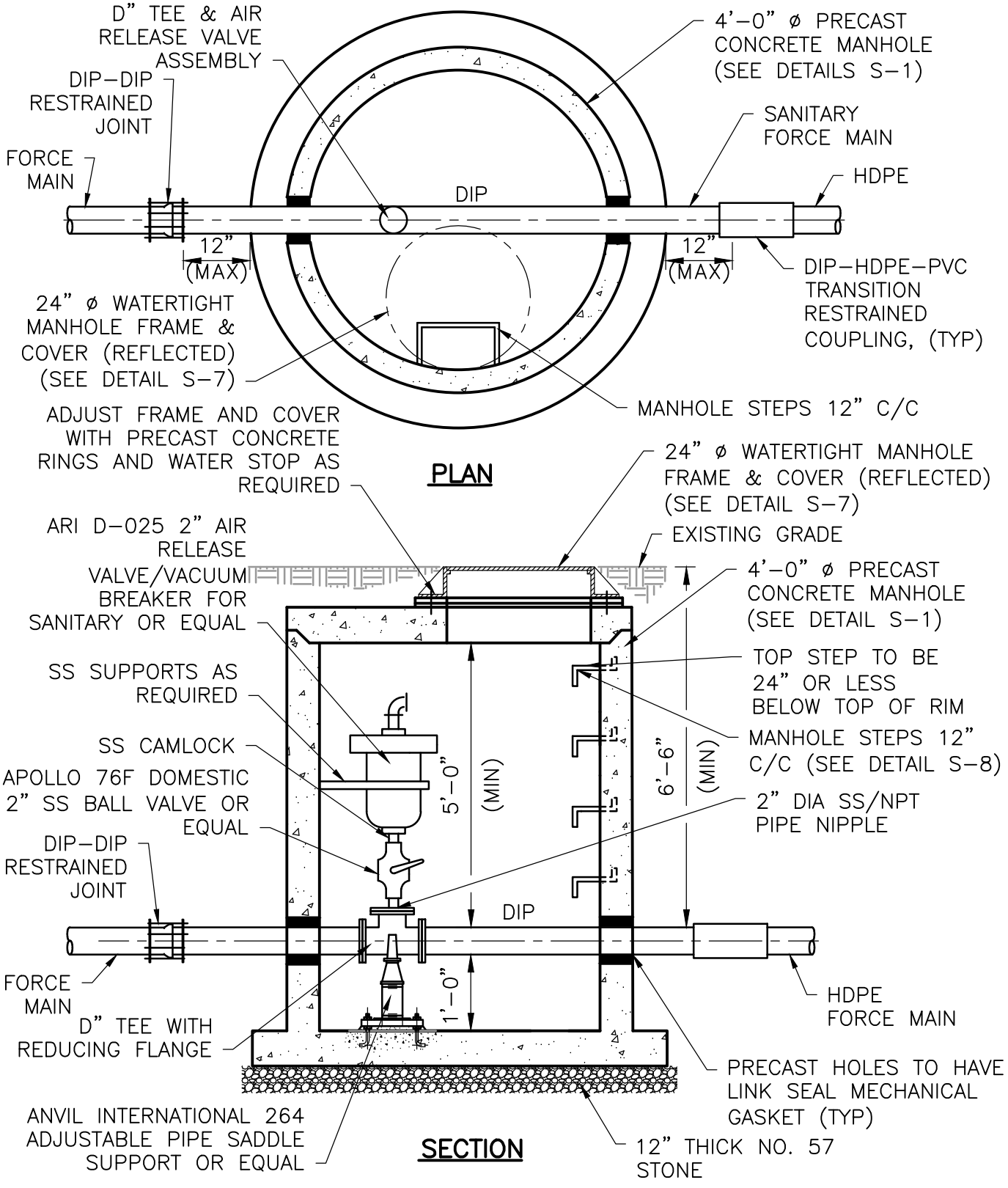




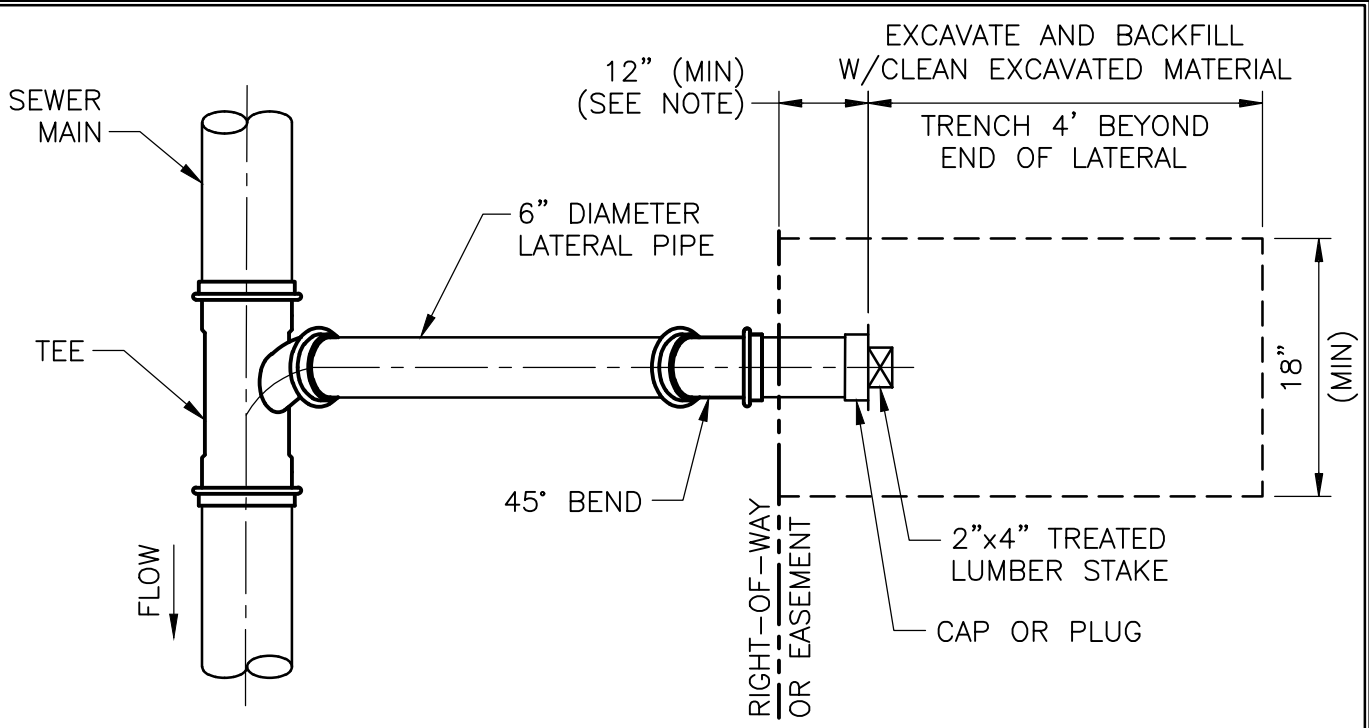
TYPE 3

NOTE:
1. MANHOLES RUNGS SHALL BE ½" DIAMETER STEEL REINFORCED COPOLYMER POLYPROPYLENE PLASTIC OR 3/4" EXTENDED ALUMINUM.

CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	MANHOLE RUNG	STANDARD DETAIL S-8
July 11, 2022 DATE Andrew C Watcher CHIEF		Revised 03/2022



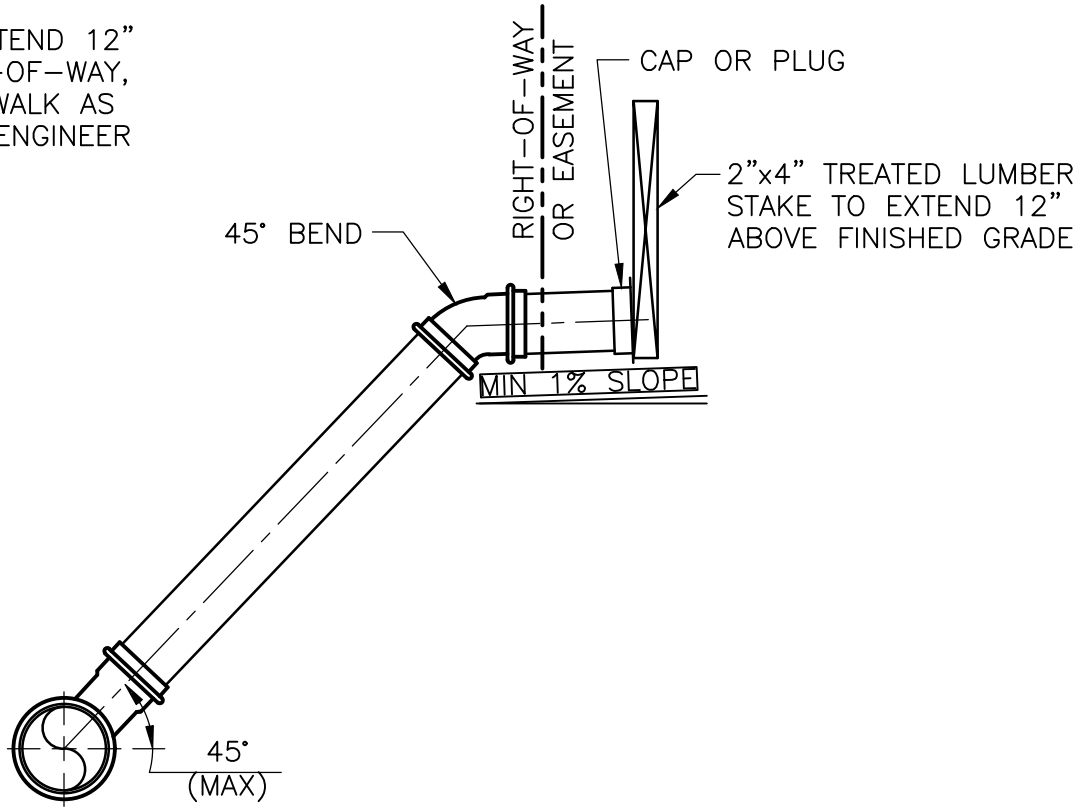
CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	AIR RELEASE VALVE VAULT	STANDARD DETAIL S-9
July 11, 2022 DATE Andrew C Watcher CHIEF		Revised 03/2022



PLAN

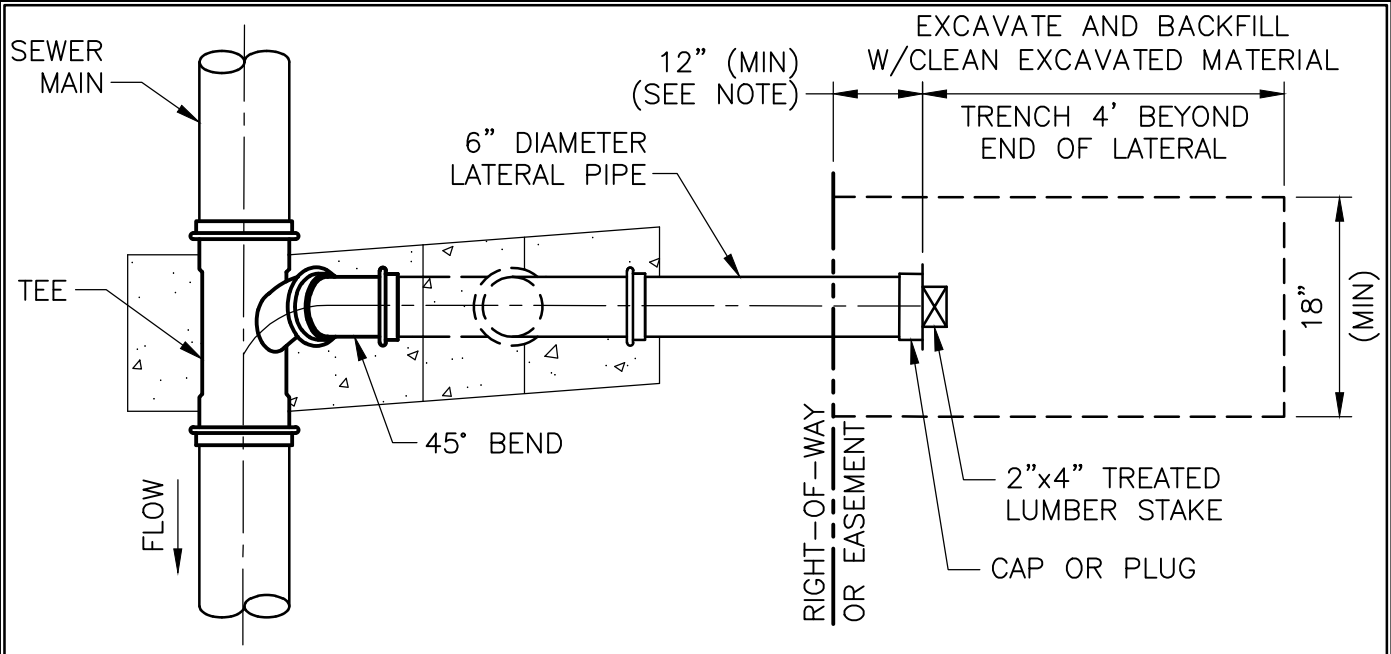
NOTE:

LATERAL TO EXTEND 12" BEYOND RIGHT-OF-WAY, CURB OR SIDEWALK AS APPROVED BY ENGINEER

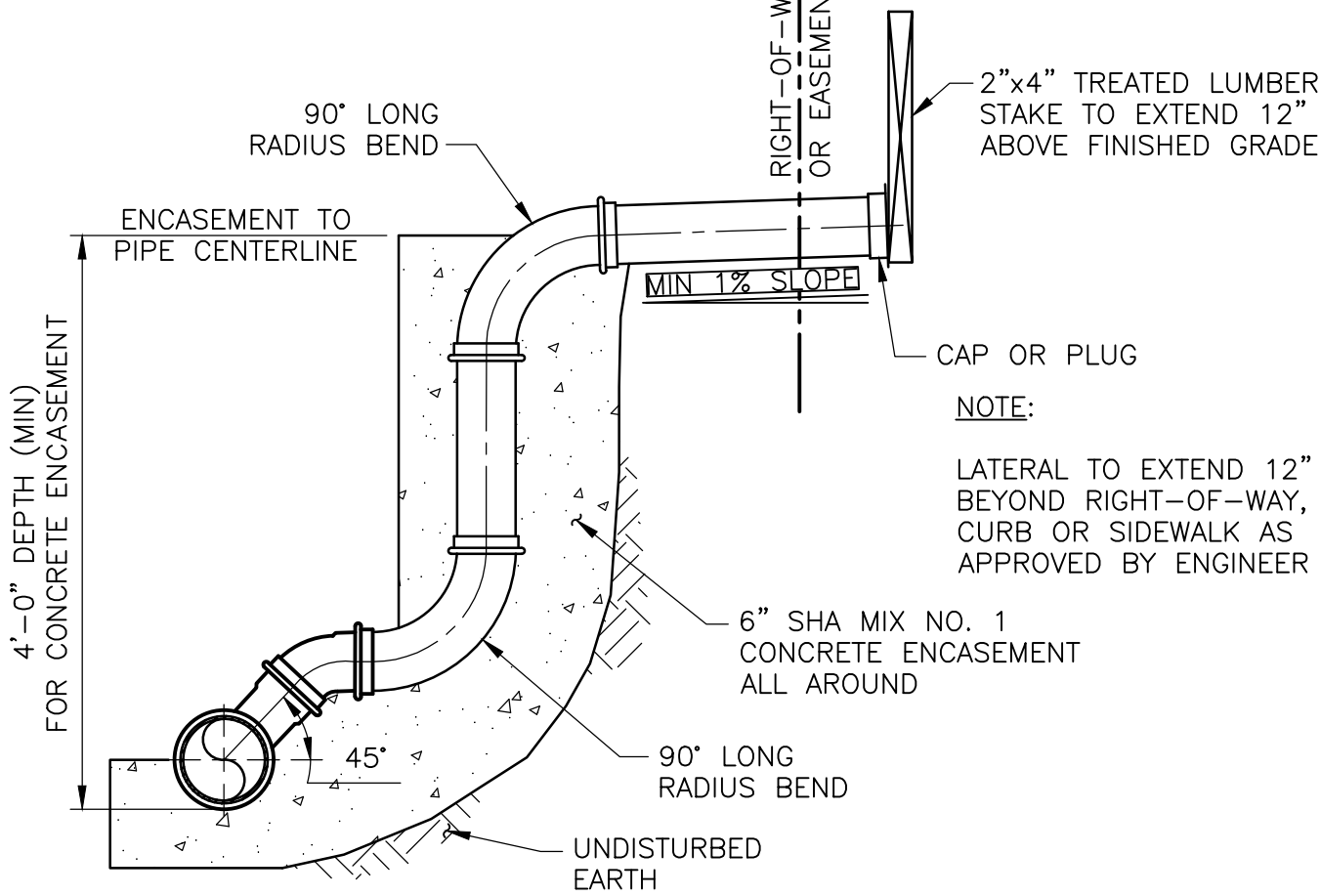


SECTION

CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	STANDARD HOUSE CONNECTIONS	STANDARD DETAIL S-10
July 11, 2022 DATE Andrew C Watcher CHIEF		Revised 03/2022



PLAN

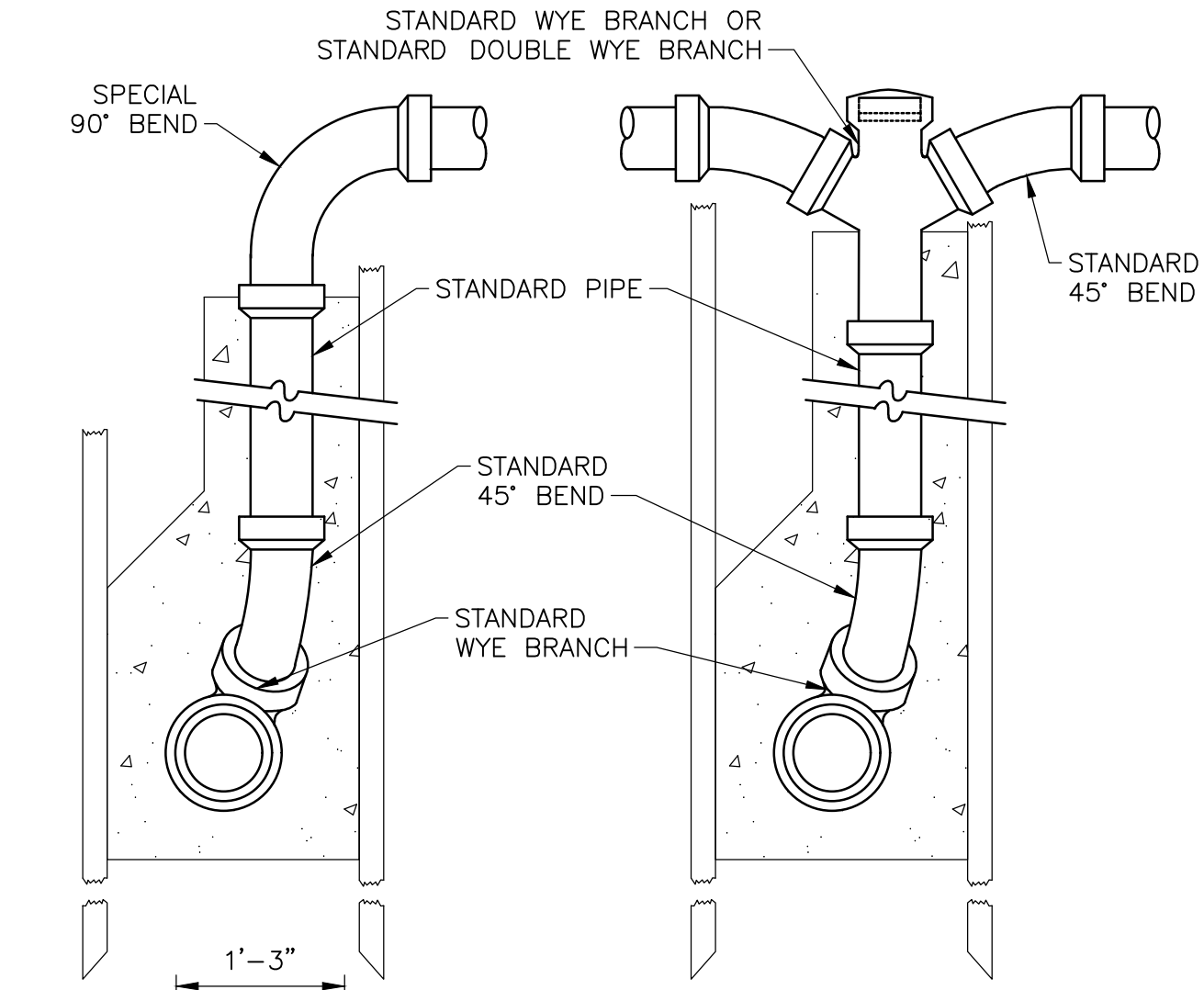


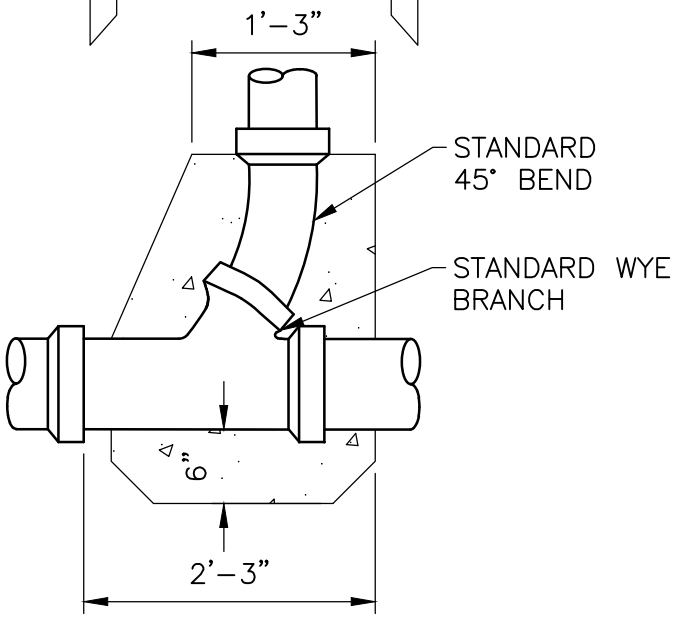
NOTE:

LATERAL TO EXTEND 12" BEYOND RIGHT-OF-WAY, CURB OR SIDEWALK AS APPROVED BY ENGINEER

SECTION

CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	LATERAL CONNECTION RISER WITH CONCRETE ENCASEMENT	STANDARD DETAIL S-11
July 11, 2022 DATE Andrew C Watcher CHIEF		Revised 03/2022

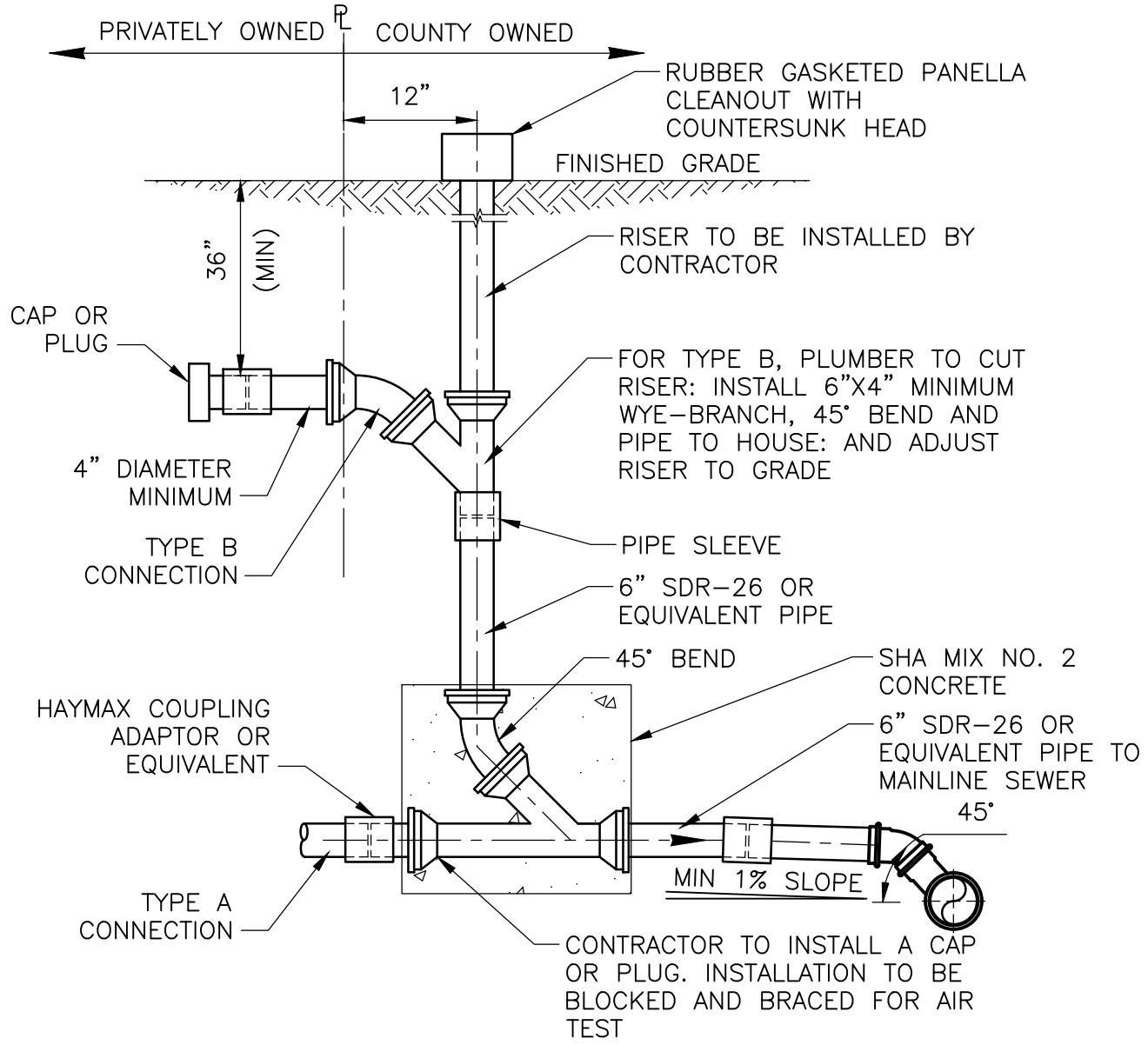




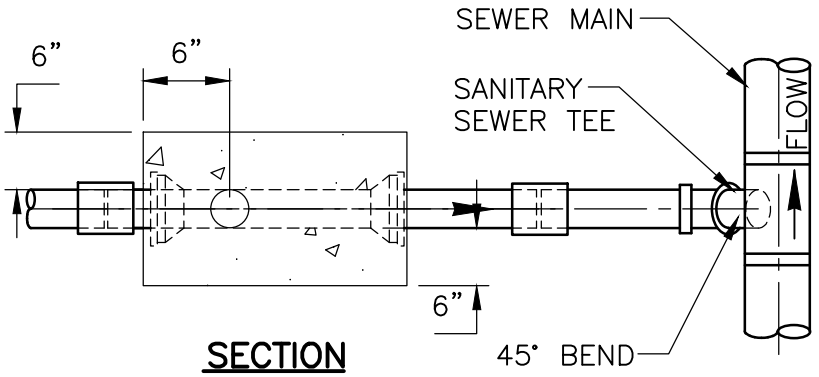
NOTES:

1. USE ALL PVC SDR 26 FITTING INCLUDING SEWER WYE.
2. ENCASE RISER IN SHA MIX NO. 1 CONCRETE UTILIZING BRACED 14" DIAMETER SONOTUBE OR APPROVED EQUAL.

CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	DROP HOUSE CONNECTION	STANDARD DETAIL S-12
July 11, 2022 DATE Andrew C Watcher CHIEF		Revised 03/2022



ELEVATION

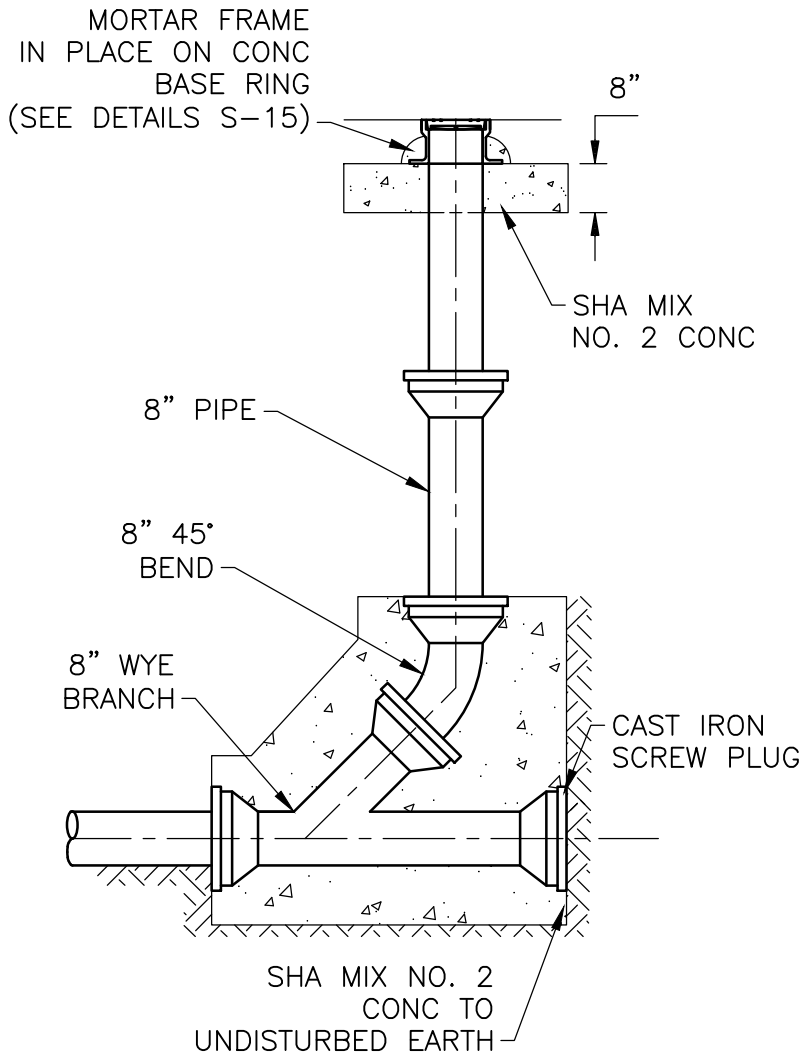


SECTION

NOTES:

1. MATERIAL TO BE SDR 26, OR EQUIVALENT. ALL JOINTS TO BE PUSH ON RUBBER GASKET JOINTS.
2. ALL LATERAL TO BE DYE TESTED AND ONLY ACTIVE LATERAL ARE TO BE REPLACED.
3. NON-ACTIVE LATERALS AND CLEANOUTS TO BE ABANDONED.

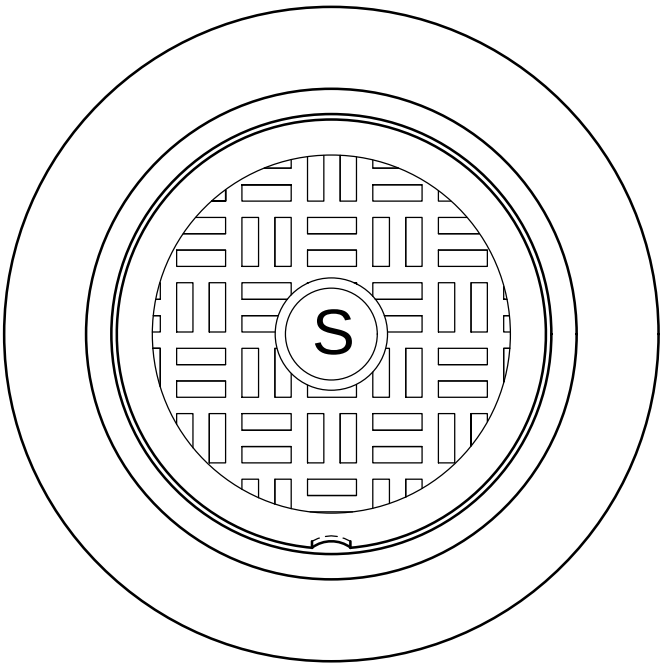
CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	CLEANOUT FOR HOUSE CONNECTION	STANDARD DETAIL S-13
July 11, 2022 DATE	*Andrew C Watcher* CHIEF	Revised 03/2022



NOTES:

1. ALL MATERIAL TO BE DUCTILE IRON PIPE.
2. PVC PIPE SHALL BE EMBEDDED IN STONE TO THE CONCRETE FRAME BASE.
3. REFERENCE DETAIL S–15 FOR FRAME AND COVER DIMENSIONS, AND ADDITIONAL INSTALLATION REQUIREMENTS.

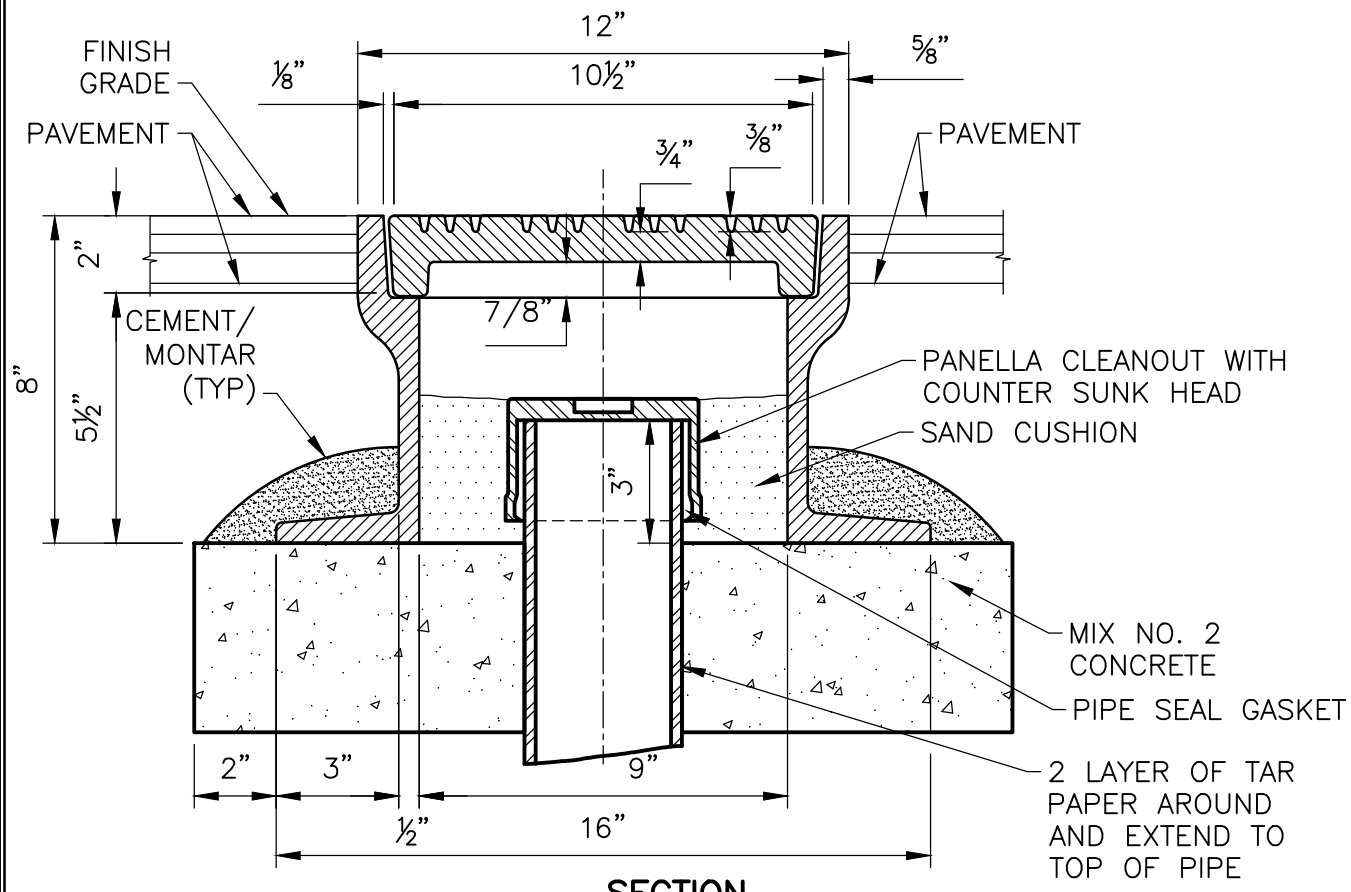
CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	MAIN LINE CLEANOUT	STANDARD DETAIL S-14
July 11, 2022 DATE Andrew C Watcher CHIEF		Revised 03/2022



NOTE:

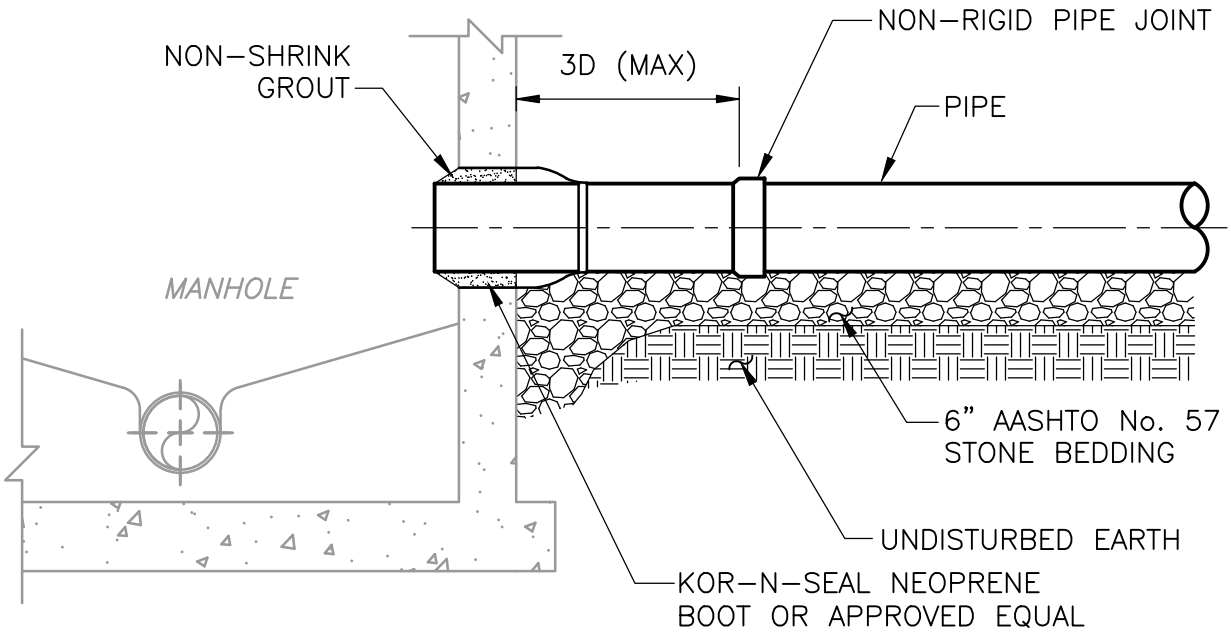
1. ASSEMBLY TO BE USED IN ROADWAYS, SIDEWALK, DRIVEWAYS, AND ALL OTHER PAVED AREAS.

PLAN



SECTION

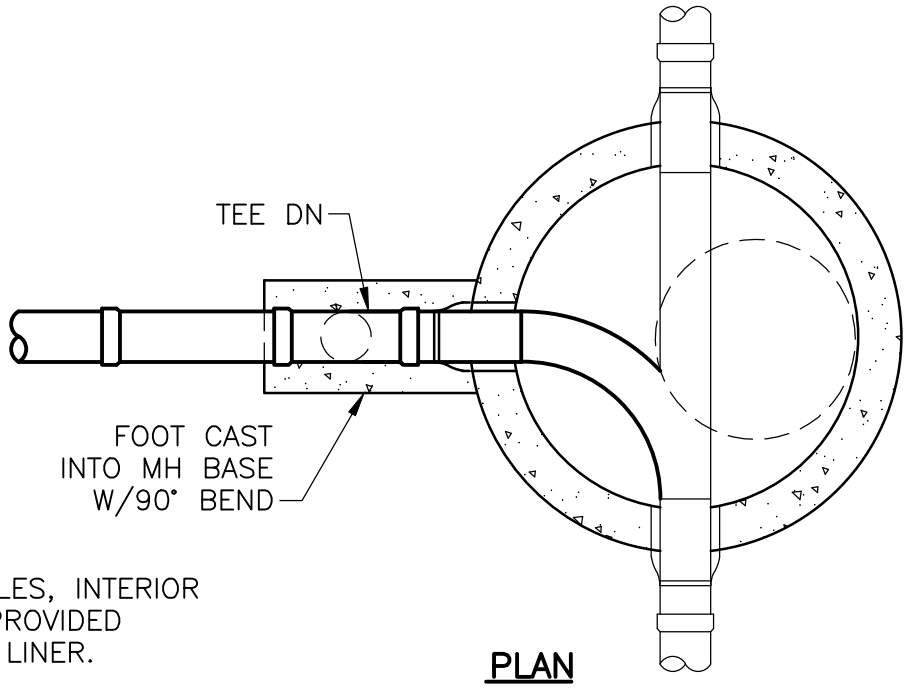
CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	CLEANOUT COVER ASSEMBLY FOR ALL PAVED AREAS	STANDARD DETAIL S-15
July 11, 2022 DATE Andrew C Watcher CHIEF		Revised 03/2022



NOTES:

1. CUT HOLE IN EXISTING MANHOLE WITH CORING MACHINE.
2. INSTALL FLEXIBLE NEOPRENE BOOT.
3. FILL ANNULAR SPACE WITH NON–SHRINK GROUT.

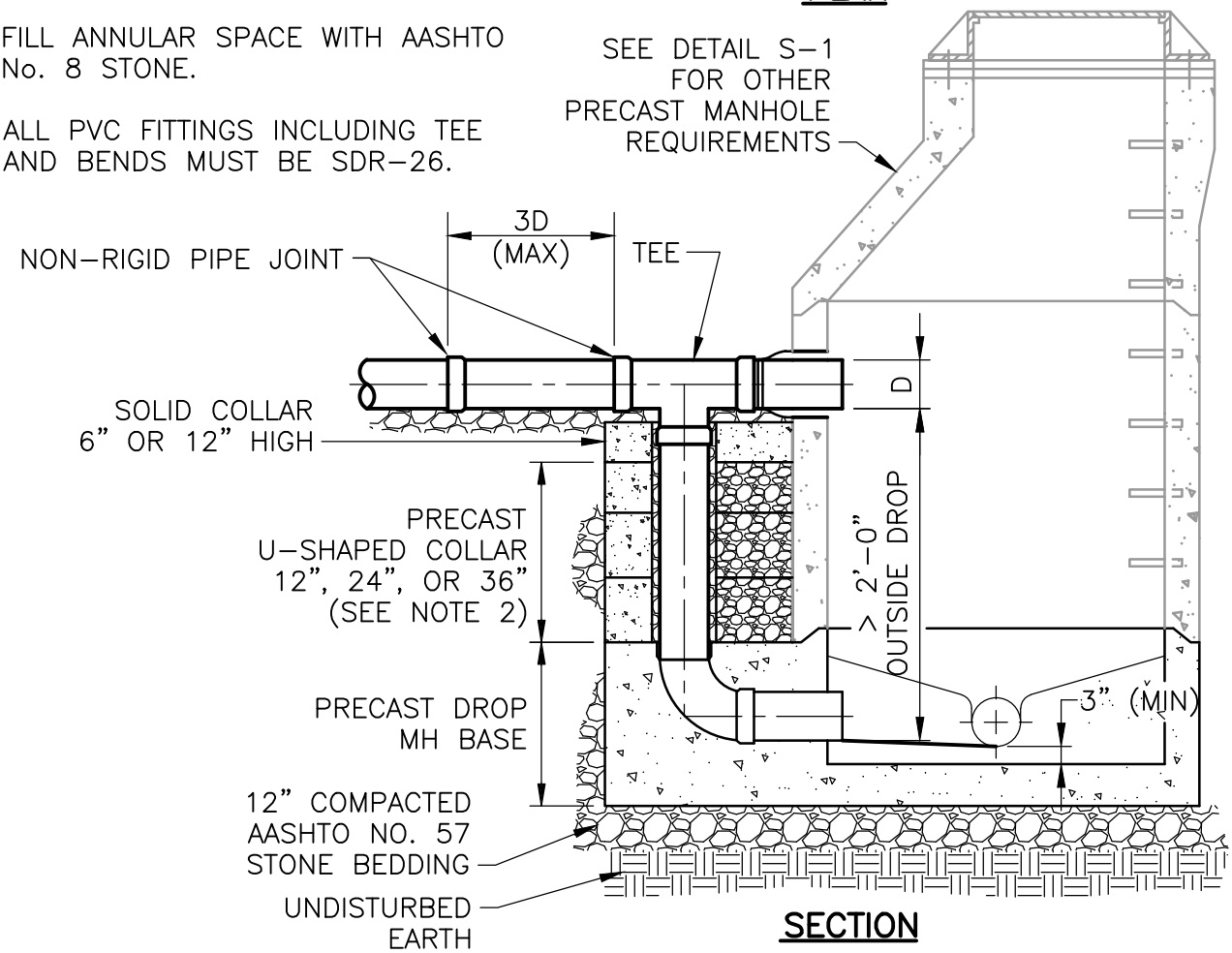
CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	SEWER TO EXISTING MANHOLE CONNECTION	STANDARD DETAIL S-16
July 11, 2022 DATE Andrew C Watcher CHIEF		Revised 03/2022



PLAN

NOTES:

1. FOR ALL DROP MANHOLES, INTERIOR SURFACES SHALL BE PROVIDED WITH A PVC OR HDPE LINER.
2. FILL ANNULAR SPACE WITH AASHTO No. 8 STONE.
3. ALL PVC FITTINGS INCLUDING TEE AND BENDS MUST BE SDR–26.

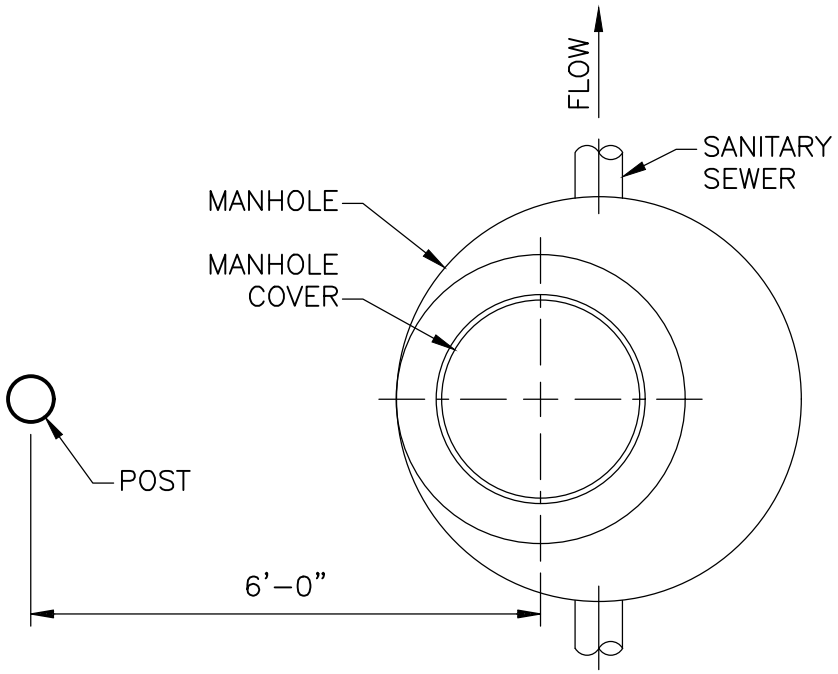


SECTION

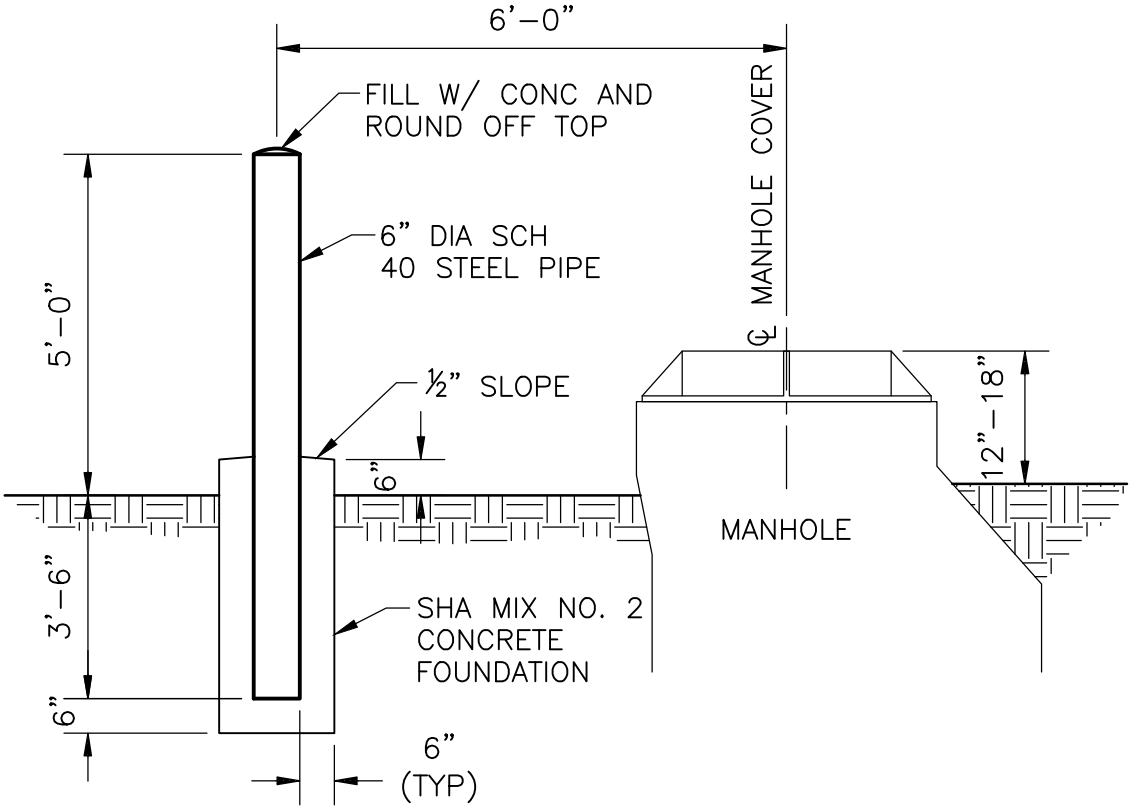
CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	EXTERNAL DROP CONNECTION	STANDARD DETAIL S-17
July 11, 2022 DATE *Andrew C Watcher* CHIEF		Revised 03/2022

NOTES:

1. INSTALL IN FIELD OR WOODED AREAS AS REQUIRED BY THE COUNTY.
2. PLACEMENT OF POSTS SHALL BE AS SHOWN ON THE PLAN WITH RESPECT TO THE ALIGNMENT OF THE SANITARY SEWER LINE AND THE DIRECTION OF FLOW.
3. POSTS SHALL BE INSTALLED WITHIN THE RIGHT–OF–WAY.
4. IF A POST CANNOT BE LOCATED AS SHOWN ON THE PLAN, THE LOCATION SHALL BE APPROVED BY THE COUNTY.
5. PAINT POST WITH TWO COATS OF YELLOW EPOXY PAINT.

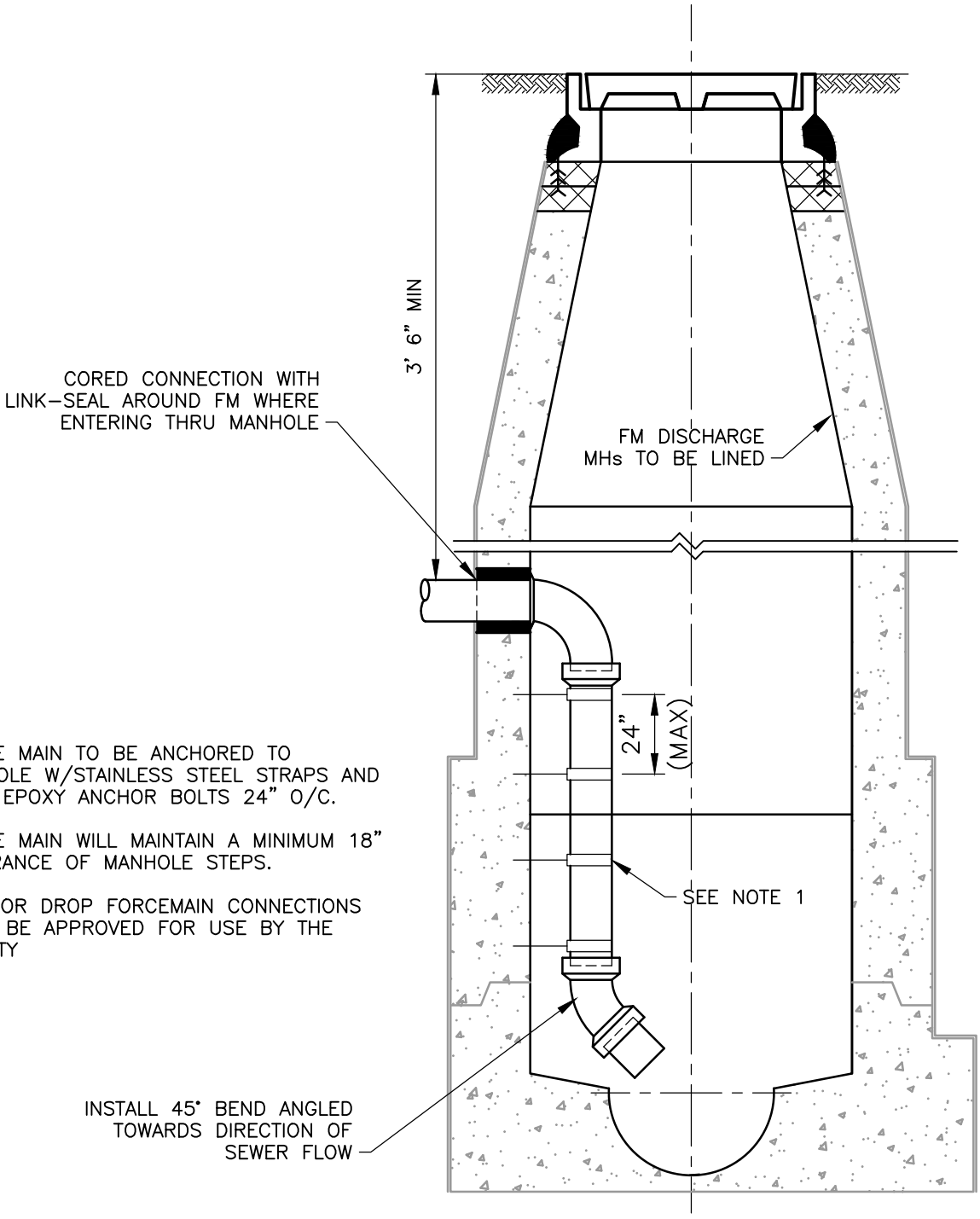


PLAN



SECTION

CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	MANHOLE LOCATION POST	STANDARD DETAIL S-18
July 11, 2022 DATE Andrew C Watcher CHIEF		Revised 03/2022



NOTES:

1. FORCE MAIN TO BE ANCHORED TO MANHOLE W/STAINLESS STEEL STRAPS AND 3/4" EPOXY ANCHOR BOLTS 24" O/C.
2. FORCE MAIN WILL MAINTAIN A MINIMUM 18" CLEARANCE OF MANHOLE STEPS.
3. INTERIOR DROP FORCEMAIN CONNECTIONS MUST BE APPROVED FOR USE BY THE COUNTY

CARROLL CNTY DEPT. OF PUBLIC WORKS
BUREAU OF UTILITIES

July 11, 2022
DATE

Andrew C Watcher
CHIEF

METHOD OF STRAPPING FORCE MAIN TO MANHOLE

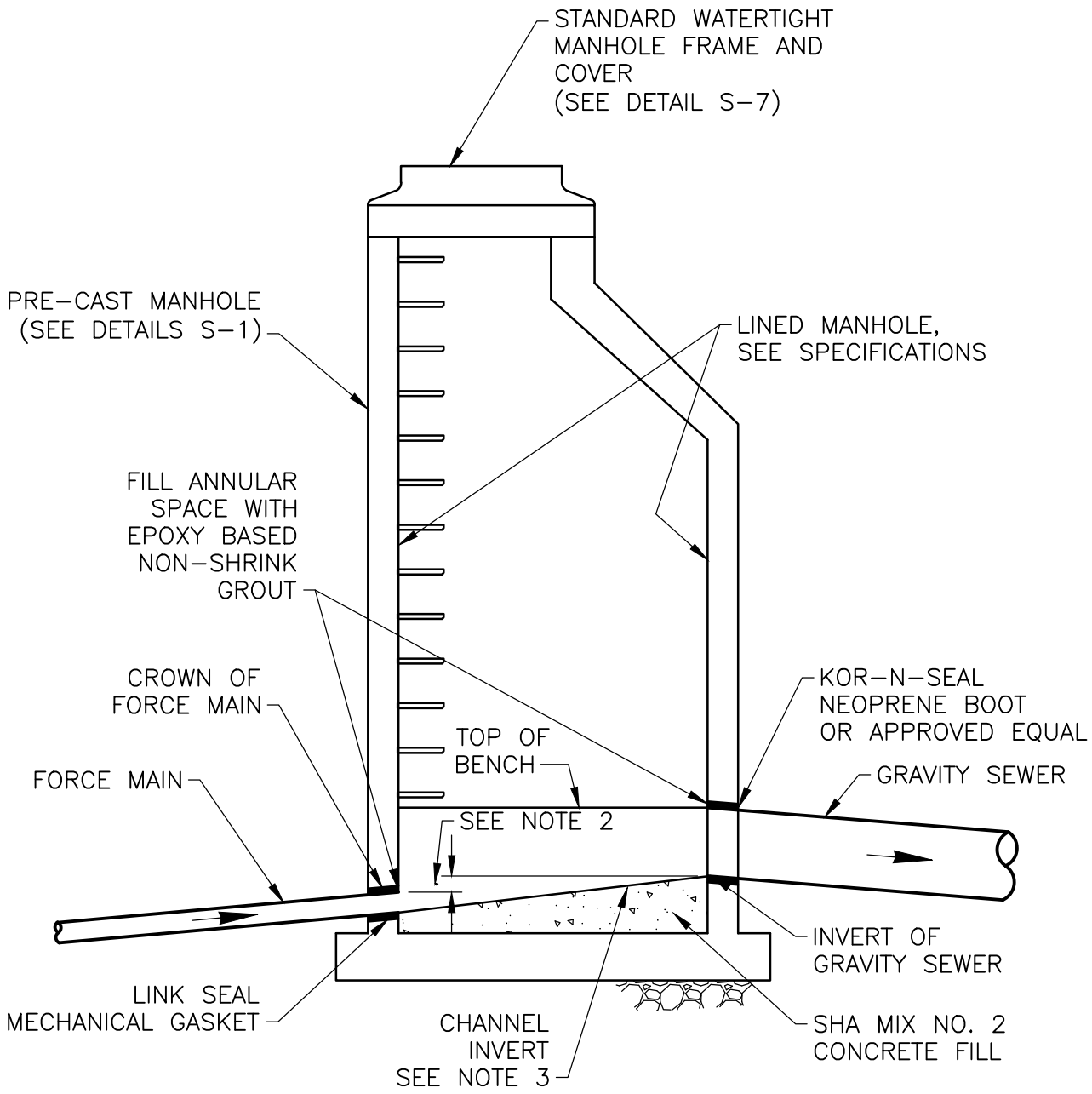
STANDARD DETAIL

S-19

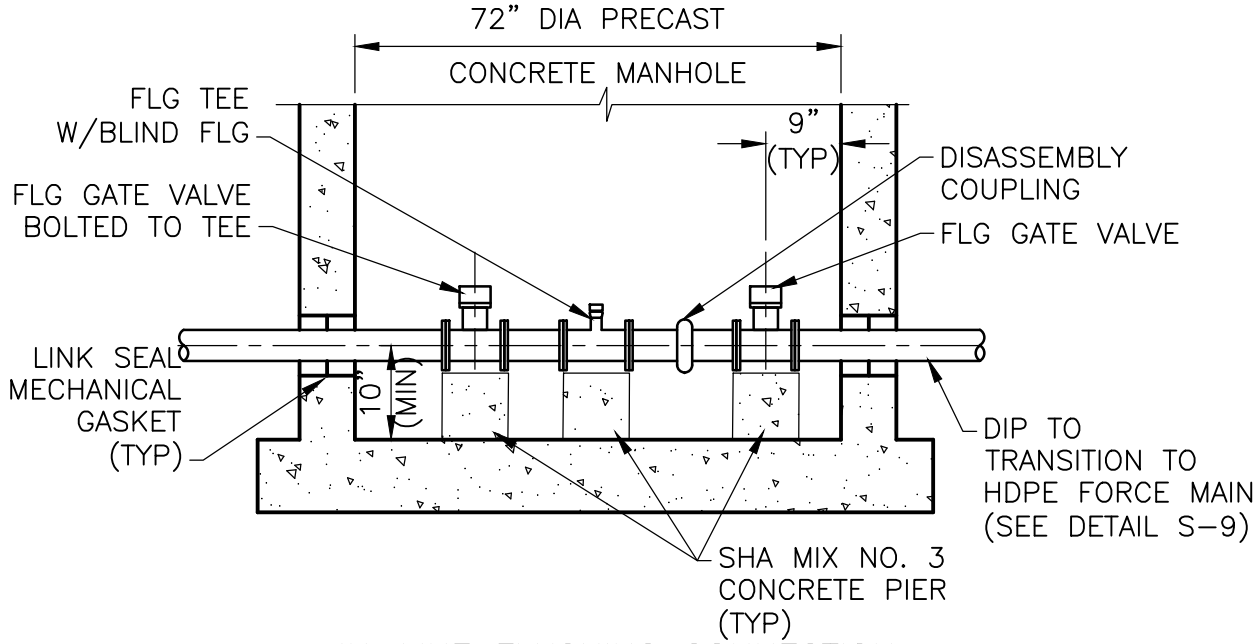
Revised 03/2022

NOTES:

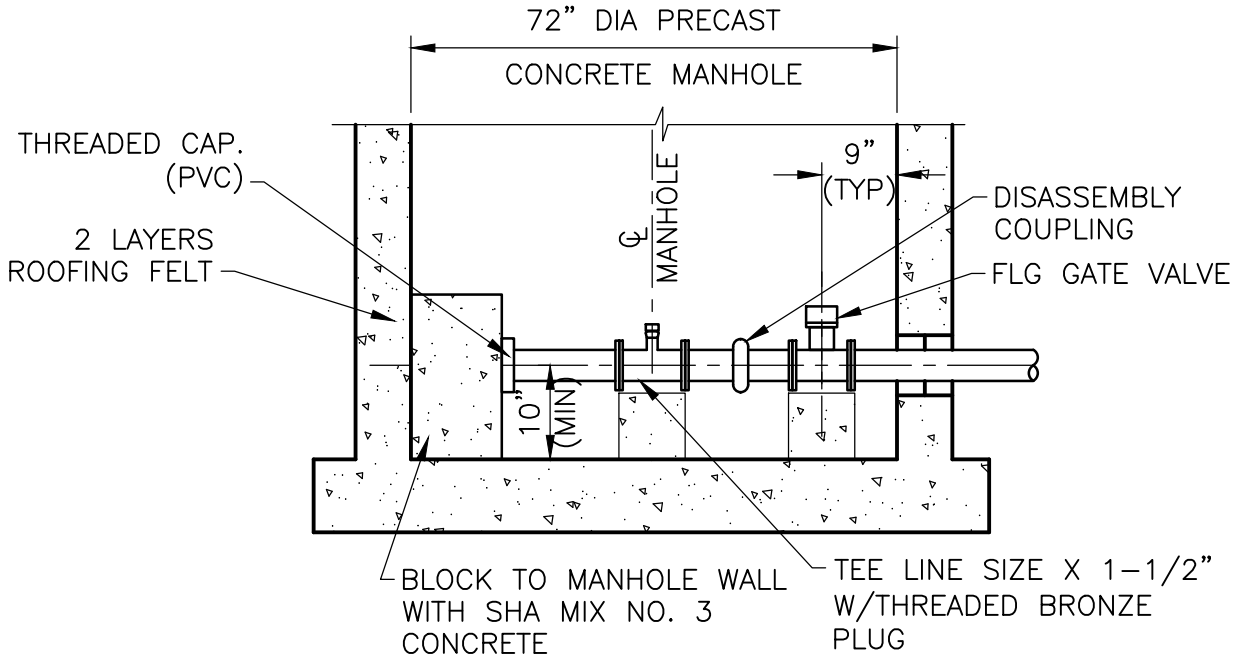
1. COAT INTERIOR OF DIP OR RCP GRAVITY SEWERS AND DIP FORCE MAINS, SEE SPECIFICATIONS.
2. ELEVATION OF GRAVITY SEWER INVERT SHALL BE MINIMUM 1" ABOVE ELEVATION OF FORCE MAIN CROWN.
3. PROVIDE SMOOTH UPWARD SLOPING CHANNEL FROM FORCE MAIN TO GRAVITY SEWER.



CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	TRANSITION MANHOLE FORCE MAIN TO GRAVITY SEWER	STANDARD DETAIL S-20
July 11, 2022 DATE *Andrew C Watcher* CHIEF		Revised 03/2022



IN-LINE FLUSHING CONNECTION
(2 1\2" THROUGH 4")



TERMINAL FLUSHING CONNECTION
(2 1\2" THROUGH 4")

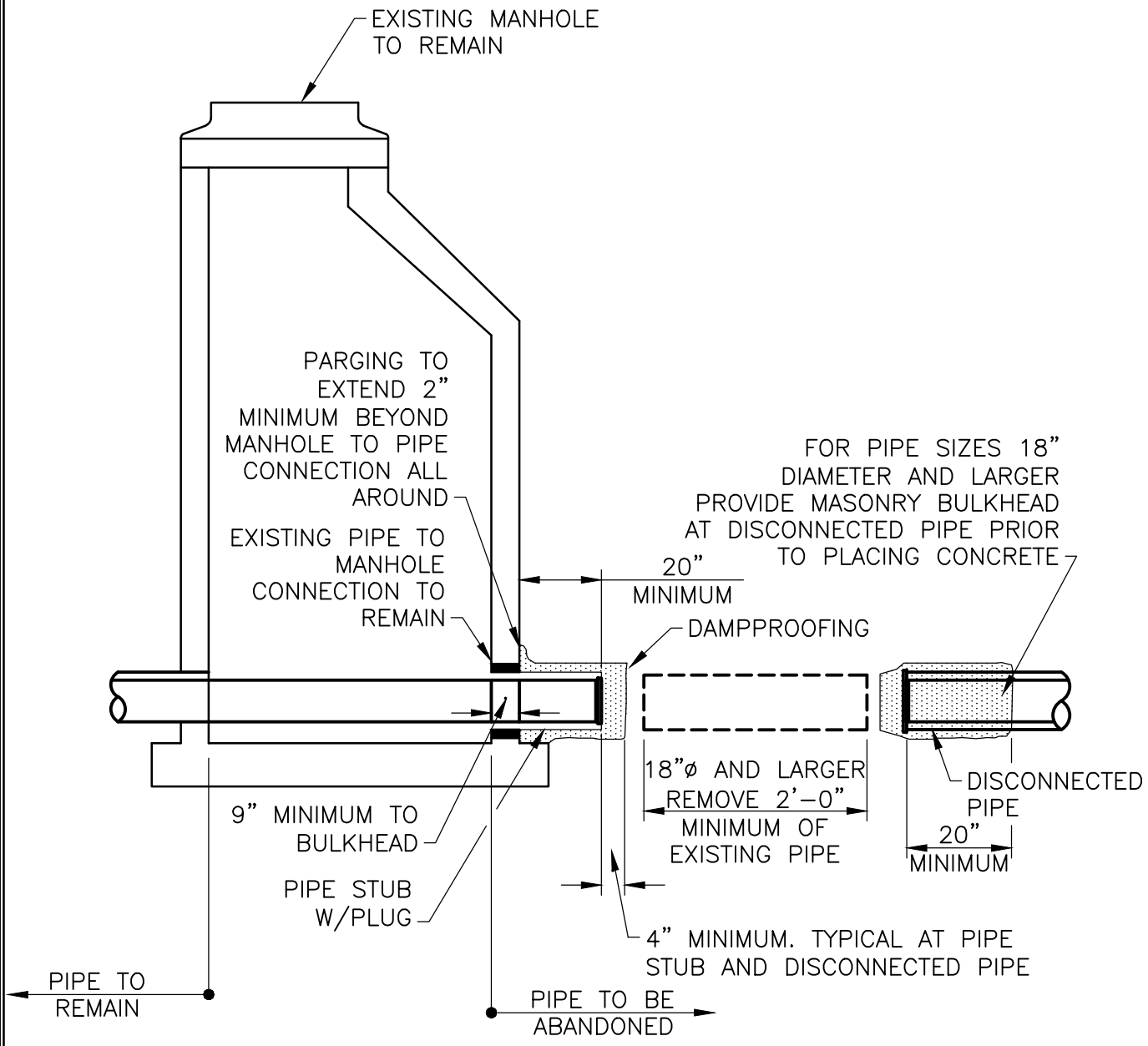
NOTES:
1. ALL JOINTS SHOWN SHALL BE FLANGED UNLESS OTHERWISE NOTED.
2. ALLOW SUFFICIENT SPACE FOR DISASSEMBLY COUPLING.
3. VALVES AND FITTINGS TO BE SAME DIAMETER AS FORCEMAIN PIPE UNLESS NOTED OTHERWISE.
4. ALL PIPING VALVES, AND FITTINGS INSIDE VAULTS TO BE DIP.

CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	FLUSHING CONNECTION 2-1/2" THROUGH 4"	STANDARD DETAIL S-21
July 11, 2022 DATE Andrew C Watcher CHIEF		Revised 03/2022

NOTES:

1. 15" DIAMETER PIPE AND SMALLER TO BE ABANDONED:
   A. CONSTRUCT 9" SHA MIX NO. 3 CONCRETE PLUGS INTO PIPE STUB.

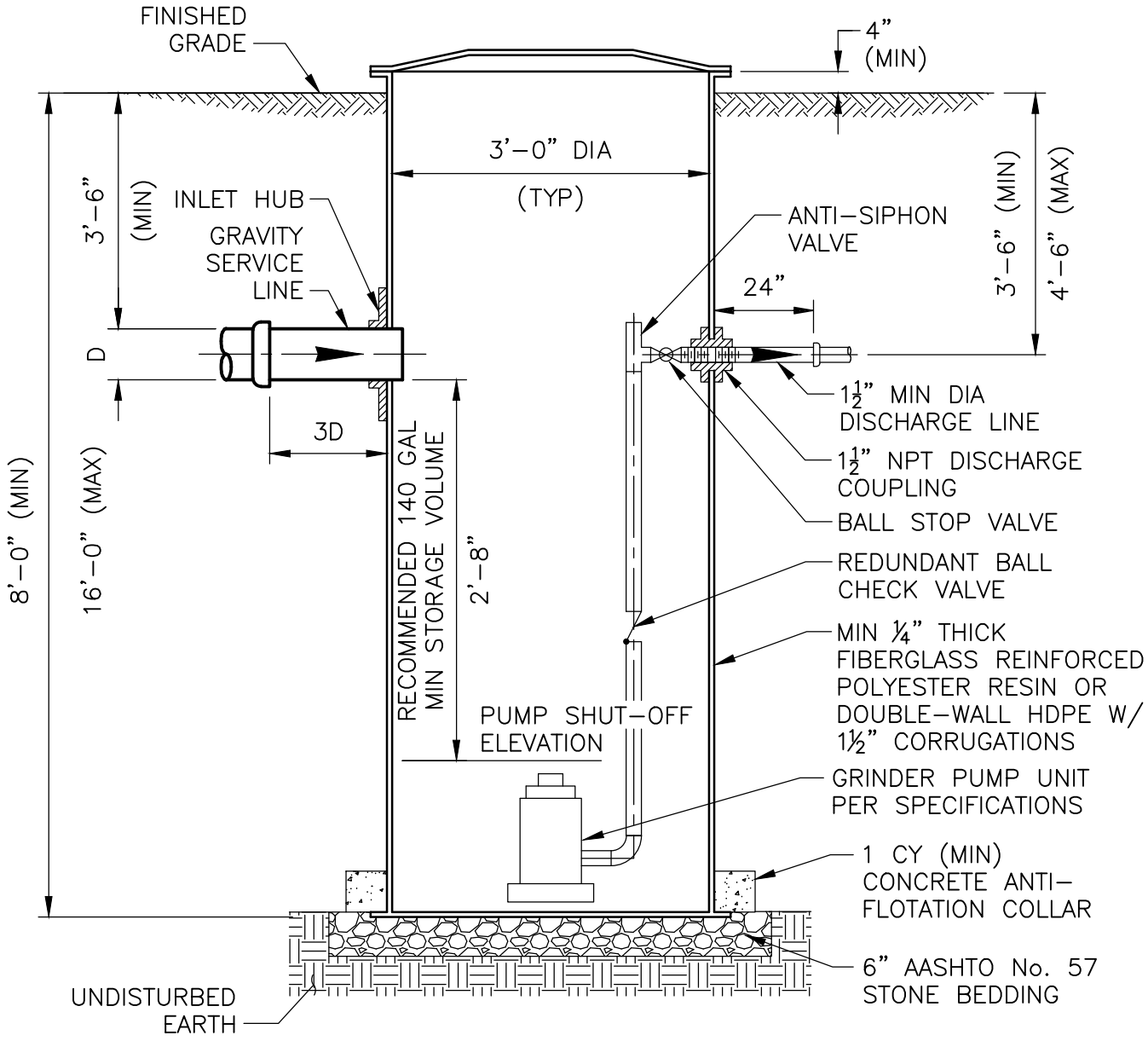
2. 18" DIAMETER PIPE AND LARGER:
   A. BULKHEAD PIPE STUB AT MANHOLE AND DISCONNECTED PIPE TO THE LIMITS SHOWN BELOW.
   B. PARGE BULKHEAD PIPE STUB AND DISCONNECTED PIPE TO THE LIMITS SHOW BELOW, PARGING THICKNESS TO BE 1/2".
   C. APPLY DAMPPROOFING TO PARGING TO EXTEND 2" MINIMUM BEYOND PARGING.



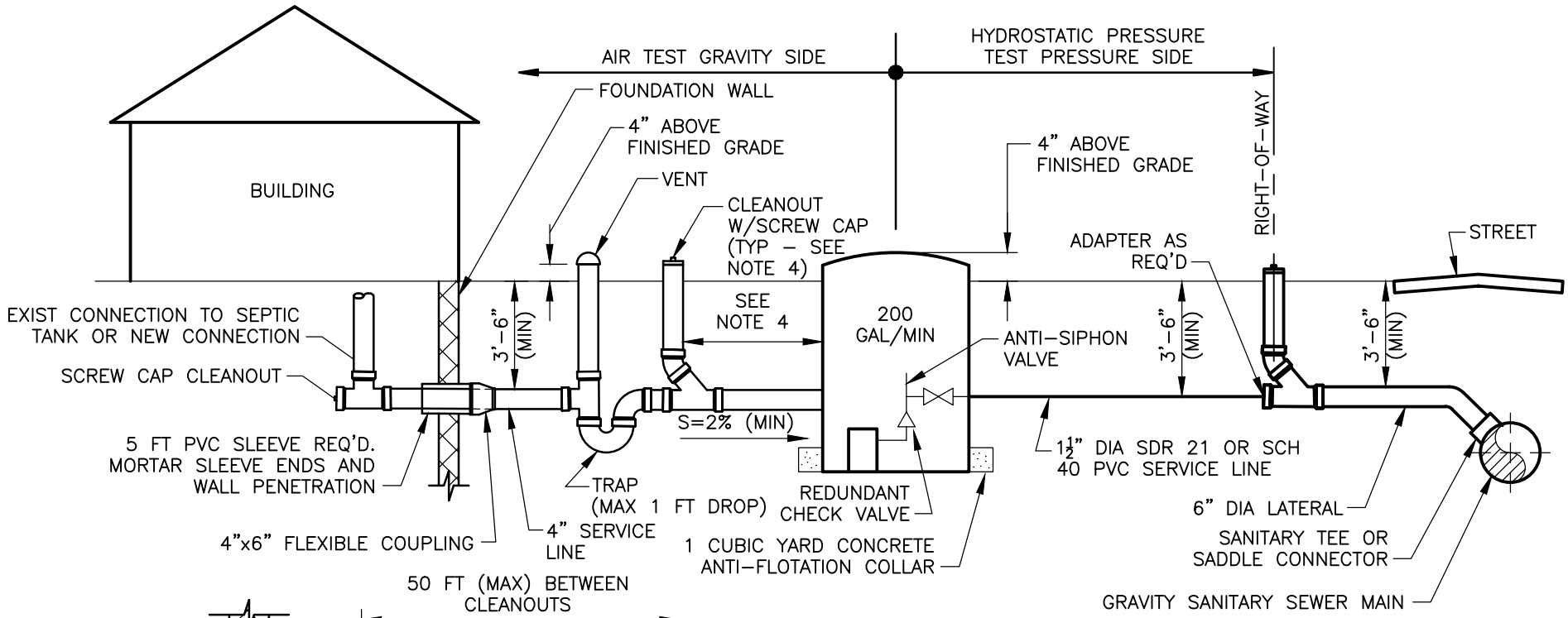
CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	ABANDONMENT OF PIPE AT MANHOLE	STANDARD DETAIL S-22
July 11, 2022 DATE Andrew C Watcher CHIEF		Revised 03/2022

NOTES:

1. FIBERGLASS BASINS MAY NOT BE USED IN AREAS SUBJECT TO TRAFFIC LOADING.
2. LOCATION OF BASIN TO BE DETERMINED BY PROPERTY OWNER OR DEVELOPER.
3. EXCAVATED AREA SHALL BE BACKFILLED TO 6" BELOW GRADE. BACKFILL MATERIAL SHALL BE EXCAVATED MATERIAL CONTAINING NO SOIL LUMPS, STONES, CONCRETE, OR FOREIGN OBJECTS LARGER THAN 1" MAX DIMENSION, OR AASHTO No. 57 STONE.
4. 6" TOPSOIL AND SEED SHALL BE PLACED TO GRADE THE SURROUNDING EXCAVATED AREA.
5. TYPICAL TANK SIZE FOR 1 EDU IS 36" DIA x 96".
6. PROVIDE A REDUNDANT CHECK VALVE ON PUMP DISCHARGE PIPING.



CARROLL CNTY DEPT. OF PUBLIC WORKS BUREAU OF UTILITIES	FIBERGLASS OR HDPE BASIN FOR TYPICAL INDIVIDUAL PUMP	STANDARD DETAIL S-23
July 11, 2022 DATE Andrew C Watcher CHIEF		Revised 03/2022



NOTES:

1. PROVIDE 6" OF AASHTO NO. 57.
2. STONE BELOW AND ON EITHER SIDE OF PIPE AND 6" ABOVE ENTIRE LENGTH OF PIPE.
3. TANK TO BE BEDDED ON 6" OF AASHTO NO. 57 STONE.
4. 50 FT MAX BETWEEN CLEANOUTS.
5. CLEANOUT COVER SHALL BE PVC IN UNPAVED AREAS AND CAST IRON IN PAVED AREAS.
6. LOW–PRESSURE SEWERS ARE SUBJECT TO APPROVAL BY THE COUNTY ONLY AFTER CONNECTION BY GRAVITY IS DEEMED NOT FEASABLE.

CARROLL CNTY DEPT. OF PUBLIC WORKS
BUREAU OF UTILITIES

July 11, 2022
DATE

Andrew C Watcher
CHIEF

TYPICAL LOW - PRESSURE SERVICE LINE TO GRAVITY SEWER

STANDARD DETAIL

S-24

Revised 03/2022

APPENDIX F

CARROLL COUNTY BUREAU OF UTILITIES
FINAL WATER AND SEWER PLAN CHECKLIST

Project Name:_____ File Number: _____

A. General:

1. Professional engineer's seal and signature required on each sheet.
2. Maximum sheet size 24"x36"
3. Plan scale 1' = 50' (maximum)
4. North arrow on each plan.
5. Place three coordinate ticks on each plan.
6. All horizontal controls are based on Maryland State Coordinates NAD 83/91.
7. All vertical controls are based on NAVD 88.
8. Show on plan view the complete survey details and the traverse and road center line stationed at least every 100 feet.
9. Show property lines, septic tank, wells, and spring locations.
10. Show existing and proposed storm drains and stormwater management ponds/structures.
11. Show and label existing water and sewer mains, house connections, manholes and all other related structures and appurtenances.
12. Show streams, lakes, trees, railway lines and related structures.
13. Show existing and proposed gas, electric, telephone and any and all other utilities.
14. Show and label existing and proposed utility rights-of-way including liber and folio.
15. Show existing and proposed buildings on lots including label identifying basement or lowest floor elevation.
16. Show existing and proposed roads, curbs, sidewalks, and associated rights-of-way, Label width of all roadways and rights-of-way and label as private if appropriate. State roads shall include route number and MSHA plat number.
17. Show driveway locations for each lot.
18. Show and label existing adjoining lots and provide names of property owners.
19. Label all lots or parcels within the development.
20. Proposed utilities and features shall be shown with solid lines and existing with dashed or ghosted lines.
21. Where continuity of view is interrupted indicate the sheet number where view continues.
22. Ensure that all standard details required for the project are included.
23. Water and sewer pipes shall be drawn to scale whenever practical.
24. Include a Water Service Chart providing info regarding meter vault location placement and invert elevation.
25. Include a Sanitary Sewer C/O Schedule providing info regarding c/o location invert and lateral slope.

B. Cover Sheet:

1. Standard Title Block
2. Owner's name, address, and phone number.
3. Developer's name, address, and phone number.

4. Surveyor's or engineer's address, phone number, seal, and signature.
5. Tax map, block and parcel.
6. Town, election district, County, State.
7. Date plan prepared.
8. Bureau of Utilities signature block.
9. Bureau of Utilities water and sewer contract number, if applicable.
10. Professional engineer's seal and signature on each drawing.
11. Vicinity Map / Info Block.
    a. Scale 1"= 2000'.
    b. North arrow.
    c. Existing streets and site labeled.
    d. Design Data provided below vicinity map including:
    1. Type of proposed building.
    2. Number of lots.
    3. Number of Water House Connections.
    4. Number of Sewer House Connections.
    5. Water & Sewer design data. (average flow, maximum, peak, fire demand and infiltration)
12. Provide a table on the first sheet showing total material quantities, i.e. type of pipe, number of water and sewer connections, number of manholes, number of fire hydrants, valves etc.
13. Provide all applicable General, Water and Sewer notes. (See **Regulations and Standard Specifications - Appendix B**)
14. Sheet Index. (Required for 3 or more total sheets)
15. Engineer's Design Certification.
16. As-Built Certification.
17. Location Map.
    a. Scale 1"= 200'-600' based on overall site size.
    b. North Arrow.
    c. Three coordinate ticks.
    d. Existing and proposed streets.
    e. Existing and proposed structures, utilities.
    f. Site outline and individual lots if applicable.
18. Show at least two permanent benchmarks with description, elevation are references (use same benchmarks as shown on road construction plans.

C. Water System Plans

1. Plan Scale 1" = 50' (maximum)
2. Mains are to be stationed along the centerline of the pipe.
3. All piping and appurtenances, existing and proposed features shall be shown and noted by standard symbols and abbreviations.
4. Clearly identify all fittings and appurtenances by size and type (valves, tees, crosses, bends, plugs, tapping sleeves, reducers, air release valves, manholes etc.)

5. Pipe alignment and fittings location by coordinates, dimensioned from traverse or proposed road centerline for field stakeout.
6. Ensure no valves have been placed under curbs or sidewalks.
7. Ensure a minimum of 18 inches of separation is provide between corporation stops.
8. Each lot shall have a single WHC and meter vault. Lots shall not have more than one WHC and meter vault. (Commercial, industrial, institutional, apartment buildings and condo sites that a comprised of a single lot shall only have a single WHC and meter vault. Privately maintained and operated submeters may be installed onsite if desired.)
9. Provide water main stationing on fire hydrant tees and label the bury line elevation and bury length for each hydrant.
10. Provide crimp radii and curve data for DIP shown for pipe curvatures along with location stationing of point of curvature (PC) and point of tangent (PT).
11. Label the material and class of pipe of existing water mains.
12. Use tapping sleeve and valve for connecting into existing water mains unless otherwise dictated and/or approved.
13. When shutdowns for tie-ins are permitted, provide connection sequence, noting the existing valves to be closed when connection to the existing system is made. Provide note on the plan outlining areas affected by the shutdown and a list (names and addresses) of all water customers affected by the outage.
14. Clearly label public and private mains/laterals. On site laterals or mains beyond the meter vault shall be private.

D. Water Main Profiles:

1. Profile scale 1” = 5’ vertical and 1” = 50’ horizontal
2. Profiles shall be shown on separate drawings and clearly identified, and cross referenced to the plan view drawings.
3. Water mains shall be shown as double lines and labeled by size.
4. Show and label existing and proposed grades.
5. All water main fittings (appurtenances) shall be labeled, stationed, and invert shown.
6. Water main stations and inverts shall be shown at 50-foot intervals.
7. Check the combined horizontal and vertical radii of pipe required to traverse over, under or around obstructions to ensure crimp radius of DIP does not exceed the maximum radius allowed.
8. Label the type of pipe material on existing water mains.
9. Show all crossings with other utilities. Check for adequate clearance at all crossings. Dimension minimum clearance. Provide inverts of other utilities.
10. Where profiles branch to other profiles, check inverts for consistency.
11. Hatch/shade structural fill and label with compaction type and joint restraint requirements.
12. Check for need for trench erosion check and pipe anchors based on slope of ground.
13. Show location of all continuity test stations on the profiles.

E. Sewer System Plans

1. Plan Scale 1” = 50’ (maximum)
2. Show existing sewer mains to which proposed sewer main will be connected.
3. Show pipe size and direction of flow of sewer mains.
4. The minimum public sewer size is 8 inch.

5. Manholes shall be numbered and identified by type (drop, watertight frame and cover, etc.). Lowest elevation manhole shall have the lowest number.
6. Manholes shall be located by coordinates, distance from applicable traverse station or from road centerline or other physical points for field stakeouts.
7. Ensure that any channels not conforming to standard geometric schemes have been detailed.
8. Show minimum basement/lowest floor elevation of lots or buildings.
9. Note on plans all lots that have a sewer service restriction (Gravity service first floor only).
10. SHCs properly shown and perpendicular to the main whenever possible.
11. Clearly label public and private sewer mains.

F. Sewer System Profile

1. Sewer profile scale 1" = 5' Vertical and 1" = 50' Horizontal.
2. Show and label existing and proposed grades.
3. Label sewer pipe size along with the slope and type of material.
4. Label the type of pipe material on existing sewer mains.
5. Hatch/shade and label all areas of structural fill.
6. Show all manholes and label invert elevations of manhole, connecting mains and rim elevation for each.
7. Distances between manholes shall be shown and stationed.
8. Label manholes with numerical numbers. Lowest elevation shall have the lowest number.
9. Check that manholes placed in fill have base extending to undisturbed earth.
10. Invert drops within manholes shall have a minimum of 0.10' and a maximum of 0.50'
11. Label all drop manholes.
12. If a drop connection is proposed to an existing manhole field verification that inside steps and joints will not conflict with the proposed connection. Edge of cored hole must be a minimum of 9" from joint.
13. Include in the Service Connections Table a column for grade elevation at cleanout to calculate the depth of the cleanout. No cleanout shall be deeper than 13 feet.
14. Show all crossings with other utilities. Check for adequate clearance at all crossings. Dimension minimum clearance. Provide inverts of other utilities.
15. Provide stream bottom elevation that parallels within 50 feet of proposed sewer.