MOREHEAD UTILITY PLANT BOARD

DESIGN and CONSTRUCTION MANUAL
for
MUPB UTILITIES

MOREHEAD UTILITY PLANT BOARD
135 South Wilson Avenue
Morehead, KY 40351
January 2022

Approved by MUPB ***Date:January 2022***
Approved by City of Morehead ***Date:February 2022***

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SECTION 1: INTRODUCTION

1.1. PURPOSE

The Morehead Utility Plant Board (MUPB) desires to have a manual to establish standard principles, procedures and practices for the design and construction of water, sanitary sewer, stormwater and natural gas facilities and infrastructure to be maintained by MUPB and within MUPB service areas. The **DESIGN and CONSTRUCTION MANUAL for MUPB UTILITIES (MANUAL)** will be amended and updated by MUPB. MUPB reserves the right to amend or modify this MANUAL without notice and to interpret the meaning of all statements made herein. See APPENDIX A for definitions of terms used in the MANUAL.

Due to the wide variety of situations that may present themselves, it is impossible to address all scenarios. Exceptional measures may be required to address project-specific conditions. Many criteria listed are minimums. MUPB reserves the right to exercise judgment, and will make the final determination as to the acceptability of each design. Final design decisions will be made, favoring the minimum life-cycle costs.

Where the designer believes that project-specific conditions warrant a variance to or waiver from the provisions of this MANUAL, they shall forward a request for such consideration to MUPB in writing.

1.2. APPEAL PROCESS

Deviation from the requirements of this MANUAL may be granted by the General Manager or Designee. An OWNER/CONTRACTOR who wishes to appeal to the General Manager or Designee regarding the design of water, sanitary sewer, stormwater and natural gas facilities may do so as long as the appeal, if granted,

- Is not detrimental to the public welfare,
- Does not involve special conditions or circumstances that affect the water, sanitary sewer, stormwater or natural gas facility in question,
- Is supported by an engineering study performed by a Professional Engineer,
- Is not based on financial interests only.

The final decision of the appeal shall be provided by the General Manager or Designee.

1.3. MUPB AUTHORITY

MUPB shall decide questions which may arise as to the quality and acceptability of construction workmanship performed. MUPB shall interpret the intent of the requirements contained in this MANUAL in a fair and unbiased manner. See APPENDIX D for UTILITY service areas.

Nothing contained in this MANUAL is intended to conflict with any Federal or State law or regulation, in such case the more stringent requirement shall be met. In no case shall the requirements of this MANUAL be less stringent than any existing Federal or State law or regulation.

Plans are approved by MUPB subject to the condition of compliance with applicable Federal, State, and local laws, rules, regulations, and standards. Approval of plans does not constitute an assurance that the proposed improvements will properly function, operate, or meet compliance with Federal, State, or local laws and regulations.

MUPB, at any time during design or construction, shall have the authority to modify any engineering or construction detail whenever required for the protection of the public interest.

This MANUAL shall be revised from time to time to ensure that the requirements contained herein keep abreast with current Federal and State laws and regulations, approved construction materials and recognized construction methods.

1.4. EXTENSION OF WATER DISTRIBUTION, SANITARY SEWER, STORMWATER AND/OR NATURAL GAS FACILITIES

The OWNER/CONTRACTOR is the entity that is requesting the construction of facilities for their benefit of a development. The term OWNER/CONTRACTOR shall also be understood to include engineers, employees, agents, contractors, subcontractors, and vendors providing support to the project's OWNER. It is the prime responsibility of the OWNER/CONTRACTOR to make all necessary provisions for the construction, and to execute the project per the approved construction plans and specifications. The OWNER/CONTRACTOR must ensure that all work is conducted in conformance with current guidelines and standards of federal, state, and local governing agencies.

OWNER/CONTRACTOR desiring water service, sanitary sewer, stormwater and natural gas service for specified areas shall make application to MUPB for Utility Availability and receive the applicable Construction Permit(s) before starting construction of any facilities. Developments that have three (3) or more lots/tracts must be approved by the MUPB for water and sewer availability in the absence of Planning & Zoning.

APPENDIX B includes all information related to the request to the MUPB General Manager or Designee for Utility Availability. Stormwater facilities will only be applicable to developments within the City of Morehead city limits. For Stormwater requirements see APPENDIX XX.

Developments in Morehead, Lakeview Heights, and Rowan County are regulated by Morehead-Rowan County Planning & Zoning (MRCP&Z). Developments are categorized as either a Rural Settlement, Low/Medium/High Density Residential, General/Highway/Central Business and Light Industrial. The guidelines for each development shall be followed in accordance with all MRCP&Z & MUPB regulations or in

the absence of planning and zoning in the county of the development the following shall govern for the entire proposed development:

1. Total acreage of the planned development.
2. Current and proposed Zoning.
3. Number of Townhomes, Apartment Units, Single Family Residences, Commercial or Retail and/or Farms.
4. Proposed water usage and sewer flow.
5. Site concept plan including the proposed water, sewer mains, stormwater & natural gas facilities.
6. Include all information regarding planned phasing and proposed timelines.

In order to ensure that the design and construction of water, sanitary sewer, stormwater and/or natural gas IMPROVEMENTS meet generally accepted engineering design criteria and recognized construction methods for such facilities, the OWNER/CONTRACTOR proposing IMPROVEMENTS that are to be connected to, and/or become a part of, Morehead Utility Plant Board, must employ an ENGINEER licensed as a professional ENGINEER in the Commonwealth of Kentucky. The OWNER/CONTRACTOR shall employ the ENGINEER to:

1. Prepare detailed construction drawings.
2. Certify to MUPB that the facilities were constructed in accordance with the approved plans and the detailed specifications contained herein with the Certificate of Substantial Completion.
3. Provide a complete set of "As-Built" drawings to the MUPB.

Once plans have been approved by the MUPB, it shall be the responsibility of the OWNER/CONTRACTOR to submit the approved plans to the Kentucky Department for Environmental Protection for their approval prior to commencing construction. The OWNER/CONTRACTOR shall provide documentation of the Department for Environmental Protection approval of the plans to MUPB prior to beginning construction of the IMPROVEMENTS.

The cost of submitting plans to the Department for Environmental Protection shall be paid for by the OWNER/DEVELOPER.

The specifications and criteria in this MANUAL are supplemented by MUPB Standard Detail Sheets which are available in Appendix C or at www.MUPB.com. These detail

sheets are required to be included in all design plans for water and/or sewer extension projects.

1.5. OBLIGATION OF THE CONTRACTOR

The CONTRACTOR shall perform and complete the work to the satisfaction of MUPB and in accordance with approved plans. The CONTRACTOR shall conduct their work so as to minimize interference with public and private business and traffic. They shall at their own expense, whenever necessary or required, provide barricades, flagmen, maintain lights, and take other precautions as may be necessary to protect life, property, adjacent buildings, and structures. The CONTRACTOR shall be liable for all damages and injuries received or sustained by any person, persons, or property in consequence of any neglect in safeguarding the work or by any act of neglect or misconduct by them or their agents, subcontractors, employees, or workers.

The CONTRACTOR shall pay for all MUPB over-time expenses for testing, inspection or "call-outs" after normal business hours or holidays.

At least two (2) working days prior to the start of any construction, the CONTRACTOR shall notify MUPB of his intent to commence work.

All work shall be performed by the CONTRACTOR in compliance with applicable codes, OSHA requirements and MUPB Safety Standards. MUPB shall not be held responsible for job site safety. The OWNER/CONTRACTOR shall implement all of the above safety standards and the most strigent. Safety is the sole responsibility of the OWNER/CONTRACTOR.

The CONTRACTOR shall cooperate with MUPB during the construction of the proposed IMPROVEMENTS. The CONTRACTOR shall maintain on the construction site a copy of the approved plans, permits and shall make them available to MUPB as requested.

The CONTRACTOR shall be responsible for correcting and/or repairing defects found to exist or which may develop in the IMPROVEMENTS for a period of one year from date of final acceptance letter and acceptance by MUPB.

1.6. DEFECTIVE MATERIAL

Materials not in accordance with the approved plans and/or specifications or defective work may be condemned by the ENGINEER or MUPB at any time prior to the end of the one-year warranty time period. Failure by the ENGINEER or MUPB to condemn defective work shall not be construed as an acceptance of same.

1.7. CONSTRUCTION INSPECTION

The ENGINEER'S, OWNER'S or CONTRACTOR'S FIELD REPRESENTATIVE shall coordinate with MUPB Inspectors on a daily/weekly basis.

A FINAL INSPECTION will be made prior to acceptance of any IMPROVEMENTS for maintenance by MUPB and only after all IMPROVEMENTS are completed.

The FINAL INSPECTION will be made upon written request by the OWNER/CONTRACTOR to MUPB stating that all IMPROVEMENTS are complete and all corrections have been made. OWNER/CONTRACTOR/ENGINEER shall provide updated construction plans reflecting all field changes made during construction for MUPB's review prior to final inspection.

The OWNER/CONTRACTOR shall provide personnel as required to aid in the performance of the FINAL INSPECTION.

1.8. EXISTING UTILITIES

Precautions shall be taken by the CONTRACTOR to avoid damage to existing overhead and underground utilities owned and operated by public or private utility companies.

Where existing underground or aboveground utilities or appurtenant structures are encountered, they shall not be displaced or molested unless necessary, and in such case shall be replaced in as good or better condition than found as quickly as possible.

Kentucky statutes (KRS 367.4901 through 367.4917) require that all excavators planning excavation or demolition work shall notify all utility companies in the area and/or an underground protection service such as KY 811 at least two (2) working days before commencing work to alert utility companies. Such utilities in MUPB service boundaries include but not limited to:

Rowan Water, Inc.
Bath County Water District
Delta Gas
Spectrum
Windstream
K.U. Electric
Fleming Mason Electric
Columbia Natural Gas
Kinder Morgan
Marathon Petroleum
Clark RECC Electric
AEP Electric
Grayson Electric

1.9. UTILITIES/AGENCIES COORDINATION

The OWNER/CONTRACTOR shall coordinate the design of all water, sanitary sewer, stormwater and/or natural gas facilities improvements with all utility companies and/or appropriate agencies actively involved in the provision of service in the MUPB service

area. Final construction plans shall accurately reflect the location of all existing and proposed utilities.

1.10. PERMITS, EASEMENTS & RIGHT-OF-WAYS

Unless otherwise required by the agencies involved, the CONTRACTOR shall make application for, obtain, and pay for all licenses and permits required to perform the work on the approved plans. The CONTRACTOR shall be required to comply with all Federal, State and local ordinances, laws, and/or codes which may apply to the same.

All easements for new water, sanitary sewer, stormwater and natural gas lines shall be clearly shown and labeled on the construction plans as well as all Final Plats and Development Plans. If off-site easements are required for water, sanitary sewer, stormwater and/or natural gas facilities to the DEVELOPMENT, they must be recorded in the County Clerk's Office of the corresponding county, prior to approval of construction plans. A copy of the recorded easement documents must be furnished to MUPB prior to plan approval.

1.11. SEWER USE ORDINANCE

The MUPB has established ordinances dictating rules and regulations applicable to the trade of plumbing, regulating the installation and use of plumbing connections and fixtures and regulating the use of public and private sewers and drains, private sewage disposal, the installation and connection of building sewers, and the discharge of water and waste into the public sewer system, including sanitary sewer pretreatment program administration, industrial discharge limits, surcharge rates and formula, enforcement of pretreatment and sewer use regulations and penalties for violation thereof. Developers are encouraged to familiarize themselves with applicable sections of these ordinances as they relate to the development of property within MUPB Service Area.

SECTION 2: APPLICATION FOR SERVICE

2.1. PURPOSE

MUPB shall review the development and construction plans for all projects that will extend its water, sanitary sewer, stormwater and/or natural gas facilities. Conformance to the procedures and standards outlined in this specification will expedite the review process. This application and review process ensures that projects are built to conform to MUPB's standards.

This section provides the following guidance:

- An overview of MUPB's planning, design, and construction approach relating to water, sanitary sewer, stormwater and natural gas facilities and their related appurtenances.
- Defines an overview of MUPB's process for the submittal, review, and approval of construction documents for water, sanitary sewer, stormwater and natural gas facilities.
- Defines information relating to area utility coordination.
- Provides direction relating in the development of water, sanitary sewer, stormwater and natural gas projects within MUPB Service Area.

2.2. WATER, SANITARY SEWER, STORMWATER, GAS RATE SCHEDULES & FEES

MUPB publishes a document identifying current schedules and fees associated with service to OWNER/CONTRACTORs within MUPB Service Area. See APPENDIX E for a list of schedules and fees.

2.3. MUPB SERVICE AREA (REQUEST)

Upon request from OWNER/DEVELOPER MUPB will provide the boundaries of utility service, see APPENDIX D.

2.4. PLANNING & ZONING

MUPB approvals will be contingent upon the OWNER/DEVELOPERS obtaining the required approvals and permits from the corresponding city/county Planning & Zoning office.

2.5. WATER, SANITARY SEWER, STORMWATER & NATURAL GAS CONSTRUCTION

MUPB may allow extensions of utility lines and facilities by OWNERS/DEVELOPER where adequate pressure, flow, and capacity are available when approved by MUPB. OWNERS/DEVELOPER shall bear the entire cost of all infrastructure including constructed facilities as well as surveying, engineering, construction plans, specifications, inspection, and other related appurtenances.

2.6. DEVELOPMENT RELATED FEES

MUPB performs design review, construction observation, and other development related activities at a cost to the OWNER/DEVELOPER, see Section 2.2. Additionally, the Commonwealth of Kentucky's Department for Environmental Protection charges a review fee for water and sanitary sewer construction documents. Developers should contact the Division of Water for fee assignments.

2.7. APPLICATION PROCEDURES

If an OWNER/DEVELOPER elects to perform the construction of water, sanitary sewer and/or gas facilities within their property limits, as required to connect to MUPB's existing system, the following is to be provided by the OWNER/DEVELOPER:

2.7.1 UTILITY AVAILABILITY REQUEST

Initial request is for OWNER/DEVELOPER to request approval of water, sanitary sewer, stormwater and/or natural gas availability of proposed development. OWNER/DEVELOPER, shall provide the following items and additional information may be requested:

A. Utility Availability Application Form (APPENDIX B).
B. Preliminary Site Plan
C. MUPB will determine availability of applicable utilities and issue a letter of availability and require plan review fees to be paid prior to the plan review, which is good for 12 months from date of issuance of MUPB letter.

2.7.2 PLAN REVIEW

Once, OWNER/DEVELOPER has received MUPB approval on Utility Availability Request, THEY shall provide the following items as required:

A. OWNER/DEVELOPER shall pay plan review fees.
B. Revised Utility Availability Application Form, if applicable
C. Checklist Construction Plans & Specifications (Appendix F)
D. PLANS and SPECIFICATIONS, stamped by licensed engineer.
E. Division of Water Construction Permit Application and all required permit application items.
F. Hydraulic Model of water facilities, if applicable.
G. Hydraulic Model of lift station and force main, if applicable.
H. OWNER/DEVELOPER shall provide all on-site and off-site easements to MUPB with Plan Review Submittal or at the sole discretion of MUPB.
I. OWNER/DEVELOPER shall provide development phasing, if applicable.

OWNER/DEVELOPER shall bear responsibility for all applications and fees associated with securing inspection and approval of constructed water, sanitary sewer and/or natural gas facilities up to MUPB system connection.

All OWNER/DEVELOPERS shall prior to the development of detailed plans and specifications for the construction of proposed improvements, shall provide complete information as requested by the MUPB so that the impact of the proposed improvements maybe evaluated and determined.

MUPB upon review and approval of design plans, shall issue a Letter of Design Plan Approval to be submitted to Division of Water by OWNER/DEVELOPER along with Plans and Specifications. If project does not require DOW approval, MUPB will issue a Letter of Design Plan Approval for OWNER/DEVELOPER records.

For DOW approved projects, MUPB's Approval Letter shall expire 24 months after the DOW approval date. For non-DOW approved projects, MUPB's Letter of Design Approval shall expire 24 months after date of issuance of said letter.

Employ a licensed CONTRACTOR experienced in the construction of such improvements according to applicable local and state plumbing codes and standards. Upon completion of said improvements, OWNER/DEVELOPER is responsible for securing inspection and approval from both the local plumbing, if applicable and/or MUPB inspectors.

2.7.3. PROJECT CLOSEOUT

After the facility(ies) have been constructed and tested but prior to approval and acceptance by MUPB the following items are required to finalize the development:

A. "As-Builts" Record Drawings (highlighting any variance from approved Construction Plans).
B. Updated Easements that reflect the changes in Construction Plans, if applicable.
C. All testing records (pump start-up, pressure test, smoke testing, CCTV, manhole vacuum, etc.).
D. All Start-up information, Operation and Maintenance Manuals, and other information as required.
E. Certificate of Substantial Completion, see SECTION 2.9.

2.8. CONSTRUCTION PLAN REQUIREMENTS

Construction Plans shall be prepared by a registered Professional Engineer with a valid and current license in the Commonwealth of Kentucky per KRS Chapter 322. Plans shall be on 24-inch x 36-inch size sheet. Construction Plan set shall include the following items:

2.8.1. Cover Sheet – Cover sheet shall include the project name; name, address, and phone number for all the following: MUPB, OWNER/DEVELOPER, ENGINEER, and other utilities; vicinity map; sheet index and revision block.

2.8.2. Plan Sheet – Plan Sheets shall include either aerial images or planimetric mapping of the proposed development; scale (maximum of 1' = 100'); shall be in Kentucky Single Zone Coordinate System NAD83 and NAVD88; lots or property lines with owner information; easement boundaries that will become a MUPB utility easement; natural features (wetlands, waters of the Commonwealth of Kentucky, intermittent streams, ponds, etc.); manmade features (building, below and above ground structures, roads, bridges, etc.); existing utilities (overhead and underground, associated facilities, etc.); and proposed site work/utilities. Gravity sanitary sewer lines shall be of a maximum scale of 1" = 50' with topographic mapping of the proposed development. Booster pump stations and sewage lift station site plans shall have a maximum scale of 1" = 20' with topographic mapping.

2.8.3. Standard Details – ENGINEER may need to use additional standard details other than those provided by MUPB, but all MUPB standards shall govern over all ENGINEER provided details, unless approved otherwise.

2.8.4. Digital Copy – OWNER/DEVELOPER's ENGINEER shall provide a digital file in AutoCAD format to MUPB for use in their GIS system. MUPB agrees to protect CAD files as intellectual property and will not distribute the drawings for a third party's use other than to be utilized through a contract with MUPB to review said plans.

2.8.5 PLAT VERBIAGE

The following adopted verbiage shall be included on all final plats and/or development plans presented to MUPB for signature:

CERTIFICATION OF MUPB UTILITIES

"*The Ownership of water lines, sewer lines, force mains, booster pump stations, lift stations, stormwater, natural gas, regulating stations and/or appurtenant facilities thereto existing or installed, and located within easements shown hereon are hereby dedicated to the City of Morehead, by and through Morehead Utility Plant Board (MUPB) for operation. For a period of one (1) year following recording of this plat with the Rowan/Bath/Fleming County Clerk's Office and final acceptance of all water lines, sewer lines, natural gas lines and other appurtenances, any and all maintenance costs incurred by MUPB as a result of faulty equipment or installation will be invoiced to the developer for reimbursement to MUPB.*"

_____ *Date*

_____
OWNER/DEVELOPER

Where projects are located within the city limits of Morehead and include water, sanitary sewer, stormwater, and natural gas services provided by MUPB, the following adopted verbiage shall be placed on all final plats and/or development plans presented to MUPB for signature.

CERTIFICATION FOR WATER, SANITARY SEWER, STORMWATER & NATURAL GAS SERVICE

I hereby certify that Morehead Utility Plant Board (MUPB) has the capacity within the water distribution system/sewer collection system/stormwater conveyance/natural gas system to serve _____ with water services/sanitary sewer collection services/stormwater conveyance/natural gas services. Provision of service will be contingent upon the review and approval of all on-site and off-site plans and specifications for the proposed system. Construction of the water distribution system/sanitary sewer collection system/stormwater conveyance system/natural gas system to be by/at the cost of the developer without reimbursement, built to MUPB approved specifications and approval by MUPB of the as-built improvements and/or the bonding amount, and hereby dedicated to MUPB.

_____ *Date* _____

General Manager

Where projects are located within the city limits of Morehead and include water, sanitary sewer, and stormwater services provided by MUPB, the following adopted verbiage shall be placed on all final plats and/or development plans presented to MUPB for signature.

CERTIFICATION FOR WATER, SANITARY SEWER, & STORMWATER SERVICE

I hereby certify that Morehead Utility Plant Board (MUPB) has the capacity within the water distribution system/sewer collection system/stormwater conveyance system to serve _____ with water services/sanitary sewer collection services/stormwater conveyance services. Provision of service will be contingent upon the review and approval of all on-site and off-site plans and specifications for the proposed system. Construction of the water distribution system/sanitary sewer collection system/stormwater conveyance system to be by/at the cost of the developer without reimbursement, built to MUPB approved specifications and approval by MUPB of the as-built improvements and/or the bonding amount, and hereby dedicated to MUPB.

_____ *Date* _____

General Manager

Where projects include only sanitary sewer services provided by MUPB, the following adopted verbiage shall be placed on all final plats and/or development plans presented to MUPB for signature.

CERTIFICATION FOR SANITARY SEWER SERVICE

I hereby certify that Morehead Utility Plant Board (MUPB) has the capacity within the sanitary sewer service system to serve _____ with sanitary sewer services. Provision of service will be contingent upon the review and approval of all on-site and off-site plans and specifications for the proposed system. Construction of the sanitary sewer collection system to be by/at the cost of the developer without reimbursement, built to MUPB approved specifications and approval by MUPB of the as-built improvements and/or the bonding amount, and hereby dedicated to MUPB.

_____ *Date* _____

General Manager

CERTIFICATION FOR NATURAL GAS SERVICE

I hereby certify that Morehead Utility Plant Board (MUPB) has the capacity within the natural gas system to serve _____ with natural gas services. Provision of service will be contingent upon the review and approval of all on-site and off-site plans and specifications for the proposed system. Construction of the natural gas distribution system to be by/at the cost of the developer without reimbursement, built to MUPB approved specifications and approval by MUPB of the as-built improvements and/or the bonding amount, and hereby dedicated to MUPB.

_____ *Date* _____

General Manager

2.8.6. EASEMENTS & RIGHT-OF-WAY

All easements for new water, sanitary sewer, stormwater, and natural gas mains shall be clearly shown and labeled on the construction plans as well as all Final Plats and Development Plans. If easements are required for water, sanitary sewer, stormwater, and natural gas facilities to the development, they must be recorded in the corresponding county Clerk's Office prior to approval of construction plans. All easements for the execution of the proposed project shall be secured and paid for by the OWNER/DEVELOPER. A copy of the recorded easement documents shall be furnished to the MUPB prior to plan approval.

For constructing major structures, the OWNER/DEVELOPER shall be required to provide all rights to the required property in a fee simple title, including all ingress and egress requirements, with the MUPB retaining permanent ownership. This generally refers to booster station(s), lift station(s), gas regulator sites, detention/retention areas and associated access roads.

No existing or proposed non-utility structures shall be located within an existing or proposed easement. An OWNER/DEVELOPER is restricted from constructing any facility within the limits of a utility easement that might interfere with the maintenance, operation, or reconstruction of the facility.

Permanent utility easement widths shall be minimum fifteen (15) feet wide for pipeline installation 36" diameter or less. A pipeline with a diameter greater than 36" will be determined on a case-by-case basis. MUPB reserves the right to require a greater permeant easement width at their sole discretion. Temporary construction easements shall be a minimum of thirty (30) feet wide for pipeline installation of 36" diameter or less.

Water, natural gas, and force main line easement widths shall be minimum 15 feet wide for standard depth water lines. In cases requiring water line depths more than 5 feet, MUPB shall determine the minimum easement width necessary.

Gravity sanitary sewer easement widths shall be sized based on the following criteria:

0' to 7' depth – minimum 15 feet wide permanent easement
7' to 15' depth – minimum 30 feet wide permanent easement

Sanitary sewer mains deeper than 15 feet shall only be allowed with prior MUPB approval.

2.8.7. PERMITS

Unless otherwise required by the agencies involved, the OWNER/DEVELOPER shall make application for, obtain, and pay for all licenses and permits required to perform the work on the approved plans. The OWNER/DEVELOPER shall be required to comply with all Federal, State, and local ordinances, laws, and/or codes which may apply to same.

2.8.8 COMPLIANCE WITH LAWS

The OWNER, DEVELOPER, and the CONTRACTOR shall fully comply with all local, state, and federal laws, including all codes, ordinances, and regulations applicable to the work.

2.9 CONNECTION TO UTILITIES

Prior to any service connections, OWNER/DEVELOPER shall have received MUPB Letter of Acceptance for the approved utility plan phasing, including all current punch list items.

2.10 FINAL RECORD DRAWINGS & CLOSEOUT DOCUMENTS

Final Record Drawings, also known as "as-built drawings," and Letter of Substantial Completion shall be submitted by the Engineer before issuance of the "Letter of Acceptance" by MUPB. Once, MUPB has issued the Letter of Acceptance and began ownership and operation of facility(ies), the one-year workmanship and material warranty shall begin.

These Final Record Drawings shall be prepared to ensure that all proposed water, sanitary sewer, stormwater and natural gas plans correctly depict the facilities as constructed. The Engineer shall stamp and sign ALL SHEETS of the Final Record Drawings.
Note that Final Record Drawings shall be submitted in both digital (DWG & PDF format) and hard copy formats.

SECTION 3: DESIGN OF WATER FACILITIES

3.1. PURPOSE

MUPB's intent of this section describes the minimum requirements for design of water facilities. These requirements are listed to ensure that any development/extensions have adequate capacity to supply the average daily demand (ADD), maximum daily demand (MDD) and peak hourly demands (PHD) while maintaining a pressure of 30 psi at each meter. MUPB desires to maintain a static pressure of not less than 45 psi or better for all customers.

3.2. DESIGN APPROACH & CRITERIA

Proposed construction or expansion of water within the MUPB Service Area shall be in compliance with the Recommended Standards for Water Works (Commonly referenced as the 10 State Standards), the Kentucky Administrative Regulations (KAR) and guidelines defined in this Manual.

Any person, company, corporation, or other entity proposing to develop land or proposing to install new or replacement water facilities within the MUPB Service Area must prepare, for review and approval by MUPB, planning and design documents according to the standards and requirements of this Manual. Planning and construction documents must be prepared and certified by a Professional Engineer licensed in the Commonwealth of Kentucky. The service level of proposed facilities shall be according to design standards referenced in these documents.

3.3. ESTIMATED CUSTOMER DEMANDS

MUPB has established the following tables to be utilized to determine the customer demand of proposed developments. These tables shall be considered the minimum demands. Alternative demand calculations may be presented to MUPB for consideration. MUPB determination is final on alternative demand calculations.

RESIDENTIAL WATER DEMAND

Types of Dwelling	Demand (gallons per day)
Apartment – 1 Bedroom	250
Apartment – 2 Bedroom, Mobile Home	300
Apartment – 3 Bedroom, Condo	350
Single Family Residence	400
Duplex	800

COMMERCIAL WATER DEMAND

Commercial Description	Demand (gallons per day)
Bars (w. Food Service)	20 per seat[1]
Bars (wo Food Service)	2 per seat[1]
Bowling Alleys (w. Food Service)	75 per lane[1]
Bowling Alleys (wo Food Service)	25 per lane[1]
Motels	100 per unit
Factory (w. Showers)	35 per person[1]
Factory (wo Showers)	25 per person[1]
Industrial (manufacturing, industrial parks, etc.)	2,000 per acre[1]
Industrial – Light (distribution centers, etc.)	1,000 per acre[1]
Shopping Centers (w Food Service or Laundries)	0.2 per square feet of space[1]
Shopping Centers (wo Food Service or Laundries)	0.1 per square feet of space[1]
General Commercial	5,000 per acre[1]
Coin Laundries	400 per machine[1]
Service Station	1,000 per 1st Bay[1] 500 per each add bay[1]

Note: [1] Demand based upon 8-hour shift or period.

INSTITUTIONAL WATER DEMAND

Institutional Description	Demand (gallons per day)
Hospital	200 per bed
Institutions	100 per person
Nursing Home & Rest Homes	100 per person

Institutional Description	Demand (gallons per day)
Youth & Recreational Camps	50 per camper
RV Camps	100 per site
Schools (elementary & middle schools)	15 per person[1]
Schools (high school)	20 per person[1]
Church	7 per seat[2]

Note: [1] Demand based upon 8-hour shift or period.
[2] Demand based upon 2-hour shift or period.

Average Daily Demand (ADD) will be determined by the above tables and summed together for all planned development types. Any development containing commercial and/or institutional demands shall calculate an equivalent residential unit (ERU) for the development.

Maximum Daily Demand (MDD) is to be calculated by using a peaking factor of 1.8 to ADD.

MDD (gpd) = 1.8 x ADD (gpd)

Peak Hourly Demand (PHD) will be calculated by using a peaking factor of 3.6 to ADD.

PHD (gph) = (3.6 x ADD) ÷ 24

3.4. HYDRAULIC MODEL

MUPB requires a hydraulic model to be presented with submittal of plans for review. The hydraulic model shall be based upon a two-point flow test at the nearest available fire hydrants to the development/extension or model shall include all associated connections and include the nearest water storage facility. MUPB will provide OWNER/ENGINEER the necessary information regarding a two-point flow test, conducted by MUPB or assigned representatives.

As an alternate to providing a hydraulic model to MUPB, the OWNER/ENGINEER may elect to have MUPB develop the required hydraulic model of the development/extension with all associated connections and facilities necessary. In order for MUPB to develop the required hydraulic model, the OWNER/ENGINEER acknowledges that the cost for developing the model will be paid by the OWNER/DEVELOPER at the rate described below.

EXTENSION LENGTH (Total Footage)	FEE
Small Extension (<1,000 Total LF)	$ 1,000

EXTENSION LENGTH (Total Footage)	FEE
Medium Extension (1,001 to 5,000 Total LF)	$ 2,000
Large Extension (> 5,001 Total LF)	$ TBD

The Hydraulic Model shall follow guidelines set forth by Kentucky Division of Water (KDOW) in Construction Permit Application (DW-1). OWNER/ENGINEER shall submit the Hydraulic Model Information Sheet in APPENDIX G.

3.4.1 KDOW REQUIREMENTS

KDOW DW-1 requires at a minimum the following hydraulic information to be provided with the hydraulic model:

A. Provide pump sizing calculations and the proposed pump's characteristics curve along with the efficiency, horsepower and NPSHR data, if applicable.
B. Provide an Extended Period Simulation (EPS) for the addition of a storage tank to demonstrate a complete fill and drain cycle every 72 hours, if applicable.
C. Model must demonstrate the availability of 30 psi under peak demand conditions.
D. Model must demonstrate that the proposed water lines are capable of providing a flushing velocity of 2.5 ft per second while maintaining a minimum of 20 psi at all times.

3.4.2 MUPB REQUIREMENTS

MUPB requires the following information to be included in addition to KDOW requirements:

A. A written hydraulic model summary, area map and electronic copy of the model for review. Identify the computer modeling software utilized and provide all related database files to ensure model will import to PIPE2020 or latest version.
B. Provide a system map showing the modeled pipe network. Label all pipes, nodes, road names, north arrow, scale, number of units, unit type, demands, elevation contours and outline of the phasing, if applicable.
C. Save files such that each file demonstrates that the development meets KDOW criteria separately. This ensures that during the review by MUPB it is an accurate representation of the model prepared by ENGINEER.
D. The model must represent the entire development, including all known future phases.
E. All existing demands shall be represented in model to accurately represent system flows and pressures.
F. Identify the source of water (i.e. pressure zone) and type of pressure source being modeled (tank, PRV or two-point flow test curve).

G. Provide a node report to display name, elevation, corresponding connected pipes, demand, hydraulic grade line (HGL) and pressure.
H. Provide a pipe report to display name, diameter, flow, velocity, length and head loss.
I. Provide a conclusion of results, table listing nodes with maximum and minimum pressures for all situations modeled. Table of Max/Min shall include 10% of the number of nodes within development, minimum of 5 for each.

3.5. WATER FACILITY EASEMENT

For public water mains, provide permanent easements with widths no less than fifteen (15) feet, centered upon installed pipe and temporary construction easements with widths no less than thirty (30) feet for water mains less than 36" diameter. All water mains shall be located a minimum of ten (10) feet from all permanent structures.

Where public water mains run along a lot line within a subdivision, locate the water facilities a minimum of 3 feet from the parcel or lot boundary line. Where public water mains parallels such lot line, the water easement shall straddle the parcel boundary, in order to allow MUPB access to both lots for maintenance work.

Where proposed construction is across land of others, temporary construction easements shall be established in sufficient widths to accommodate the work area, see SECTION 2.

Public water mains shall be located in areas (public right-of-way or easements with access adjacent to public right-of-way) with access available through and/or adjacent to proposed roadways. Public water mains laid in the back of properties with access only via entering private property is not permitted; however, a request may be made and will be reviewed by MUPB on a case-by-case situation.

Easement plats, instrument of conveyance and/or deed shall be reviewed prior to being executed and filed according to the procedures found in SECTION 2.

3.6. CONSTRUCTION PLAN REQUIREMENTS

Construction Plans are to be prepared by a licensed Professional Engineer with a valid and current license in the Commonwealth of Kentucky per KRS Chapter 322. Plans shall be submitted per Section 2 – Application for Service.

SECTION 4: DESIGN OF BOOSTER PUMP STATION

4.1. PURPOSE

MUPB's intent of this section describes the minimum requirements for the design of booster pump stations to augment existing water pressures for a proposed development. These requirements are listed to ensure that any development/extensions have adequate pressure while not having a negative impact upon other existing water facilities and customers.

4.2. DESIGN APPROACH

Proposed construction or expansion of water facilities, within the MUPB Service Area shall be in compliance with the Recommended Standards for Water Works (Commonly referenced as the 10 State Standards), the Kentucky Administrative Regulations (KAR) and guidelines defined in this Manual.

Any person, company, corporation, or other entity proposing to develop land or proposing to install new or replacement water main(s) and/or booster pump station(s) within the MUPB Service Area must prepare, for review and approval by MUPB, planning and design documents according to the standards and requirements of this Manual.

Planning and construction documents must be prepared and certified by a Professional Engineer licensed in the Commonwealth of Kentucky. The service level of proposed facilities shall be according to design standards referenced in these documents.

4.3. ESTIMATED CUSTOMER DEMANDS

MUPB has established the tables in SECTION 3 to be utilized to determine the customer demand of proposed developments. These tables shall be considered the minimum demands. Consideration of alternative demand calculations may be presented to MUPB for consideration. MUPB determination is final on alternative demand calculations.

4.4. HYDRAULIC MODEL

MUPB requires a hydraulic model to be presented with the submittal of plans for review. The hydraulic model shall be based upon a two-point flow test at the nearest available fire hydrant to the development/extension, or model shall include all associated connections and include the nearest water storage facility. MUPB will provide OWNER/DEVELOPER the necessary information regarding a two-point flow test, conducted by MUPB or assigned representatives.

As an alternate to providing a hydraulic model to MUPB, the OWNER/DEVELOPER may elect to have MUPB develop the required hydraulic model of the development/extension with all associated connections and facilities necessary. In order for MUPB to develop the required hydraulic model, the OWNER/DEVELOPER acknowledges that the cost for

developing the model will be paid by the OWNER/DEVELOPER at the rate described below.

DEVELOPMENT SIZE (# of Lots)	FEE
Small Development (<5 lots)	$ 1,500
Medium Development (6 to 20 Lots)	$ 2,500
Large Development (> 20 lots)	$ TBD

The hydraulic model shall follow guidelines set forth by Kentucky Division of Water (KDOW) in the Construction Permit Application (DW-1). OWNER/DEVELOPER shall submit the Hydraulic Model Information Sheet in Appendix G.

4.4.1. KDOW REQUIREMENTS

KDOW DW-1 requires at a minimum the following hydraulic information to be provided with the hydraulic model:

A. Provide pump sizing calculations and the proposed pump's characteristics curve along with the efficiency, horsepower, and NPSHR data, if applicable.

B. The model must demonstrate the availability of 30 psi under peak demand conditions.

C. The model must demonstrate that the proposed water lines are capable of providing a flushing velocity of 2.5 ft per second while maintaining a minimum of 20 psi at all times.

4.4.2. MUPB REQUIREMENTS

MUPB requires the following information to be included in addition to KDOW requirements:

A. A written hydraulic model summary, area map, and electronic copy of the model for review. Identify the computer modeling software utilized and provide all related database files to ensure model will import to PIPE 2020 or latest version.

B. Provide a system map showing the modeled pipe network. Label all pipes, nodes, road names, north arrow, scale, number of units, unit type, demands, elevation contours, and outline of the phasing, if applicable.

C. Save files such that each file demonstrates that the development meets KDOW

criteria separately. This ensures that during the review by MUPB it is an accurate representation of the model prepared by the ENGINEER.

D. The model must represent the entire development, including all known future phases.

E. All existing demands shall be represented in the model to accurately represent system flows and pressures.

F. Identify the source of water (i.e. pressure zone) and type of pressure source being modeled (tank, PRV or two-point flow test curve).

G. Provide a node report to display name, elevation, corresponding connected pipes, demand, hydraulic grade line (HGL), and pressure.

H. Provide a pipe report to display name, diameter, flow, velocity, length, and head loss.

I. Provide a conclusion of results, table listing nodes with maximum and minimum pressures for all situations modeled. The table of Max/Min shall include 10% of the number of nodes within development, minimum of 5 for each.

J. Provide booster pump results table listing each pump, flowrate, inlet head, outlet head, pump head, and available NPSH.

4.5. BOOSTER PUMP STATION SITE

A. Booster pump station sites will be determined with input from MUPB. Booster pump station shall be located outside of flood prone areas. If the station must be located within a flood prone area specific precaution shall be made to protect the station. All finished floors, tops of all structures (below ground), and equipment shall be above the 100-year flood elevation, at minimum of one-foot.

B. Booster pump station shall have a dedicated paved access drive, security fence, landscape, and exterior lighting. All booster pump station sites shall be deeded to MUPB prior to MUPB assuming ownership, operational and maintenance controls. An easement may be permitted at MUPB sole discretion. An easement for ingress/egress for an access road would be permissible.

C. Booster pump station shall be placed in an area with ease of access for maintenance equipment including but not limited to the following: crane, excavation equipment (backhoe, excavator, etc.), and maintenance trucks.

D. The need for and quantity of exterior lighting shall be determined on a case-by-case basis. Wherever possible, booster pump stations shall be hidden from view of nearby neighbors and roads. If necessary, booster pump stations shall be hidden through the use of tree plantings or privacy fencing. Quantity and type of

tree must be approved by MUPB and meet the requirements set forth by MRCP&Z. Required buffers shall comply with MRCP&Z.

E. The booster pump station's lot will be fenced and screened/landscaped per MUPB and MRCP&Z requirements.

F. A 12-foot wide, paved access road with gravel shoulders shall be provided to the station. The minimum road section will consist of a compacted sub-grade, 8 inches of DGA stone, and 2 inches of bituminous pavement. The gradient of the roadway centerline shall not exceed 5 percent. Unrestricted ingress and egress will be granted to MUPB from a public right of way to the booster pump station.

G. An unrestricted, all weather access road to the station shall be maintained by the CONTRACTOR/DEVELOPER until the permanent access road is complete and accepted by MUPB. MUPB must have access to the station at all times.

H. A 6-foot high, chain link security fence topped with angle arms pointing out and 3 strands of barbed wire shall be provided around the booster pump station lot. The total height of this assembly is 7 feet. The fence shall be equipped with a top rail and a bottom tension wire. Access into the station will be through a minimum 14-foot wide, lockable gate. Depending upon the location of the booster pump station an alternative fencing system may be required by MUPB.

I. All door locks and padlocks in the station will be keyed to MUPB's standard keys.

J. Adequate provisions will be made for parking and turning large vehicles around at the station.

K. The project specifications will specify a paint or other protective coating for all corrodible materials not otherwise protected. The type, color, and thickness of the paint or other protective coating are subject to the approval of MUPB.

4.6. BOOSTER PUMP STATION DESIGN CRITERIA

The following parameters have been established by MUPB to ensure that future booster pump station(s) and modifications made to existing booster pump station(s) meet a minimum standard. The parameters listed in the following paragraphs are not a complete listing of all situations that may be encountered but is a minimum standard to be met. Any variance from these parameters requires MUPB approval and at MUPB discretion. Booster pump stations shall meet the following parameters:

4.6.1. PUMP SIZING

A. The pump shall be sized in accordance with KDOW, Ten State Standards, KAR, and industry standards to supply the necessary average day demand, peak hourly demand, and flushing flow rates.

B. Pumps shall be sized accordingly to all future development not just the initial phase.

C. Pumps shall be vertical multi-stage centrifugal type.

4.6.2. MOTOR SIZING

A. Motor shall be sized to ensure the pump is non-overloading when operating on the specified pump curve.

B. Motor shall be totally enclosed fan cooled (TEFC) with a NEMA C face design with a minimum service factor of 1.15.

C. Motor shall be premium efficient for suitable use with variable frequency drive (VFD) unit.

4.6.3. INTERNAL PIPING

A. All internal piping shall be flanged ductile iron class 350 for pipe diameters 3-inch and larger and SCH 40 welded steel pipe or threaded pipe for pipe diameters less than 3-inch.

B. Pipe entering/exiting the booster station building shall be sized same size as the main water main. Pipe shall only be reduced within the building.

C. All internal piping shall be supported by pipe supports, anchored to the concrete floor slab.

4.6.4. EXTERNAL PIPING

A. All external piping shall be mechanical joints (restrained) until the piping has exited the booster station slab/foundation. Once outside the slab/foundation of booster station shall be material that meet the pressure requirements of operating pressure ranges.

B. All external piping shall be backfilled according to this MANUAL.

4.6.5. PRESSURE GAUGES

All booster pump stations shall have suction and discharge pressure gauges panel mounted off of the pipeline and be connected to their respective sensing point. The gauge panel shall include isolating and vent valves. Tubing to each gauge shall be arranged as to easily vent air and facilitate gauge replacement. Gauges shall not be mounted directly to the pipeline or at the sensing point.

Pressure gauges shall be sized accordingly to normal operating pressures (average pressures). Gauge ranges shall be no more than twice the operating

pressure. Gauge assemblies shall be furnished with shutoff stops, diaphragm seals and pulsation dampers, which shall be constructed of brass or stainless steel. Gauges shall be 4-1/2-inch in diameter. Gauges shall have the following graduations:

Pressure Gauges (psi)

Maximum *Indications*	*Figure Intervals*	Intermediate Graduations	Minor Graduations
15	1	0.5	0.1
30	5	1	0.2
60	5	1	0.5
100	10	5	1
160	20	5	1
200	20	10	2
300	30	10	2

4.6.6. BACKUP POWER

A. Certain booster pump stations will require on-site backup power via generator. All backup power shall be designed to handle full load application with all ancillary items operating. Automatic transfer switches are required for all pumps where generator and/or engine driven motors are on-site.

B. Standby generators shall be diesel or natural gas driven with fuel storage on the underside of the generator in a double-walled containment tank. The tank shall be sized for 48 hours of continuous use at full load, if possible. Skid mounted tanks are not acceptable. A fuel storage level indicator will be provided on the generator and in the control building via display. Fuel tank shall be refilled after all startup and testing is complete.

C. The generator will be equipped with an alarm indicator and output contacts to display the cause of a generator failure, both locally and remotely. The means for starting an emergency generator shall be completely independent of the normal electric power source. The starting system shall be sufficient to start the generator a minimum of 3 times without recharging. The starting system shall be alarmed and instrumented to indicate a loss of readiness via SCADA System.

4.6.7. ISOLATION VALVES

A. Isolation valves shall be located on the discharge and suction side of each

pump to allow the pump to be isolated. A check valve shall be installed on each discharge line, between the pump and the isolation valve. Isolation and check valves shall be located on the interior of the booster station building. Isolation valves shall be installed in the horizontal position, so that the valve wedge is in the top when open.

4.6.8. SWING CHECK VALVES

A. Swing Check Valves shall be constructed of a heavy-duty body of cast iron conforming to ASTM A126 Class B with integral flanges, faced and drilled per ANSI B16.1 Class 125 or 250. The valve shall have a replaceable stainless steel body seat. The swing check valves shall have limit switch circuitry for pump failure logic.

B. The valve shall be supplied with an outside lever and adjustable counterweight to initiate valve closure. Final closure shall be dampened by means of a single, side-mounted bronze oil-cushion assembly directly mounted to the valve body.

C. MUPB may allow for differing styles of check valves for differing pumping and discharge pressures.

4.6.9. STRAINER

Strainer shall be either a plate strainer or “Y” strainer located on the common suction side of the pump(s).

4.6.10. LIGHTING

Adequate lighting shall be provided throughout the booster pump station. All lighting fixtures shall be rated for the environment in which they are installed. Where applicable LED fixtures shall be installed in accordance with the manufacturer’s recommendations to provide adequate heat dissipation and maximize the life expectancy of the fixture. LED fixtures shall have a 0º F start ballast and have a plastic lens to protect the lamps. All exterior-photoelectric switches shall be intrinsic safe. All lighting shall have an HOA switch.

4.6.11. VARIABLE FREQUENCY DRIVES

All booster pump stations shall have variable frequency drives (VFD) for operation of a pressure-controlled situations. VFDs shall be DANFOSS and most recent model available.

4.6.12. CONTROLS

A. Control panel shall be wall mounted or integrally strut mounted as part of a skid style station.

B. The pumps shall be controlled by means of a pressure transducer or telemetry (SCADA). The pressure transducer shall be programmed to turn the pumps on or off at various pressures (maximum/minimum). A spare transducer shall be provided for each booster station.

C. Check valve limit switch circuitry shall be used for pump failure logic, at MUPB's discretion.

D. An elapsed run time indicator shall be provided for each pump.

E. A press-to-test circuit shall be provided for the control panel indicator lights.

F. All control wiring and interface wiring shall be number coordinated with the schematic drawing. All panel and field wiring shall be identified with non-repeating numbers. All instrumentation and control devices shall be wired with stranded copper conductors.

G. All motor controls shall be equipped with a motor overload indicator light for each motor equipped with a thermal overload protection device.

H. Provide an uninterruptible power supply (UPS) with 2-hour battery for the control system.

I. Two sets of laminated drawings of the final wiring schematic(s) shall be provided to MUPB with one set of drawings attached to the inside face of the interior door of the control panel.

4.6.13. TELEMETRY

MUPB shall specify the method of communications and specific brands of hardware and software to be used. MUPB may require additional telemetry at a particular booster pump station. The following signals are required:

Description	Booster Pump Station	
	Monitor	Required Signals
Pump Run for each pump	Yes	Per # of pumps
Power Failure	Yes	1
Phase Failure	Yes	1

Generator or Backup Power Run	Yes	1
Generator or Backup Power Failure	Yes	1
Telemetry Failure	Yes	1
Building Intrusion	Yes	1
Control Panel Intrusion	Yes	1
Low Suction Pressure	Yes	1
Generator Fuel Level	Yes	1
Pump Run Failure	Yes	Per # of pumps

Telemetry equipment shall be housed in a NEMA 4X Stainless Steel enclosure for outdoor use. Costs to modify the master station will be borne by OWNER/DEVELOPER.

4.6.14. HVAC EQUIPMENT

A. Each booster pump station shall include a one piece, wall mounted, factory assembled, pre-charged, prewired, tested and ready to operate HVAC unit. The unit shall be approved and listed by UL.

B. Each booster pump station shall include a dehumidifier that is UL approved and listed by UL and adequately sized for the booster pump station.

4.6.15. ELECTRICAL

A. Electric power shall be provided to the station by distribution lines and by a standby generator. Both power sources shall be sufficient to operate all pumps, critical lighting, and ventilation systems for all operating conditions.

B. The distribution lines and generator shall have a means of being disconnected before the transfer switch. The generator will automatically switch sources in the event of a power failure. The transfer switch will be fully automatic with the ability to sense a single-phase power condition and switch to the generator power system with a minimum time delay. Both power sources shall be protected by fuses or breakers prior to the transfer switch. The transfer switch shall be capable of being operated manually.

C. The station's power supply shall be protected from lightning.

D. A final step-down transformer shall be provided on each electric feed line with adequate physical separation between them to prevent a common mode failure. Separate fuses shall be provided for each power source.

E. The electric distribution line and the standby generator will remain separate and form separate distributions up to the internal fuse system to preclude a common mode failure of both sources.

F. Breaker settings or fuse ratings shall be coordinated to affect sequential tripping such that the breaker or fuse nearest the fault will clear the fault prior to activations of other breakers or fuses to the degree practical.

G. The load distribution panel shall not be an internal part of the transformer.

H. All motors and control enclosures will be adequately protected from moisture, the weather, and water under pressure.

I. All equipment shall be installed in accordance with the manufacturer's recommendations. When laying out the location of the equipment in the control and generator building, the ENGINEER will consider the necessary separation between devices to provide adequate ventilation and the location of doors, hatches, and panel covers to avoid conflicts between these items when they are opened and closed.

J. Provide arc flash study and rating for the facility with design of corresponding safety features. Design system to Class 2 or lower rating for arc flash. Arc flash study shall be performed on the design and again at the substantial completion of the station.

4.6.16. STARTUP

A. Successful test shall include the confirmation of the following:

1. All major equipment operated, as specified.

2. The control systems worked, as specified.

3. The telemetry systems worked, as specified.

4. Adjustments of control settings within the normal operating parameters are allowed as long as the booster pump station remains operational and no unplanned alarm signals are generated.

B. Substantial Completion

1. All successful start-up tests shall be performed by the

CONTRACTOR/DEVELOPER, certified by the ENGINEER, and accepted by MUPB prior to the Certificate of Substantial Completion.

2. MUPB shall be provided with sufficient spare parts for all major equipment. See MUPB's Spare Parts Checklist, APPENDIX K. Special tools may also be required for a given booster pump station that uses special (non-standard) equipment, that has been preapproved by MUPB. Special tools shall be specified during the review of the booster pump station plans by MUPB.

3. Four copies of the approved Operations and Maintenance Manual and one digital copy on CD will be supplied to MUPB prior to completion of the station. The Operations and Maintenance Manual will contain a reduced set of the booster pump station plans including as-built electrical and control schematics, equipment model and serial numbers, installation instructions, maintenance schedules, names, and telephone numbers for local representative for each item of equipment.

4.7 CONSTRUCTION PLAN REQUIREMENTS

Construction Plans are to prepared by licensed Professional Engineer with a valid and current license in the Commonwealth of Kentucky per KRS Chapter 322. Plans shall be submitted per Section 2.

SECTION 5: CONSTRUCTION OF WATER FACILITIES

5.1. PURPOSE

The purpose of this SECTION is to outline requirements for construction, inspection, and final acceptance of potable water mains and appurtenances, water service connections, and public fire protections systems.

5.2. REQUIREMENTS

Water system improvements shall be installed in public rights-of-way or upon MUPB approval, in a utility easement granted to MUPB. All easement information must be submitted as outlined in Section 1 and 2 of this MANUAL. Water mains shall not be closer than ten feet (10) to all permanent structures.

Dead end water mains shall be minimized by looping of water mains with multiple feed points. Where dead ends occur, they shall terminate with a fire hydrant, flushing hydrant, or automatic flush valve.

The CONTRACTOR shall install a waterline marker post at the ends of all water lines, including water mains and water service connections, so as to identify the termination point of the line. The location posts shall be blue in color and marked so as to identify the line as a water pipe.

5.2.1 WATER MAINS

Water mains are those pipes used to distribute potable water to water service connections and public fire hydrants and are owned or under the control of MUPB. Water mains must be sized to meet current water consumption and projected average and maximum daily demands, including fire flow demand, if required.

Mains serving fire hydrants shall be minimum 6-inch diameter.

Mains without hydrants shall be minimum 3-inch diameter. Any departure from minimum requirements shall be justified by hydraulic analysis and future water use, and can be considered only in special circumstances.

5.2.2. SYSTEM PRESSURES

Minimum system pressure for all normal operating conditions shall be 30 psi. Water lines should be hydraulically capable of a flow velocity of 2.5 ft/s while maintaining a pressure of at least 20 psi.

All water mains, including those not designed to provide fire protection, shall be sized after a hydraulic analysis based on flow demands and pressure requirements. The system shall be designed to maintain a minimum normal

operating pressure of 30 psi at ground level at all points in the distribution system under all normal conditions of flow**. The normal working pressure in the water distribution system shall not be less than 30 psi and should be approximately 60 to 80 psi.**

When static pressure exceeds 90 psi, pressure reducing devices shall be provided on mains or as part of the meter setting on individual service lines in the distribution system.

5.2.3. WATER SERVICE LINES

Water service lines are those water lines that tap off the water main and provide water service to a specific property, utility customer or water user.

The normal working pressure in the distribution system at the service connection should be approximately 60-80 psi and shall not be less than 30 psi under peak demand flow conditions. Peak demand is defined as the maximum customer water usage rate, expressed in gallons per minute (gpm), in the pressure zone of interest during a 24-hour (diurnal) time period.

All water service lines shall be designed and sized to maintain a minimum 30 psi pressure at peak design flow. Water service lines for single residences shall be at least 3/4 inch in diameter. When two residences are served by one service line a minimum of a 1" line shall be installed.

All water service lines shall be covered with a minimum of 36” to top of pipe within city and a minimum cover of 42” within KYTC ROW or county ROW.

Water line plans shall show individual meter locations. All double water service lines across streets from the main shall be a minimum 1” PE Tubing and encased in 2” PVC pipe in gravel bedding. Single meter services shall be 3/4” PE Tubing encased in 2” PVC piping. The service line shall have a shutoff valve at the meter box and corporation stop at the main and turned on. MUPB will set the meter when a customer applies for service. All non-metal tubing shall have a coated solid copper 12-gauge tracer wire shall be taped to the casing pipes for all street crossings.

5.2.4. WATER LINE LOCATION

The water main shall be constructed to a depth providing a minimum cover of 36” to top of pipe within city and a minimum cover of 42” within KYTC ROW or county ROW.

Water mains and water service lines shall be separated from sanitary sewer mains. Water lines shall be constructed with a lateral separation of 10 feet or more from any gravity sanitary or force main measured edge to edge where practical. If not practical a variance may be requested to allow the water pipe to be installed closer

to the gravity sanitary or force main provided the water pipe is laid in a separate trench or undisturbed shelf located on one side of the sewer with the bottom of the pipe at least 18 inches above the top of the gravity sanitary or combined sewer pipe.

Water lines crossing gravity sanitary sewer or force main sewers shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sanitary sewer main with preference to the water main located above the sanitary sewer.

A plan for a water line that would propose a section of line be laid within a 200-foot radius of an underground storage tank as defined in KRS 224.60-100 or a petroleum storage tank as defined in KRS 224.60-115, shall provide that all water lines within the 200-foot radius shall be ductile iron pipe with appropriate gaskets or other non-permeable pipe approved by the cabinet. Any future replacement of an existing water line within a 200-foot radius of a storage tank, whether or not plans are submitted to KDOW, shall also meet this requirement.

Non-permeable materials shall be used for all portions of the piping system present within a 200-foot radius of an area of known soil contamination by organic compounds, including hydrant leads and service connections.

5.3. PIPE MATERIAL

Water mains shall be constructed of ductile iron or polyvinyl chloride (PVC) pipe unless otherwise approved by MUPB. HDPE (directionally drilled) pipe may be used for stream or river crossings where approved by MUPB.

5.3.1. DUCTILE IRON PIPE, FITTINGS & JOINTS

Ductile iron shall conform to the latest AWWA Specifications C151 (ANSI A21-51). Pressure class shall be Class 350.

The interior of the pipe shall be cement-mortar lined in accordance with AWWA C104 (ANSI A21.40). The exterior of the pipe shall be bituminous coated in accordance with AWWA C151 (ANSI A21.51) for pipe and AWWA C 110 (ANSI A21.10) for fittings.

Fittings shall be Mechanical Joint, conforming to AWWA Specification C110, for short body cast iron fittings. Fittings shall be tar-coated outside and shall receive the standard cement lining on the inside as specified for the ductile iron pipe. All bolts shall be wrapped in plastic prior to thrust blocking. All fittings shall have grip rings.

Pipe joints shall be of the push-on or mechanical joint type (see MUPB approved manufacturers list), conforming to AWWA C111 (ANSI 21.11). Bells for push-on type joints shall have an annular recess in the pipe socket to accommodate a single

rubber gasket. Plain ends shall be suitably beveled to permit easy entry into the bell. The gasket and annular recess of the socket shall be so designed and shaped that the gasket is locked in place against displacement as the joint is assembled.

All buried pipe shall have copper tracer wire taped to the line for the purpose of pipe location. See paragraph 5.20. for specifics of tracer wire requirements.

5.3.2. DUCTILE IRON BALL & SOCKET PIPE

Ductile Iron Ball and Socket pipe shall be used for large stream or river crossings where directional drilled creek crossing is not utilized. The pipe material shall be ANSI A21.51 with a pressure rating of 350. The bell, ball and retainer shall be made of ANSI A21.10 ductile iron.

5.3.3. POLYVINYL CHLORIDE PIPE (PVC), FITTINGS AND JOINTS

PVC water pipe shall conform, at a minimum to normal working pressure of 150 psi A21 10 per AWWA standards. The pipe furnished under ASTM F477 and joints in compliance with ASTM D3139 and shall be rated to a working pressure of at least 150 PSI at 73.4-degree Fahrenheit. Higher pressure rated PVC pipe shall be considered on a case-by-case basis and the pipe material and classification shall be determined by MUPB.

Fittings shall be Ductile Iron Mechanical Joint conforming to AWWA Specifications C110 for short body fittings. Fitting shall be tar-coated exterior, and shall receive the standard cement lining with bituminous seal coat on the interior as specified for ductile iron pipe.

Pipe joints shall be of the rubber gasketed type, conforming to ASTM D3139 and ASTM F477. All jointing material and lubricants shall be non-toxic.

All buried pipe shall have copper tracer wire taped to the line for the purpose of pipe location. See paragraph 5.20. for specifics of tracer wire requirements.

5.3.4. HDPE PIPE & FITTINGS

HDPE (directionally drilled) pipe may be used for stream or river crossings where approved by MUPB. HDPE pipe shall conform, as a minimum to AWWA C906 and shall be of a pressure class to provide a 2.5 safety factor of normal working pressure. Higher pressure rated HDPE pipe shall be considered on a case-by-case basis and the pipe material and classification shall be determine by the MUPB.

Fittings shall be HDPE butt fused fittings, mechanical joint adapters, flanges, unions, grooved-couplers, transition fittings and some mechanical couplings conforming to AWWA Specifications and manufacturer recommendations. Pipe joints shall be butt fused.

All buried pipe shall have copper tracer wire taped to the line for the purpose of pipe location. See paragraph 5.20. for specifics of tracer wire requirements.

5.3.5. ENCASEMENT PIPE

Encasement pipe shall be steel, plain end, uncoated and unwrapped, have minimum yield point strength of 35,000 PSI and conform to ASTM Grade 2 of ASTM A130 Grade B without hydrostatic tests. The steel pipe shall have welded joints and be in at least 18-foot lengths.

The wall thickness of the pipe shall be a minimum of 0.375 (3/8") inches for highway crossings and for railroad crossings. Refer to MUPB Standard Details for wall thickness and diameter requirements. The diameter of the pipe shall conform to the requirements of American Railway Engineering Association for railroad crossings, and the requirements of the Kentucky Department of Transportation.

5.4. WATER LINE APPURTENANCES

5.4.1. GATE VALVES

All gate valves shall be mechanical joint resilient seat wedge, iron body, non-rising stem, fully bronze mounted and suitable for 200 PSI working pressure and hydrostatic tested to 400 PSI pressure. Valves shall be of standard manufacture and of the highest quality both as to material and workmanship

All gate valves shall have the name or monogram of the manufacturer, the year the valve casting was made, the size of the valve, and the working water pressure cast on the body of the valve.

Gate valves set with valve boxes shall be provided with a two-inch square operating nut and shall open by turning to the left (counterclockwise).

Gate valves for installation in meter vaults shall be flanged ANSI B16.1 Class 125 and hand wheel operated.

All valves shall conform to the latest revision of AWWA Standard for Gate Valves for Ordinary Water Works Service, AWWA C500.

5.4.2. TAPPING SLEEVES AND VALVES

Tapping sleeves and valves for connection to existing water mains shall be in accordance with MUPB approved manufacturers list and be tested according to the manufacturer's recommendations.

5.4.3. VALVE BOXES

Valve boxes shall be of 5.25-inch standard cast iron, two pieces, and screw type valve box with drop cover marked "WATER". For water mains with a cover greater than 5', 8" PVC pipe may be used to raise the valve box to grade and a long valve wrench. Valve boxes shall be accurately centered over valve operating nut, and backfill thoroughly tamped about them.

Valve box bases shall not rest on the valves but shall be supported on crushed stone fill below the valve stem. They shall be set vertically and properly cut and/or adjusted so that the tops of boxes will be at grade in any paving, walk or road surface. In non-paved areas, an 18" round or 18" square concrete valve marker shall be installed around the valve box, minimum of 4" thickness.

5.4.4. FIRE HYDRANT

Fire hydrants installed within MUPB distribution system shall follow the approved material list and standard details.

The CONTRACTOR shall furnish and install fire hydrants were shown on the plans. Hydrants shall conform in all respects to the requirements of AWWA C502-73. Hydrant barrel shall have safety breakage feature above the ground line. All hydrants shall have 6-inch (6") mechanical joint shoe connection, two 2.5-inch (2.5") discharge nozzles and one (4.5") inch pumper nozzle with caps fitted with cap chains. Connection threads and operation nuts shall conform to National Standard Specifications as adopted by National Board of Fire underwriters.

Operation nut shall be pentagonal in shape, conform to current standard in use, and shall open by turning to the left (counterclockwise). Main valve shall have 5.25 inch (5.25") full opening and be of the compression type opening against water pressure so that the valve remains closed should the barrel be broken off.

Hydrant shall be fully bronze mounted. Main valve shall have a threaded bronze set ring assembly of such design that it is easily removable by unscrewing from a threaded bronze drain ring. Bronze drain ring shall have multiple ports providing positive automatic drainage as the main valve is opened or closed. Drainage waterway shall be completely bronze to prevent rust or corrosion.

Operating stem shall be equipped with anti-friction thrust bearing to reduce operating torque and assure easy opening. Stop shall be provided to limit stem travel. Stem threads shall be enclosed in a permanently sealed lubricant reservoir protected from weather and the waterway with O-ring seals.

Hydrants shall be designed for 250 PSI working pressure and shop tested to 500 PSI pressure with main valve both opened and closed. Under test the valve shall not leak, the automatic drain shall function and there shall be no leakage into the bonnet.

Fire hydrants shall be located not more than 6 feet (6') nor less than 2.5 feet from the edge of existing or proposed edge of pavement unless otherwise approved by MUPB. Hydrants shall be installed with a vertical distance from the center of the pumper nozzle to the ground of at least 18 inches. All fire hydrants shall be provided with a shut-off valve on the hydrant lateral.

Fire hydrants shall be secured to the shut off valve by AWWA approved restraint joints, joint restraints or another method approved by MUPB. MUPB shall determine spacing, placement and orientation of all fire hydrants

The fire hydrants shall have the NFPA identification color on the bonnet that signifies the correct flow rate for that hydrant.

a. Red – 0 – 499 gpm
b. Orange – 500 – 999 gpm
c. Green – 1000 – 1499 gpm
d. Blue – 1500 and up gpm

5.4.5. AIR RELEASE VALVES AND BOXES

Air release valves shall be installed at the high point on the water main as shown on the approved standard details. They shall be connected to the main by a corporation stop with inside I.P.S. threaded outlet. The inlet pipe to the air release valve shall be seamless red brass or stainless-steel pipe with I.P.S. male threaded ends and isolation valve.

Air release valves shall be per the approved equal manufacturer list of water parts and supplies. Valve shall have a threaded inlet and be suitable for 250 PSI water working pressure. The air release valve shall be installed as shown in MUPB Standard Details.

5.4.6. FIRE PROTECTION LINES

Installation of water service lines to be used for private fire protection systems (i.e. sprinkler systems) shall have a MUPB approved backflow preventer installed at the property line. Backflow Preventer shall be installed in the Fire Vault or other approved location, where the facility owner of the installed backflow preventer, can have it tested regularly and provide certified test results to MUPB.

5.5. TRENCH EXCAVATION

Trenches in which pipes are to be laid shall be excavated in open cut to the depths shown on the approved plans. The minimum allowable trench width shall not be less than the outside diameter of the pipe plus twelve (12) inches. Where rock is encountered, it shall be removed to a minimum depth of six inches below the pipe bell and twelve (12) inches on either side.

Trenches shall be kept free of water during the installation of pipe and until the pipeline has been backfilled. Backfilling shall be as specified herein.

5.5.1. OBSTRUCTIONS

In cases where storm sewers, sanitary sewers, gas lines, water lines, telephone lines, and other utilities, or other underground structures are encountered, they shall not be displaced. All precautions shall be made to not damage any other utility. In the event that a utility is damaged (as defined by the owner of the said utility) all fines/repairs/damage fees associated with these damages will be incurred at the expense of CONTRACTOR/OWNER. See KY PSC rules on Natural Gas/Hazardous Liquids pipeline incidents.

The CONTRACTOR shall notify KY 811 prior to beginning construction work.

5.5.2. SHORING SHEETING AND BRACING

The shoring, sheeting, and bracing of excavation shall be performed by the CONTRACTOR in compliance with applicable codes and OSHA requirements. MUPB shall not be held responsible for job site safety. Safety is the responsibility of the OWNER/CONTRACTOR.

5.6. PIPE BEDDING

In all cases the foundation for pipes shall be prepared so that the entire load of the backfill on top of this pipe will be carried on the barrel of the pipe and, insofar as possible, where bell and spigot pipe are involved so that none of the load will be carried on the bells.

When undercutting and granular bedding are involved, the depth at the bottom of the bells of the pipe will be at least six inches above the bottom of the trench as excavated.

Supporting of the pipe shall be as set out hereinbefore, and in no case shall the supporting of pipe on blocks be permitted.

5.6.1. EARTH FOUNDATION

Bedding material shall be free from rock and be acceptable to MUPB. In no case shall pipe be supported directly on rock. Pipe may be supported on excavated earth, if acceptable by MUPB.

5.6.2. ROCK FOUNDATION

If the trench bottom is in rock, the excavation shall be undercut to a minimum depth of six inches below the bottom of the pipe. The pipe shall be laid on a bed of granular material to provide continuous support for the lower section of the pipe.

Granular bedding shall be size No. 9 or No. 68 crushed stone as defined by KYTC-KDHSS.

5.6.3. SPECIAL BEDDING

In wet, yielding, mucky locations, where pipe is in danger of sinking below grade or floating out of line or grade, or where backfill materials are of such fluid nature that such movements of the pipe might take place during the placing of the backfill, the pipe must be weighted or secured permanently in place by such means as will prove effective. When ordered by MUPB, yielding and mucky material in sub-grades shall be removed below ordinary trench depth in order to prepare a proper bed for the pipe. No. 9, No. 68 or No. 57 crushed stone or approved equal shall be used to replace poor sub-grade material and shall be classified as "Special Pipe Bedding."

5.7. INSTALLATION OF PIPE

All pipes shall be laid with ends abutting a true to line and grade as shown on the plans. Supporting of pipe shall be as specified under "Pipe Bedding" specified herein and in no case, shall be supported on blocks.

Fittings for the water mains shall be provided and placed as shown on the plans. All open ends of pipes and of branches shall be sealed or plugged.

Before each piece of pipe is lowered into the trench, it shall be thoroughly cleaned and inspected for defects. Any piece of pipe or fitting which is known to be defective shall not be laid or placed in the lines. Any defective pipe or fitting discovered after the pipe is laid shall be removed and replaced with a satisfactory pipe or fitting. In case a length of pipe is cut to fit in a line, it shall be so cut as to leave a smooth and at right angles to the horizontal axis of the pipe.

Granular bedding material as specified herein, shall be used to correct irregularities in the earth trench sub-grade.

The interior of the pipe shall be maintained clean. Pipe shall be stored in a location where dirt, mud and debris cannot easily enter and contaminate the pipe. When laying of any pipe is stopped for any reason, the exposed end of such pipe shall be closed with a proper plug fitted into the pipe bell, so as to exclude earth or other material.

No backfilling (except for securing pipe in place) over pipe will be allowed until MUPB or their representative has made an inspection of the joints, alignment and grade in the section laid, but such inspection shall not relieve the CONTRACTOR of further liability in case of defective joints, misalignment caused by backfilling and other such deficiencies that are identified later.

5.7.1. PIPE INSTALLATION WITHIN FILL AREAS

Any water main to be installed in fill areas shall require the OWNER/DEVELOPER to provide inspection and testing services by a Registered Geotechnical Engineer to ensure that each lift in the proposed trench area was constructed and compacted to 95% Standard Proctor density from bottom of fill to 30" above top of pipe. Copies of all test reports shall be certified by the Geotechnical Engineer and submitted to MUPB prior to pipe installation.

5.8. PREVENTATIVE MEASURES AGAINST CONTAMINATION

Precautions shall be taken to protect the interiors of pipes, fittings, and valves against contamination. Pipe delivered for construction shall be stored so as to minimize entrance of foreign material. All openings in the pipeline shall be closed with a watertight plug when laying is stopped at the close of day's work or other reasons such as rest breaks and meal periods.

The CONTRACTOR shall follow the procedures for contamination prevention below for all material delivered to the construction site.

1. All piping, valves, fittings, etc. delivered to the job site shall be stored elevated above the ground and shall be covered to protect from exposure to dust and debris.

2. All piping, fittings and valves shall be thoroughly cleaned of dust, dirt, and deposits by swabbing or other means acceptable to MUPB. Each component shall be cleaned on the same day it is to be installed.

3. All openings in the pipeline shall be closed with an approved watertight plug at the end of each day when pipe installation has stopped, or for other reasons such as rest or meal breaks.

See paragraphs 5.17, 5.18 and 5.19 for removal of contaminates from new waterlines.

5.9. JOINTING PIPE

Pipe joints described herein shall be installed in accordance with the manufacturer's recommendations.

5.10. BACKFILLING PIPELINE TRENCHES

All backfilling shall be accomplished in accordance with the pipe manufacturer's published recommended installation and backfilling method for the pipe being buried and with the requirements of this SECTION. Any variances must be approved in writing by MUPB.

When directed by MUPB, the CONTRACTOR shall add water to the backfill material or dry out the material when needed to attain a condition near optimum moisture content for a maximum density of the material when it is tamped. The CONTRACTOR shall obtain a

compaction of the backfill of at least 95 percent of standard Proctor density ASTM D698 where mechanical tamping of backfill is required.

In all cases walking or working on the completed pipelines except as may be necessary in tamping or backfilling will not be permitted until the trench has been backfilled to a point one foot above the top of the pipe. The filling of the trench and the tamping of the backfill shall be carried on simultaneously on both sides of the pipe in such a manner that the completed pipeline will not be disturbed and injurious side pressures do not occur.

Whenever water lines are installed, the OWNER/DEVELOPER shall be responsible for any trench settlement which occurs within these right-of ways/easements within one year from the time of final acceptance of the work. If paving shall require replacement because of trench settlement within this time, it shall be replaced by the OWNER/DEVELOPER. Repair of settlement damage shall meet the approval of MUPB.

All backfilling shall be accomplished in accordance with the details shown on the Standard Drawings, manufacturers recommendations and the requirements of this SECTION. Any variances must be approved in writing by MUPB.

5.10.1. WATER MAIN TRENCH BACKFILLING

There are three (3) types of trench backfill conditions where the method of final backfilling varies. The various types and trench situations are as follows:

1. PIPE LAID IN ROCK OR EARTH TRENCH: Areas not subject to vehicular traffic, no pavement including gravel.

2. ORIGINAL GRAVEL SURFACE: Gravel areas subject to light vehicular traffic such as residential driveways; church and commercial parking lots and entrances; and farm drives.

3. ORIGINAL BITUMINOUS or CONCRETE SURFACE: City, County and state roads; bituminous road shoulders; all bituminous surface areas such as residential driveways, church and commercial parking lots, and entrances.

See MUPB Standard Details (GP-001) for specific details for each case.

5.11. CONCRETE CRADLE, ANCHORS, THRUST BLOCK OR ENCASEMENT

Concrete cradle, anchors, thrust block or encasement of water mains and/or fittings shall be placed as shown on the plans. Concrete cradle shall be utilized for areas of unsuitable subsurface. Concrete anchors shall be utilized for areas where steep slopes occur. Concrete thrust blocks shall be utilized at all fittings of pipe under pressure. Concrete encasement shall be utilized in areas of less than minimum cover (with MUPB written approval), at creek crossings and drainage crossings and when horizontal separation is not available for sewer mains.

Concrete shall be 3,500 psi and shall be mixed sufficiently wet to permit it to flow under the pipe to form a continuous bed. In tamping concrete, care shall be taken not to disturb the grade or line of the pipe or injure the joints.

Concrete thrust block shall be utilized at all fittings for pressure piping, a polyethylene (plastic) sheet having a minimum thickness of 8 mil, shall be wrapped around the fitting to prevent the concrete from coming in contact with the fitting's bolts and nuts. Volume of concrete shall be derived from MUPB Standard Details.

Concrete encasement provides additional field supporting strength. Wherever the strength of the pipe is not sufficient to support the external loads, the encasement should be designed to provide the necessary additional strength. Concrete encasement shall completely surround the pipe and shall have a minimum thickness at any point of one fourth (1/4) of the outside diameter of the pipe or four inches (4") whichever is greater. In addition, four (4) reinforcing bars of a size selected by the MUPB shall be evenly spaced around the pipe and have a length equal to the length of the encasement.

Water mains constructed under creeks or drainage waterways shall be constructed of ductile iron pipe to a point at least twenty feet (20') beyond the edge of the creek of drainage waterway and shall be encased in concrete.

5.12. HIGHWAY AND RAILROAD CROSSINGS

Steel encasement pipe for road and railroad crossings shall be bored and/or jacked in place to the elevations shown on the plans. All joints between lengths shall be solidly welded with a smooth non-obstructing joint inside. The encasement pipe shall be installed without bends. The water line pipe shall be installed after the encasement pipe is in place.

Installation of the water pipe in the encasement pipe shall be as per MUPB's recommendations and shall include manufactured casing spacers. After the water main has been installed, inspected, and tested as specified, both ends of the casing pipe shall be closed with proper fitting plug or cap in a manner acceptable to MUPB.

All street cutting, street boring, highway boring, or railroad boring permits will be the responsibility of the OWNER/CONTRACTOR. All necessary permits must be approved by KDOH and/or Railroad companies prior to construction commencing.

5.13. PIPELINE CLEANING (PIGGING) PROCEDURES

After installation and prior to testing, the complete water system (including all mains, services, hydrants, blow-offs, air release valves and all other appurtenances) shall be thoroughly cleaned to remove all foreign matter. MUPB shall be notified at least 48 hours prior to cleaning activities. The cleaning of the piping system shall be accomplished by the controlled and pressurized passage through the system of a series of hydraulic or pneumatic polyurethane plugs.

A poly-pigging plan shall be approved by MUPB and all pigging of lines must be witnessed by MUPB inspector. The poly pigs shall be removed and discharged from the system at a point near to the end of the system. The CONTRACTOR must demonstrate to MUPB that this work will be performed by experienced supervisors and personnel who have provided the cleaning service of comparable systems.

5.14. TESTING OF LINES

Upon completion of the construction of water mains but prior to FINAL INSPECTION, all water mains and appurtenances shall be tested for leaks as specified herein. MUPB shall be notified at least 48 hours in advanced of the scheduled test time and, at its own discretion, have an inspector present during the performance of the test.

Where practicable, pipelines shall be tested between line valves, temporary valves, or temporary plugs in lengths of not more than 1,500 feet or between isolation valves. The CONTRACTOR may request, in writing, the testing of a section of line greater than 1,500 feet with MUPB's approval. Testing shall proceed from the source of water toward the termination of the line. The line shall be tested upon the completion of the first 1,500 feet or the first isolation valve.

5.14.1. TEST RESTRICTIONS

Water mains shall be tested at a minimum of 150 pounds per square inch in compliance with AWWA C600/C605 but not less than 1.5 times the working pressure and 1.25 times at the highest elevation at the highest elevation within the test section. The CONTRACTOR shall furnish a recording pressure gauge which shall be used for the continuous measurement and recording of test pressures and test time.

Test pressure shall not exceed pipe or thrust-restraint design pressures. The hydrostatic test shall be at least a 2-hour duration. Test pressure shall not vary by more than ±5 psi for the duration of the test.

Valves shall not be operated in either direction at differential pressure exceeding the rated valve working pressure. For test pressures, the test setup should include provision, independent of the valve, to reduce the line pressure to the rated valve pressure on completion of the test. The valve can then be opened enough to equalize the trapped pressure with the line pressure, or fully opened if desired.

Test pressure shall not exceed the rated pressure of the valves when the pressure boundary of the test section includes closed, resilient-seated gate valves. When hydrants are in the test section, the test shall be made against closed hydrant valves. Valves and hydrants connected to MUPB system cannot be operated without MUPB personnel present.

5.14.2. AIR REMOVAL

Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants. If permanent air vents are not located at all high points, the CONTRACTOR shall install corporation stops at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation stops shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged or left in place at the discretion of MUPB.

5.14.3. EXAMINATION

Any exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, valves, hydrants, or joints that are discovered following the pressure test shall be repaired or replaced with MUPB approved material, and the test shall be repeated until it is satisfactory to MUPB.

5.14.4. ALLOWABLE LEAKAGE

Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 psi of the specified test pressure after the pipe has been filled with water and the air has been expelled. Leakage shall not be measured by a drop-in pressure in a test section over a period of time.

Only after the water main has successfully passed the hydrostatic pressure test, shall the leakage test be used to determine if the water main has passed. No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

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

Where:

L = Allowable leakage, in gallons per hour
S = Length of pipe tested, in feet
D = Nominal diameter of the pipe, in inches
P = Average test pressure during the leakage test, in pounds per square inch (gauge)

If loss exceeds L, the CONTRACTOR shall locate and repair to MUPB's satisfaction all leaks until the pipe section will pass another leakage test.

For the pipe line to be accepted, the following will be required:

1. Pass the pressure test.

2. Pass the leakage test, unless waived under the pressure test.

3. All evidence of leakage identified and repaired.

Should the sections under test fail to meet the requirements, the CONTRACTOR shall do all work of locating and repairing the leaks and retesting as MUPB may require.

If in the judgment of MUPB, it is impracticable to follow the foregoing procedures for any reason, modifications in the procedures shall be made as required and as acceptable to MUPB, but in any event, the CONTRACTOR shall be responsible for the ultimate tightness of the line within the above test requirements.

5.14.5. PRESSURE GAUGES

Pressure gauges shall be sized accordingly to normal operating pressures (average pressures). Gauge ranges shall be no more than twice the operating pressure. Gauge assemblies shall be furnished with shutoff stops, diaphragm seals and pulsation dampers, which shall be constructed of brass or stainless steel. Gauges shall be 4-1/2-inch in diameter. Gauges shall have the following graduations:

Pressure Gauges (psi)

Maximum *Indications*	*Figure Intervals*	Intermediate Graduations	Minor Graduations
15	1	0.5	0.1
30	5	1	0.2
60	5	1	0.5
100	10	5	1
160	20	5	1
200	20	10	2
300	30	10	2

5.15. DISINFECTION OF WATER LINES

New potable water lines shall not be placed into service, either temporarily or permanently, until they have been thoroughly disinfected in accordance with the following requirements and to the satisfaction of MUPB and in accordance with AWWA 651 (latest revision).

MUPB will allow one of the three AWWA approved methods for disinfection/chlorination: tablet, continuous feed and slug. The tablet method gives an average chlorine dose of

approximately 25 mg/L; the continuous feed method gives a 24-hour chlorine residual of not less than 10 mg/L; and the slug method gives a 3-hour exposure of not less than 50 mg/L free chlorine.

5.15.1 TABLET METHOD

The tablet method consists of placing calcium hypochlorite granules or tablets in the water main as it is being installed and then filling the main with potable water when installation is completed. This method may be used only if the pipes and appurtenances are kept clean and dry during construction. Additional chlorine may be required due to excessive flushing.

The placement of granules shall be placed at the upstream end of the first section of pipe, at the upstream end of each branch line and at 500-foot intervals. The quantity of granules shall be:

Pipe Diameter (d)	Calcium Hypochlorite Granules	
inch	ounce	gram
2	0.5	12
3	1.0	27
4	1.7	48
6	3.8	108
8	6.7	190
10	10.5	298
12	15.1	428
14 and larger	D^2 x 15.1	D^2 x 428

The placement of a 5-gram tablet shall be placed in each section of pipe. Also, one tablet shall be placed in each hydrant, hydrant branch and other appurtenance. The tablets shall be attached with a food grade adhesive. Tablets shall be attached inside and at the top of the main, with approximately equal numbers of tablets at each end of a given pipe length. The number of 5-gram tablets required for each pipe section shall be 0.0012 x d^2 x L; d is the inside pipe diameter in inches and L is the length of the pipe section in feet.

Pipe Diameter (d)	Length of Pipe Section (ft)				
inch	13 or less	18	20	30	40
	Number of 5-gram tablets				
2	1	1	1	1	1
3	1	1	1	1	1
4	1	1	1	1	1
6	1	1	1	2	2
8	1	2	2	3	4
10	2	3	3	4	5
12	3	4	4	6	7

Once construction has been completed, the main shall be filled with water at a rate to ensure that the water within the main will flow at a velocity no greater than 1 fps. Precautions shall be taken to ensure that air pockets are eliminated. This water shall remain in the pipe for 24-hours. A free chlorine residual should be found at each sampling point after the 24-hour hold period.

5.15.2 CONTINUOUS FEED METHOD

The continuous-feed method consists of placing calcium hypochlorite granules in the main during construction (optional), completely filling the main to remove air pockets, flushing the completed main to remove particulates and filling the main with potable water. The potable water shall be chlorinated so that after a 24-hr holding period in the main there will be a free chlorine residual of not less than 10 mg/L.

Water shall be supplied to the water main at a constant, measured rate into the newly installed water main. At a point downstream from new water main, water-chlorine solution shall be introduced at a constant rate with a concentration of not less 25 mg/L free chlorine. The table below shows the amount of chlorine required to produce 24 mg/L concentration in 100 feet of pipe by diameter.

Pipe Diameter Inches	100 Chlorine	1% Chlorine Solution
4	0.013	0.16
6	0.030	0.36
8	0.054	0.65
10	0.085	1.02
12	0.120	1.44
16	0.217	2.60

Chlorine application shall not cease until the entire main is filled with heavily chlorinated water. The chlorinated water shall be retained in the main for at least 24-hour, during which time valves and hydrants in the treated section shall be operated to ensure disinfection of the appurtenances. At the end of this 24-hour period, the treated water in all portions of the main shall have a residual of not less than 10 mg/L of free chlorine.

5.15.3. SLUG FLOW

The slug method consists of placing calcium hypochlorite granules in the main during construction; completely filling the main to eliminate air pockets; flushing the main to remove particulates; and slowly flowing through the main a slug of water dosed with chlorine to a concentration of 100 mg/L. The slow rate of flow ensures that all parts of the main and its appurtenances will be exposed to a highly chlorinated water for a period of not less than three hours.

Downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water will have not less than 100 mg/L free chlorine. The chlorine shall be applied continuously and for a sufficient period to develop a solid column, or slug, of chlorinated water that will, as it moves through the main, expose all interior surfaces to a concentration of approximately 100 mg/L for at least three hours. As the chlorinated water flows past fittings and valves, related valves and hydrants shall be operated so as to disinfect appurtenances.

5.16. DECHLORINATION OF HEAVILY CHLORINATED WATER

Dechlorination of heavily chlorinated water shall be in accordance with AWWA C651 and shall be accomplished using sodium bisulfite, sodium thiosulfate, sodium sulfite, or calcium thiosulfate solution of a concentration sufficient to remove all chlorine to a level not to exceed 0.019 mg/l. The solution shall be applied by a metering pump directly into the chlorinated water flow stream by injection into a discharge line or into the free discharge from a hydrant. The dechlorinated treated water may then be conveyed to the nearest sanitary sewer storm sewer, or local stream.

Feed System: The dechlorinating agent shall be fed from prepared carboys utilizing a metering pump or other approved metering equipment and equipped with a suitable meter and valve to adjust/monitor the feed rate.

The feed rate (gpm) of solution shall be governed by the chlorine (ppm) concentration of the water to be dechlorinated and the rate (gpm) at which it can be discharged. Constant monitoring of the chlorine residual concentration shall be made using the colorimetric method to ensure the optimum solution feed rate.

5.17. BACTERIOLOGICAL SAMPLES

Following disinfection of the line, bacteriological samples shall be collected and analyzed in accordance with the requirements of Kentucky Department for Environmental Protection by MUPB. Contractor shall give 48-hour notice to MUPB to request the collection of necessary samples. When the samples have been tested and reported safe from contamination, the water line may be placed into service

Bacteriological samples shall be taken in the following manner consistent with 401 KAR 8:150:

1. Within 1,200 feet downstream of each connection point between the existing and new lines;
2. One (1) mile intervals; and
3. At each dead end, without omitting any branch line.

5.18. CONNECTING TO THE WATER SYSTEM

Unless otherwise directed by MUPB, the CONTRACTOR shall connect the new water main to the existing water system. The CONTRACTOR shall notify MUPB when the connection is to be made so that representatives of MUPB may operate existing valves and witness the connection. A minimum notice of at least 48 hours in advance of the connection shall be given to MUPB.

In cases where a wet tap must be made to connect to the existing system, the tapping sleeve, valve and box, and all other necessary material and labor shall be provided by the CONTRACTOR.

5.19. CUSTOMER SERVICE CONNECTIONS

Prior to any service connections, OWNER/DEVELOPER shall have received MUPB Letter of Acceptance for the approved plan phasing, including all current punch list items. After water line has been tested and approved by MUPB, OWNER/CONTRACTOR shall install the service saddle, corporation stop, service line, meter box, setter, lid and 5' pigtail on customer side of meter. MUPB will provide meter. The meter box shall be located within 5' of property line. If development has a normal working pressure greater than 90 psi than OWNER/CONTRACTOR shall provide tandem setter and individual pressure reducing valve.

5.20. RESPONSIBILITY FOR MAINTENANCE

Prior to formal acceptance of the IMPROVEMENTS by MUPB, the CONTRACTOR and/or OWNER/DEVELOPER shall be responsible for the maintenance and repair of the IMPROVEMENTS in compliance with these specifications, which shall include routine maintenance, cleaning, flushing, debris removal and general operation of water mains, booster stations and appurtenances.

After formal acceptance of the IMPROVEMENTS by MUPB, MUPB will maintain and repair the water mains and appurtenances. MUPB will maintain the water main to the outlet side of the water meter or setter.

The adopted verbiage of SECTION 2 shall be placed on all correspondence and the final plats presented to MUPB for signature.

5.21. PLACEMENT OF TRACING WIRE

5.21.1. Direct Burial

Tracer wire shall be #12 AWG solid copper insulated with a 30 mil, high-density, high molecular weight polyethylene (HDPE) insulation and rated for direct burial use at 30 volts. Insulation color shall meet the APWA color code standard for identification of buried utilities. Detectable underground copper tracing wire shall be installed with all water mains lines. Tracer wire shall be attached to the top of

the pipe with adhesive tape or other suitable devices. At each hydrant, valve, customer meter services and end of new pipe installation, the trace wire shall be daylighted and the ends connected together with waterproof connectors. For long runs of pipe, the maximum length between tracing stations (above or below grade) shall be 500 feet. Underground splicing shall be made using waterproof connectors designed for direct bury and covered with waterproof tape or wrap.

5.21.2. Directional Drilled

Tracer wire shall be a #12 AWG (0.0808" diameter) fully annealed, high carbon 1055 grade steel, high strength solid copper clad steel conductor (HS-CCS), insulated with a 30 mil, high-density, high molecular weight polyethylene (HDPE) insulation, and rated for direct burial use at 30 volts. HS-CCS conductor must be at 21% conductivity for locate purposes. Break load of 452 lbs. HDPE insulation shall be RoHS compliant and utilize virgin grade material. Insulation color shall meet the APWA color code standard for identification of buried utilities. Manufacturers supplying copper clad steel tracer wire must have available detailed performance data including 5 years of underground testing in terms of durability related to damage of protective insulation and effects of potential corrosion of the specific copper clad steel used. Origin of copper clad steel manufacturer is required and steel core must be manufactured in the United States. If manufacturer has not completed 5-year corrosion testing, a 5-year warranty must be provided. Tracer wire shall be Copperhead® High Strength HS-CCS HDPE 30 mil or district pre-approved equal and made in the USA.

Use Copperhead High Strength Tracer Wire - Part # 1230*-HS-**

* = Color: B=Blue Water, G=Green Sewer, P=Purple Reclaim Water R=Red Electric, N=Orange Communications, K=Black

** = Spool Size: 500', 1000', 2500'

5.22. SECOND HAND & SALVAGED MATERIALS

The use of second hand or salvaged materials will not be permitted unless authorized by MUPB. All materials and/or equipment specified to be salvaged from existing structures shall remain the property of the MUPB. Such materials and/or equipment shall be delivered by the CONTRACTOR and stored on sites as directed by MUPB.

5.23. CONTRACTOR'S GUARANTEE & UNDERSTANDING

All work that has been rejected shall be repaired, or if it cannot be repaired satisfactorily, it shall be removed and replaced at the OWNER/DEVELOPER's expense. Defective materials shall be immediately removed from the site of the work. Work done without line and grade having been given, work done beyond the lines or not in conformity with the grades shown on the plans or as given, same as herein provided, work done without written authority and prior agreement in writing as to process, shall be done at the

OWNER/DEVELOPER's risk and shall be considered unauthorized and, at the option of the ENGINEER and MUPB, may be ordered removed at the OWNER/DEVELOPER's expense.

5.24. PROTECTION OF WORK, PERSONS & PROPERTY

During performance and up to the date of final acceptance, the OWNER/DEVELOPER shall be under the absolute obligation to protect the finished work against any damage, loss or injury. All risk of loss or damage to the work shall be borne solely by the OWNER/DEVELOPER until completion and acceptance of all work by the ENGINEER and MUPB, as evidenced by the MUPB's issuance of a Letter of Acceptance.

The OWNER/DEVELOPER shall have the full responsibility to provide and maintain all warning devices and take all precautionary measures required by law or otherwise to protect persons and property while said persons or property are approaching, leaving, or within the work site or any area adjacent to the work site. Minimum standards for safeguarding pedestrian and vehicular traffic are contained in the "Manual of Uniform Traffic Control Devices," Federal Highway Administration of the U.S. Department of Transportation, and the "Kentucky Manual of Uniform Traffic Control Devices," Kentucky Transportation Cabinet. The OWNER/DEVELOPER shall be responsible for complying with state laws and federal regulations relating to trench safety.

The OWNER/DEVELOPER shall provide normal routine maintenance on all items including booster stations, flushing and fire hydrants prior to formal acceptance. Maintenance shall be documented and provided to MUPB prior to final acceptance of improvements.

5.25. MATERIALS & WORKMANSHIP

The work shall be performed according to the best modern practice with materials and construction of the highest quality and suitable for the purpose. The ENGINEER and MUPB shall judge and determine the CONTRACTOR's compliance with these requirements. The CONTRACTOR shall promptly correct or replace all work rejected by the ENGINEER or MUPB as defective or as failing to conform to the construction documents. If defective materials or workmanship found within one year of final acceptance by MUPB, as evidenced by the final Certificate of Acceptance or within such longer or shorter period as may be prescribed by law or by the terms of any other applicable special warranty on designed equipment or portions of work as required by the construction documents, the CONTRACTOR shall correct it promptly after receipt of a written notice from MUPB or the ENGINEER to do so. MUPB shall give notice promptly after discovery of such condition. The CONTRACTOR shall remove from the site all portions of the work that are defective or nonconforming which have not been corrected unless removal is waived in writing by MUPB.

5.26. SUBSTITUTIONS

Whenever materials or equipment is specified or described in this MANUAL by using the name of a proprietary item or the name of a particular supplier, the naming of the item is to be intended to establish the type, function and quality desired. Unless the name is followed by words indicating that no substitution is permitted, materials and equipment of other suppliers may be accepted by MUPB, if sufficient information is submitted by the ENGINEER to determine that the material or equipment proposed is equivalent or equal to that named. Request for review of substitute items or material and equipment will not be accepted by the MUPB from anyone other than the ENGINEER. If the ENGINEER wishes to furnish or use a substitute item of material or equipment, the ENGINEER shall make written application to the MUPB General Manager and/or Designee for acceptance thereof, certifying that the proposed substitute will perform adequately the functions and achieve the results called for by the general design, be similar and of equal substance to that specified and be suited to the same use as that specified. MUPB will be the sole judge of acceptability, and no substitute will be ordered, installed, or used without MUPB's prior written acceptance.

5.27. FINAL INSPECTION & ACCEPTANCE

The CONTRACTOR shall furnish MUPB with every reasonable facility for ascertaining whether or not the work performed was according to the requirements and intent of the construction documents. Any work done or materials used without suitable inspection by MUPB may be ordered removed and replaced at the CONTRACTOR's expense. The OWNER/CONTRACTOR and MUPB shall make final inspection of all work included in the construction documents, and provisions provided in the Division of Water approval letter when practicable after the work is completed and ready for acceptance. If the work is not acceptable to MUPB at the time of such inspection, MUPB shall inform the OWNER/DEVELOPER/CONTRACTOR as to the particular defects to be remedied before final acceptance shall be made.

When the project is completed, the ENGINEER shall submit a written certification to the Division of Water that the project has been constructed and tested according to the approved construction plans and specifications, and the provisions listed in the Division of Water approval letter. The certification must be sealed, signed, and dated by a Professional Engineer licensed in the Commonwealth of Kentucky. One (1) digital and Two (2) original copy of the certification shall be submitted to MUPB General Manager and/or Designee.

SECTION 6: DESIGN OF SANITARY SEWER FACILITIES

6.1. PURPOSE

MUPB's intent of this section describes the minimum requirements for design of sanitary sewer facilities. These requirements are listed to ensure that any development/extensions have adequate capacity to transport sanitary sewer from the development throughout the collection system. MUPB requires that planning of gravity sewer mains, force mains and lift stations be based upon ultimate sewershed population and not just the development population, to minimize maintenance and operational costs.

6.2. DESIGN APPROACH & CRITERIA

Proposed construction or expansion of wastewater facilities within the MUPB Service Area shall be in compliance with the approved MUPB Regional Facilities Plan, the Recommended Standards for Wastewater Facilities (Commonly referenced as the 10 State Standards), the MUPB Sewer Use Ordinance, the Kentucky Administrative Regulations (KAR), and guidelines defined in this Manual.

Any person, company, corporation, or other entity proposing to develop land or proposing to install new and/or replacement sanitary sewer facilities within the MUPB Service Area must prepare, for review and approval by MUPB, planning and design documents according to the standards and requirements of this Manual. Planning and construction documents must be prepared and certified by a Professional Engineer licensed in the Commonwealth of Kentucky. The service level of proposed facilities shall be according to design standards referenced in these documents.

6.3. HYDRAULIC LOADINGS

MUPB has established the policy of sizing facilities based upon ultimate sewershed populations. This policy requires the OWNER to design based upon all future flows within the sewershed and not just the proposed development. A total sewershed approach, will reduce the number of lift stations that are required to serve the watershed and in return reduce the maintenance and operational costs for MUPB after development. Future flows are to be based upon current residential, commercial, and industrial uses; and where land is vacant, according to allowable land use, as established by local planning and zoning or based upon additional information yet incorporated into planning or based upon customer demands as outlined in SECTION 3 – Design of Water Facilities.

6.3.1. SEWERSHED POPULATION

A. Sewershed population and projected flow rates shall be calculated as a basis of design for all sanitary sewers. Development site plan(s) shall be incorporated into a topographic map, displaying the proposed development in relationship to the sewershed it is to be incorporated into.

B. Estimated sewershed population shall be based upon a 20-year time period, based upon available land and projected population growth. Current planning and zoning maps shall be utilized to estimate flow rates.

6.3.2. FLOW PROJECTIONS & CAPACITIES

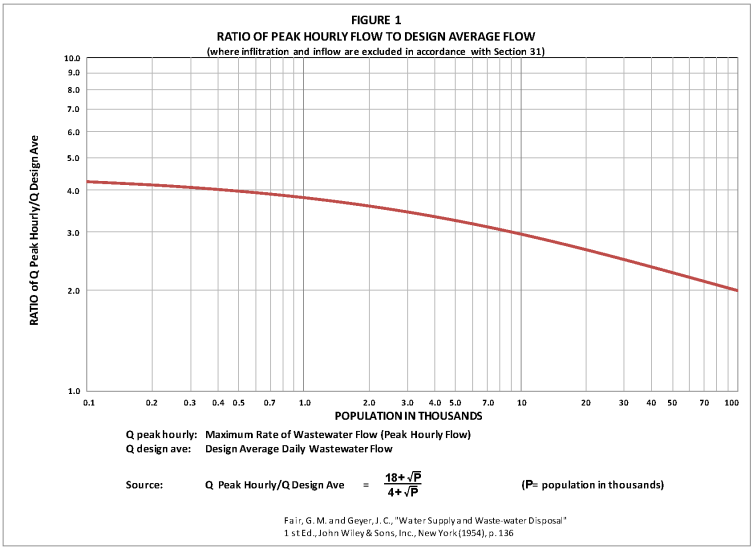
A. In determining the necessary capacity of sanitary sewer facilities, the following factors shall be considered:

1. Peak quantity of domestic sanitary sewer

2. Industrial and/or Commercial sanitary sewer

B. Sanitary Sewer facilities shall be designed on the basis of an average flow with respect to standardized flow rates of residential structures, Equivalent Residential Units (ERUs). Calculations of sanitary sewer generation shall be based upon water demand, see SECTION 3 – Design of Water Facilities.

C. Sanitary Sewer facilities shall be designed to transport peak flows (Q_{peak}). The peaking factor shall be based upon the criteria as shown in RECOMMENDED STANDARDS FOR WASTEWATER FACILITIES (2014 Edition), TEN STATE STANDARDS, Hydraulic Capacity for Wastewater Facilities to Serve New Collection Systems (Figure 1).



D. OWNER may submit an alternate design flow formula/calculation for approval by MUPB. MUPB's decision shall be final.

E. Minimum diameter of gravity sanitary sewer shall be 8-inch, with a maximum distance between manhole-to-manhole of 400 linear feet.

6.3.3. HYDRAULIC MODEL

See SECTIONs 7 & 8 for requirements of hydraulic model for force main, lift stations and/or low-pressure sewer systems.

6.3.4. DESIGN CRITERIA

A. Gravity sanitary sewers shall have a uniform slope and straight alignment between manholes.

B. The diameter of local collection sewer and trunk sewer mains shall be continually increasing, with increase in sewershed flow. Isolated segments shall not be oversized to take advantage of lower minimum slopes, in an attempt to compensate for a lack of natural topographic slope along the route.

C. At all manholes where a smaller diameter sewer discharges into a larger diameter sewer, and at all locations where the sewer main increases in size, the invert of the larger sewer shall be lowered so that the energy gradients of the sewers at the junction are at the same level. Generally, this condition will be met by placing the crowns of the two sewers at the same elevation.

D. Sewers shall be designed to be free flowing with hydraulic grade below the crown of the pipe, and with slopes sufficient to provide an average velocity when running full of not less than 2.0 feet per second. Generally, computation of flows will be based on the Manning's coefficient of friction (Manning's n) equal to 0.013.

E. The maximum permissible velocity at average daily flow is 15 feet per second.

F. **Table 6.1** below lists the minimum slopes to be provided in order to achieve the minimum velocity of 2.0 feet per second or greater at full pipe flow.

Table 6.1 – Minimum Slope

Sewer Size	Minimum Slope
8-inch	0.50
10-inch	0.37
12-inch	0.29
15-inch	0.25
18-inch	0.15

21-inch	0.15
24-inch	0.10
27-inch	0.09
30-inch	0.062
33-inch	0.054
36-inch	0.048
39-inch	0.041
42-inch	0.040

Minimum Slopes are shown in Feet per 100 Feet.

G. The terminal upstream section (manhole to manhole) of a local collection main, a section discharging into a lift station or treatment plant, requires a manhole to be located within ten feet (10') of lift station or treatment plant and have a minimum slope of double to that indicated in **Table 6.1.**

H. For public sewers larger than 42-inch, slopes will be determined on a project specific basis.

I. Maximum slope on all gravity sewers is 10 percent, without written MUPB approval.

6.4. SANITARY SEWER LAYOUT

The following description of sanitary sewer layout shall pertain to gravity sanitary sewer. Plan and profile views are required for all gravity sanitary sewer lines.

6.4.1. Plan View

A. Sanitary sewers of 15-inch or larger diameter are typically considered to be trunk mains or interceptors, such that service connections are not permitted directly to these pipes, without prior approval.

B. Public sewers of 12-inch, 10-inch, and 8-inch diameters are considered to be collection mains, to which service connections may be made along the pipe. These mains may be routed within streets and pavements, or be located in easements on private property, only in accessible portions of the property.

C. Routing for sanitary sewers shall be determined based upon the required separations from utilities and structures, while minimizing the use of manholes, and minimizing the number of crossings with roadways, driveways, curbing, and sidewalks.

D. Sanitary sewer routing and manhole placements shall be chosen such that manholes will be accessible for maintenance operations. All sanitary sewer lines and/or manholes shall be a minimum of ten (10') feet for any structure or foundation.

E. Impediment of existing sanitary sewers for future access and/or maintenance excavation will not be permitted. Any necessary relocation of existing sanitary sewer facilities due to development is the responsibility of the OWNER/CONTRACTOR, and shall be replaced in kind, in the form of a new, parallel facility. Where grading is to occur, resulting cover on existing sewer must remain above design minimum and may be considered excessive if resulting in the total cover in excess of 15 feet.

F. At manholes, the maximum deflection angle between influent and effluent lines is 90-degrees.

G. Separations

1. Provide a minimum 10-foot horizontal separation (outside to outside) with any water main, including at sanitary manholes for parallel installation. For a water line crossing, provide a minimum of 1-1/2 foot vertical separation (outside to outside) with any water main and with a minimum of 1-1/2 foot horizontal separation with the gravity sewer main being below the water main.

   Under no circumstances may any sewer cross beneath a storm drainage structure (retention pond, etc.) or beneath any other above ground or underground structure without MUPB approval.

2. Provide minimum 10-foot horizontal separation with a building or any other above ground structure. This requirement may be increased for deep and/or large diameter sewers, as determined by MUPB.

H. Street Design

1. Manhole location in pavement is preferred. Locate manholes at crown of pavement if possible. Where separation requirements preclude manholes on crown or centerline, manholes should be placed in the center of the traffic lane.

I. Locate all manholes beyond the spread of water from the street's curb and gutter flow.

J. Future Extensions of Sanitary Sewer

MUPB may require access due to future extension of sanitary sewer or if future sanitary sewer service connection appears practical, to allow service to other properties or buildings. Sewer is to be constructed to the limits of the area being developed, so as to terminate in a location from which it can readily be extended in the future. This will be beyond proposed pavements, past adjacent buildings, and beyond adjacent or crossing waterlines or storm drains, ducts, or other utilities that would otherwise be undermined during subsequent sewer installation. Temporary terminations of public sewer will be at a manhole. Easements for the future line(s) must be conveyed, extending to the site or subdivision boundary. Associated temporary construction easement(s) may also be needed, as dictated by the scope of the future installation.

K. Sewers parallel to or crossing streams shall be designed as follows:

1. Sewers and their appurtenances located along streams shall be protected against the 100-year flood. Sewers located along streams shall be located outside of the streambed wherever possible and be sufficiently separated to provide for possible future channel widening.

2. Depending on cover and magnitude of stream, sewers crossing streams may require concrete encasement. Where encasement is determined necessary, encasement shall extend minimum 20 feet beyond the stream bank on each side of the stream. The pipe and joints shall be tested in place, must exhibit zero infiltration, and shall be designed, constructed and protected against anticipated hydraulic and physical stresses; longitudinal, vertical and horizontal loads; and erosion.

3. Sewers parallel to streams shall be of sufficient depth so that tributary extensions can be made under the streams while maintaining adequate cover. Anticipated future extensions must be shown in plan view, and corresponding actual surveyed stream depths will be required for plan review.

L. Elevated sewers are permitted only on a case-by-case situation at the sole discretion of MUPB.

6.4.2. Profile View

A. Maintain a minimum cover of six (6.0) feet. Cover may be reduced to four (4.0) feet in isolated instances at the upper reaches of the system, and where the public sewer is located outside of pavement. Where approved to be at less than four (4.0) feet of cover, sewers may be required to be protected from superimposed loads by means of concrete encasement.

B. Minimum cover at a stream crossing is one (1.0) foot, in a rock streambed or three (3.0) feet, if in soil or alluvium streambed. Concrete encasement may be provided, where cover is less than four (4.0) feet and may be specified wherever needed to ensure that the sewer is not compromised during flooding. Concrete encasement shall be specified for existing or proposed sewer when the sewer is located below rip-rap channel lining or large stone used for slope protection.

C. Maintain minimum vertical separation of 1.5 feet (outside to outside of pipe) and below when crossing a water main or gas main, 2.0 feet (outside to outside of pipe) only if the sewer is above the storm sewer.

D. Show all crossing utilities and specify required clearances for all pipes. Crossings shown in profile must account for pipe wall thicknesses and be labeled with **designed** clearances, not required clearances.

E. Include the following note, prominently displayed on each profile view:

"THE CONTRACTOR SHALL ENSURE THAT SANITARY SEWER IS CONSTRUCTED TO THE APPROVED SLOPES. IF DURING THE AS-BUILT SURVEY, THE SLOPE OF ANY SEWER IS FOUND TO BE INADEQUATE TO CONVEY THE DESIGN FLOW, OR LESS THAN THE MINIMUM PER KENTUCKY REGULATIONS, THE SEWER SHALL BE REINSTALLED TO CORRECT SLOPES AT THE EXPENSE OF THE CONTRACTOR."

F. Sewers installed above existing grade shall be placed in controlled fill. Any gravity sewer main or lateral to be installed in fill areas shall require the OWNER/DEVELOPER to provide on-site inspection and testing services by a Licensed Geotechnical Engineer to ensure that each lift in the proposed trench area was constructed and compacted to 95% Standard Proctor density from bottom of the fill to 30" above the top of the pipe. Copies of all test reports shall be certified by the Geotechnical Engineer and submitted to MUPB prior to pipe installation.

G. Locate sanitary sewers outside of areas supporting foundations of buildings or structures.

H. Specify type of pipe material for each section or branch line. Typical sanitary sewer gravity pipe material shall be PVC SDR-35, ASTM D3034/F679. Pipe material and dimension ratio shall remain constant between manholes.

6.4.3. Easement

A. For public sanitary sewer mains, provide easements with widths no less than twenty (20) feet, centered upon installed pipe and temporary

construction easements with widths no less than forty (40) feet for gravity sanitary sewer mains less than seven (7) feet of depth. For gravity sanitary sewer mains greater than seven (7) feet of depth, shall be provided with easements with widths no less than thirty (30) feet, centered upon installed pipe and temporary construction easements with width no less than fifty (50) feet.

B. Where public sewer runs along a lot line within a subdivision, locate the sewer a minimum of 10 feet from the parcel or lot boundary line. Where public sewer parallels such a lot line, the sewer easement shall be placed on a single parcel boundary, in order to allow MUPB access without impediment of a fence at the property line.

C. Where proposed construction is across land of others, temporary construction easements shall be established in sufficient widths to accommodate the work area.

D. Sanitary sewer mains shall be located in areas (public right-of-way or easements with access adjacent to public right-of-way) with access available through and/or adjacent to proposed roadways. Sanitary sewers laid in the back of properties with access only via entering private property is not permitted; however, a request may be made and will be reviewed by MUPB on a case-by-case situation.

E. Easement plats, instrument of conveyance and/or deed shall be reviewed prior to being executed and filed according to the procedures found in SECTION 2.

F. Should public sewer be installed outside the boundaries of the recorded easement, a Deed of Easement and Easement Vacation with accompanying plat shall be prepared, approved, and recorded, so as to establish the easement at the as-built location(s).

6.4.4. Miscellaneous

A. Show sanitary sewer crossings of other utilities on all applicable profiles.

B. Facilities being decommissioned shall be abandoned and associated easements vacated. Manholes, structures, and appurtenances are to be removed to the depth specified by MUPB.

C. For sewers greater than fifteen (15) feet in depth the pipe material shall be ductile iron with bituminous coated outside and shall receive Protect 401 or equal ceramic epoxy lining on the inside, unless otherwise approved by MUPB.

6.5. MANHOLES

6.5.1. Plan View

A. A manhole shall be provided at each of the following:

1. all junctions, changes in horizontal alignment, changes in gradient, and temporary or permanent terminus of public sewer;

2. every 400 linear foot (maximum distance) of gravity sanitary sewer.

3. changes in pipe diameter;

4. lateral connections for laterals 8-inch diameter and larger.

B. Separation

1. Provide a minimum horizontal separation of 10 feet between exterior of manhole and all potable water mains or lines.

2. Provide minimum 6-foot horizontal separation (outside to outside) with storm structures, drainage piping, duct banks, vaults, and other utility type structures.

3. Do not locate a manhole in a parking space, or where continuous access would otherwise be obstructed.

C. Maximum number of connecting pipes per manhole is four, (one out; three in), with a pipe entering by a drop connection counting as one.

D. Inside diameter of manholes shall be four (4.0) feet for public sewers less than or equal to 12-inch diameter. Manhole diameter requirements for sewers larger than 12-inch diameter but less than 18-inch diameter shall be five (5.0) feet. Manhole diameter requirements for sewers larger than 18-inch shall be approved on a project-specific basis.

E. Provide a minimum of 12 inches between openings (cores).

F. Existing manholes that are to receive a proposed sewer pipe shall be cored or bored. Chiseled or hammered openings shall not allowed.

G. A manhole is required at each temporary termination of the public sewer. In isolated instances, when stubbing out of commercially zoned land which is not fully planned or engineered, plugged stubs of 8-inch diameter may be used. Minimum slope for such a stubbed section shall be 1.00 percent.

6.5.2. Profile View

A. Minimum depth of manhole in shall be 6 feet. Depth may be reduced to four (4.0) feet in isolated instances, and where the public sewer is located outside of pavement. Where approved to be at less than four (4.0) feet of cover, sewers may be required to be protected from superimposed loads by means of concrete encasement.

B. Manhole depth shall not exceed 20 feet. In cases where excessive depth is unavoidable, MUPB, at their discretion, may approve depths greater than 20 feet.

C. Typical drops in elevation between influent and effluent pipe inverts shall be between 0.10 – 0.50 feet.

Drop manholes shall only be used where excessive slope or depth of sanitary sewer would result. Drop manholes shall be used where a drop in invert elevations exceeds two (2) feet, via a precast concrete manhole with an external drop. Interior drop manholes shall only be used for connection to existing manhole for a new sanitary sewer line.

D. “Doghouse” manholes must be preapproved by MUPB.

E. Specify traffic rated frame and cover in proposed or future pavement areas.

F. Specify watertight frame and cover, if less than one (1) foot above the 100-year flood water surface elevation.

G. Provide positive drainage for sanitary manholes located outside of pavement areas.

H. Where future grading can be anticipated, manholes are to be installed to ultimate top of rim elevations, wherever practical. However, where doing so would result in top of rims that are more than 4 feet above the interim grade, manhole tops are to be set to the existing ground elevations.

I. Where grading is being proposed at existing manholes, specify adjustment of tops so as to conform to the new grade. Due to the limited adjustment available within the manhole chimney, the components of the manhole will typically need to be disassembled, and new sections installed to accomplish the necessary stack-out. Joints in new components must be made with dimensions that conform to the joints of existing components, where new and old must intersect. The new assembly will be subject to exfiltration testing, and watertight construction is required. If watertight joining to existing components cannot be attained, the entire manhole must

be replaced.

6.6. LATERAL CONNECTIONS

A. All lateral connections shall be installed with a cleanout installed in the lateral line and the cleanout shall be located at the edge of the permanent easement or public right-of-way.

B. Lateral connections of single-family dwellings shall be made along the sanitary sewer main and not at a manhole unless prior approval by MUPB. Lateral connections of multi-family residential, commercial and industrial premises shall be at a manhole.

C. Commercial and industrial connections that require a grease trap and/or oil/water separator shall connect at a manhole.

D. No sump pumps, gutter drains, yard inlets or other storm water connections shall be discharged into the sanitary sewer.

E. Laterals located within public right-of-way or sanitary sewer easement shall be straight with minimal fittings.

F. Lateral shall be made water tight and marked above grade.

G. Lateral connections made on sanitary sewer main shall be made no less than the centerline of lateral at 45° above the spring line of the sanitary sewer pipe.

SECTION 7: DESIGN OF LOW-PRESSURE SEWER SYSTEM

7.1. PURPOSE

MUPB's intent of this section describes the minimum requirements for design of low-pressure sewer system (LPS) facilities. These requirements are listed to ensure that any development/extensions have adequate capacity to transport sanitary sewer from the development throughout the collection system. MUPB requires that planning of LPS systems shall be based upon ultimate development population and not just the first phase, to minimize maintenance and operational costs. The effects of the LPS upon the existing MUPB collection system shall be reviewed to ensure no surcharging or sanitary sewer overflows will occur due to the added flows.

This section describes the requirements of OWNER/DEVELOPER in requesting a LPS. A LPS will only be considered where a thorough study of all alternatives clearly indicates that a gravity sanitary sewer with or without a sanitary sewer lift station is not feasible and shall be considered at the sole discretion of MUPB. Cost shall not be considered a valid reason for consideration of an LPS. MUPB will not accept ownership, operational control or maintenance of any LPS that does not meet the requirements set forth in this manual.

7.2. DESIGN APPROACH & CRITERIA

Proposed construction or expansion of LPS facilities within the MUPB Service Area shall be in compliance with the approved MUPB Regional Facilities Plan, the Recommended Standards for Wastewater Facilities (Commonly referenced as the 10 State Standards), the MUPB Sewer Use Ordinance, the Kentucky Administrative Regulations, and guidelines defined in this Manual.

Any person, company, corporation, or other entity proposing to develop land or proposing to install new and/or replacement wastewater facilities within the MUPB Service Area must prepare, for review and approval by MUPB, planning and design documents according to the standards and requirements of this Manual. Planning and construction documents must be prepared and certified by a Professional Engineer licensed in the Commonwealth of Kentucky. The service level of proposed facilities shall be according to standards referenced in these documents. Design standards shall be those referenced herein.

7.2.1. GUIDELINES

MUPB has established the following guidelines to be followed for all proposed LPS systems. These requirements are mandatory and may be altered at MUPB's sole discretion.

A. All grinder pumps and appurtenances from the grinder unit to the force main shall be owned by MUPB. Property owner shall be liable for the

maintenance and operation of their lateral service from the housing plumbing to the grinder unit.

B. The curb box located at the property line shall include a box and lid, stainless steel ball valve and check valve, that meets the standard details of MUPB.

C. Curb boxes for opposite side services shall have stainless steel ball valve and valve box per standard details of MUPB.

D. All lateral force mains shall be on the property of primary service and have a permanent dedicated easement.

E. MUPB may require in-line or end-of-line flushing connections on force mains to provide periodic cleansing of the force main(s) at MUPB discretion.

F. All force mains shall be sized according to the selected type of grinder pumps being utilized. The Rational Method shall be used for centrifugal type grinder pumps.

G. Gate valves shall be required at junctions of force mains and shall be sized accordingly to the force main size.

H. If the LPS discharge ultimately reaches an existing lift station, a hydraulic capacity analysis will be necessary to verify the existing lift station(s) and force main(s) are able to accept the flow or if additional capacity is necessary.

I. LPS systems require easements from force main along the path of installation of the lateral force main to the grinder pump. Easements shall follow requirements as listed in SECTION 6 – Design of Sanitary Sewer Facilities.

7.3. LPS DESIGN REQUIREMENTS

Two different designs may be required for LPS systems:

7.3.1. NEW LPS SYSTEM TO EXISTING SEWER FACILITIES (FM OR MH)

All phases will need to be modeled independent of the future phases, but includes all previous phases, thus allowing MUPB to determine the operation and maintenance expense of the partially constructed LPS system.

The LPS system shall be designed in accordance with the grinder pump manufacturer and the applicable design method (Rational Methods) per EPA Design Manual 625/1-91/024. Grinder pumps for the proposed development shall

be homogenous in make, model and motor size shall be Liberty LSG200 or Liberty LSGX200 as the basis of design. Force mains shall be sized for ultimate buildout.

7.3.2. NEW GRINDERS CONNECTING TO AN EXISTING LPS SYSTEM

Connection to an existing LPS system will require a hydraulic model of the existing LPS system and the proposed development. OWNER/DEVELOPER shall request hydraulic information from MUPB of existing LPS system (pipe diameters, pipe lengths, grinder types, number of active grinders, etc) and shall be incorporated in the hydraulic analysis of the proposed development. MUPB will provide all information that is available; however, the effort to verify that information is the responsibility of the OWNER/DEVELOPER.

The new LPS system shall not have adverse effects upon the existing LPS system. Grinder pumps for the proposed development shall be homogenous in make, model and motor size to those in the existing LPS system shall be Liberty LSG200 or Liberty LSGX200 as the basis of design. Force mains shall be sized for ultimate buildout.

7.3.3. LPS DESIGN SUBMITTAL

The OWNER/DEVELOPER may request for MUPB to develop the required LPS Design Report. In order for MUPB to develop the required hydraulic model, the OWNER/DEVELOPER acknowledges that the cost for developing the report will be paid by the OWNER/DEVELOPER at the rate described below.

EXTENSION LENGTH (Total Footage)	**FEE**
Small Extension (<1,000 Total LF)	$ 2,000
Medium Extension (1,001 to 5,000 Total LF)	$ 3,000
Large Extension (> 5,001 Total LF)	$ TBD

The following submittals shall be provided to MUPB for review of any proposed LPS system. Plans, specifications, and LPS Design Report shall be completed per the following guidance prior to being reviewed. Incomplete submittals will not be reviewed.

A. Design Plans

Three (3) copies of the design plans shall be provided to MUPB for review. The plans shall be 24” x 36” sheets. Plans shall be stamped and signed by licensed professional engineer in the Commonwealth of Kentucky. An electronic copy of the plans may be submitted in lieu of the three sets of plans.

Plans shall have the following pages:

1. Cover Sheet
   - Development Name
   - Owner Name and Address
   - Engineer's stamp and signature
   - Date

2. Index Sheet
   - Location Map
   - Sheet Index of Plan Sheets
   - General Construction Notes

3. Plan & Profile Sheets

   - Plans shall be scaled to a maximum of 1" = 100' and minimum of 1" = 50'.
   - Overall schematic layout of the LPS system identifying the grinder pump stations, force mains, combination air release valves, and isolation valves.
   - Identify the force main size, pipe material & stationing of the force main.
   - Locate force main appurtenances: combination air release valves, valves, curb boxes, grinder units
   - Location of existing utilities
   - For Profile: show the existing ground line, proposed ground line (if applicable), force main test pressure between isolation valves, combination air release valves, valves, curb boxes, grinder units.

4. Specific Standard Details
   - Details for any specific item or design standard that is not included in the MUPB Standard Sanitary Sewer Details.

5. MUPB Standard Sanitary Sewer Details

B. Design Report

An electronic format of the low-pressure sewer system design report shall be provided in pdf format.

1. Title Page

   Title Page shall include the following:

   a. Development Name

b. Date of Submission
c. OWNER/DEVELOPER Name, address, phone number & email.
d. ENGINEER's name, company name, address, phone number & email.
e. Professional Engineer's Stamp (signed and dated)

2. LPS System Information

a. Type, location and size of development
b. Number of and range of lot sizes to be incorporated into the development.
c. State if the development will be constructed in phases and provide a breakdown of the distribution of phases/development type per phase(s) and time period for each phase(s).
d. Determine if adjacent areas will be incorporated into the LPS design.

3. LPS Hydraulic Analysis

An electronic copy of the model shall be submitted via a USB thumb drive or DVD. The model must include either an USGS or aerial photos as a background image on Kentucky State Plane Single Zone coordinate system.

a. Computerized Hydraulic Model

ENGINEER shall provide a computer based electronic hydraulic model utilizing KYPIPE or other similar software programs as approved by MUPB. ENGINEER shall submit Tabulated Model – Pipe Results (See APPENDIX H). This table shall list every pipe upstream and downstream of the following:

- Pipe changes diameter
- A branch force main ties into the force main

A Tabulated Model – Grinder Pump Results spreadsheet shall also be provided (See APPENDIX H).

b. Grinder Station Calculations

ENGINEER shall provide the grinder pump manufacturer's specification for the grinder pump being utilized as part of the design. A pump curve shall also be provided and display the highest head operating point and the lowest head

operating point on the pump curve with the grinder pump identification number, corresponding to the hydraulic model.

c. Force Main Design Calculations

ENGINEER shall provide force main sizing to achieve a flow rate of a minimum of 2 fps and a maximum of 8 fps.

SECTION 8: DESIGN OF FORCE MAINS & LIFT STATIONS

8.1. PURPOSE

MUPB's intent of this section describes the minimum requirements for design of force main(s) and lift station(s). These requirements are listed to ensure that any development/extensions have adequate capacity to transport sanitary sewer while not having a negative impact upon other existing sanitary sewer facility. MUPB requires that planning of gravity sewer mains, force mains, low pressure collection systems and lift stations be based upon ultimate sewershed population and not just the development population, to minimize maintenance and operational costs

8.2. DESIGN APPROACH & CRITERIA

Proposed construction or expansion of the wastewater facilities within the MUPB Service Area shall be in compliance with the approved MUPB Regional Facilities Plan, Recommended Standards for Wastewater Works (Commonly referenced as the 10 State Standards), the MUPB Sewer Use Ordinance, the Kentucky Administrative Regulations (KAR) and guidelines defined in this Manual.

Any person, company, corporation, or other entity proposing to develop land or to install new or replacement force main(s) and/or lift station(s) within the MUPB Service Area must prepare, for review and approval by MUPB, planning and design documents according to the standards and requirements of this Manual. Planning and construction documents must be prepared and certified by a Professional Engineer licensed in the Commonwealth of Kentucky. The service level of proposed facilities shall be according to standards referenced in these documents. Design standards shall be those referenced herein.

8.3. HYDRAULIC LOADINGS

MUPB has established the policy of sizing facilities based upon ultimate sewershed populations. This policy requires the OWNER/DEVELOPER to design based upon all future flows within the sewershed and not just the proposed development. In time, future developments may connect to the existing infrastructure limiting the amount of sanitary sewer facilities to be maintained and operated, thus reducing the maintenance and operational costs for MUPB. Future flows are to be based upon current and anticipated residential, commercial, and industrial uses; and where land is vacant, or based upon customer demands as outlined in SECTION 3 – Design of Water Facilities.

8.3.1. SEWERSHED POPULATION

A. Sewershed population and projected flow rates shall be calculated as a basis of design for all sanitary sewers. Development site plan(s) shall be incorporated into a topographic map, displaying the proposed development in relationship to the sewershed it is to be incorporated into.

B. Estimated sewershed population shall be based upon a 20-year time period, based upon available land and projected population growth. Current zoning and planning maps shall be utilized to estimate flow rates.

8.3.2. FLOW CALCULATIONS & CAPACITIES

A. In determining the necessary capacity of sanitary sewer facilities, the following factors shall be considered:

1. Peak quantity of domestic sanitary sewer

2. Industrial and/or Commercial sanitary sewer

B. Sanitary Sewer facilities shall be designed on the basis of an average flow with respect to standardized flow rates of residential structures, Equivalent Residential Units (ERUs). Calculations of sanitary sewer generation shall be based upon water demand, see SECTION 3 – Design of Water Facilities.

C. Sanitary Sewer facilities shall be designed to transport peak flows (Q_{peak}). The peaking factor shall be based upon the criteria as shown in RECOMMENDED STANDARDS FOR WASTEWATER FACILITIES (2014 Edition), TEN STATE STANDARDS, Hydraulic Capacity for Wastewater Facilities to Serve New Collection Systems (Figure 1). Force mains shall be a minimum of 4-inch diameter.

8.3.3. BUOYANCY OF WET WELL/VALVE VAULT

A. ENGINEER shall provide calculations to determine the buoyancy of the designed wet well/valve vault. These calculations should be based upon the lift station plans and details.

B. Buoyancy shall be analyzed on the wet well/valve vault to determine whether additional methods of restraint are necessary. Mechanical equipment, water weight, and other temporary loads shall not be included in the analysis. A safety factor of 1.5 (minimum) is required.

8.4. CLASSES OF LIFT STATION

MUPB has established a sewershed approach for all lift stations. A lift station will only be constructed in an area to service the entire sewershed and not only the proposed DEVELOPMENT, unless expressly approved by MUPB.

Each sewershed will have differing amounts of sanitary sewer flow being generated within it, thus MUPB has established differing tiers of lift stations based upon flow rates of the pumps. These tiers have different requirements based upon the pumping rate.

8.4.1. CLASS "A" LIFT STATION

Class A Lift Station shall be designed for the ultimate design capacity of the sewershed. Class A lift station shall have submersible pumps depending on the available head conditions. Class A lift stations shall have the following components:

- Flow meter
- Odor Control
- Standby Generator or Secondary Power Source
- Telemetry/SCADA system
- By-pass pumping connections
- Concrete, cast-in-place wet well
- Security Fence
- Access Road
- Landscaping
- Flow rate more than 500 gpm, with a single pump operating

8.4.2. CLASS "B" LIFT STATION

Class B Lift Station shall be designed for the ultimate design capacity of the sewershed. Class B lift station shall have submersible pumps depending on the available head conditions. Class B lift stations shall have the following components:

- Odor Control, as required
- Standby Generator or Secondary Power Source
- Telemetry/SCADA system
- By-pass pumping connections
- Precast concrete wet well
- Security Fence
- Access Road
- Landscaping
- Flow rate greater than 200 gpm and less than 500 gpm, with a single pump operating

8.4.3. CLASS "C" LIFT STATION

Class C Lift Station shall be designed for the ultimate design capacity of the sewershed. Class C lift station shall be a submersible pump. Class C lift stations shall have the following components:

- Odor Control, as required
- Two-hour Emergency Storage
- Telemetry/SCADA system
- By-pass pumping connections
- Precast concrete wet well or fiberglass

- Security Fence
- Access Road
- Landscaping
- Flow rate less than 200 gpm, with a single pump operating

8.4.4. LIFT STATION STYLE

A. SUBMERSIBLE: Submersible lift stations are defined as pumps located within the wet well and have discharge piping that extend up in the wet well into a valve vault. Pumps can be raised and lowered out of the wet well by the guiderails and crane or lifting chain.

8.5. HYDRAULIC MODEL

MUPB requires a hydraulic model to be presented with submittal of plans for review. The hydraulic model shall include all connected lift station(s), grinders and associated force main(s), to demonstrate the impact of the proposed lift station upon the existing sanitary sewer facilities. MUPB will provide OWNER the necessary information regarding the existing pressure network of force mains, grinders and lift stations.

As an alternate to providing a hydraulic model to MUPB, the OWNER/DEVELOPER may elect to have MUPB develop the required hydraulic model of the development/extension with all associated connections and facilities necessary. In order for MUPB to develop the required hydraulic model, the OWNER/DEVELOPER acknowledges that the cost for developing the model will be paid by the OWNER/DEVELOPER at the rate described below.

EXTENSION LENGTH (Total Footage)	**FEE**
Small Extension (<1,000 Total LF)	$ 1,000
Medium Extension (1,001 to 5,000 Total LF)	$ 2,000
Large Extension (> 5,001 Total LF)	$ TBD

The hydraulic model shall follow guidelines set forth by Kentucky Division of Water (KDOW) in Construction Permit Application (S-1). OWNER/DEVELOPER shall submit the Hydraulic Model Information Sheet in APPENDIX J.

8.5.1. KDOW REQUIREMENTS

KDOW S-1 requires at a minimum the following hydraulic information to be provided with the hydraulic model:

A. Provide pump sizing calculations and the proposed pump's characteristics curve along with the efficiency, horsepower and NPSHR data, if applicable.

B. Wet well design calculations: cycling of pumps, on/off levels, buoyancy calculations and 2-hour storage.

C. Hydraulic model must demonstrate the availability of pipe velocity of 2.0 fps, under normal operation of a single pump.

8.5.2. MUPB REQUIREMENTS

MUPB requires the following information to be included in addition to KDOW requirements:

A. A written hydraulic model summary, area map and electronic copy of the model for review. Identify the computer modeling software utilized and provide all related database files to ensure model will import to PIPE2020 or latest version.

B. Provide a system map showing the modeled pipe network. Label all pipes, nodes, road names, north arrow, scale, number of units, unit type, demands, elevation contours and outline of the phasing, if applicable.

C. Save model files to be descriptive of the scenario being modeled (ie both pumps at alarm.p2k, both pumps at off level.p2k, etc.) to ensure that during the review by MUPB it is an accurate representation of the model prepared by ENGINEER.

D. Model must represent the entire development, including all known future phases.

E. All existing wastewater flows shall be represented in model to accurately represent actual operating conditions.

F. If lift station and force mains discharge into a section of gravity sanitary sewer, it shall be demonstrated that new flows will not cause surcharging in the existing system.

G. If new flows ultimately will be transported by an existing lift station, then ENGINEER shall demonstrate that new wastewater flows will not cause harm (SSOs, continuous pump operation, etc.) to the existing lift station.

H. Provide a pipe report to display name, diameter, flow, velocity, length and head loss.

I. Provide a conclusion of results, table listing nodes with maximum and minimum pressures for all situations modeled. Table of Max/Min shall include 10% of the number of nodes within development, minimum of 5 for each.

8.6. LIFT STATION SITE

A. Sanitary sewer lift station sites will be determined with input from MUPB. Lift stations shall be located outside of flood prone areas, if the station must be located within a flood prone area, specific precautions shall be made to protect the station. All finished floors, tops of all structures (below ground) and equipment shall be above the 100-year flood elevation at minimum at least 1 foot above.

B. Lift station shall have a dedicated paved access drive, security fence, landscape, and exterior lighting. All lift station sites shall be deeded to MUPB in fee simple prior to MUPB assuming ownership, operational and maintenance controls. An easement for ingress/egress for an access road would be permissible.

C. Lift station shall be placed in area with ease of access for maintenance equipment including but not limited to the following: crane, excavation equipment (backhoe, excavator, etc.), jetter, vacuum truck and maintenance trucks.

D. Lift station site shall have an access road with enough room to allow access to the wet well with a vacuum truck, tandem pumper truck and to accommodate deliveries by a chemical tanker. Recommend clearance shall be twenty feet vertically above station all appurtenances.

E. The requisite amount of exterior lighting shall be determined on a case-by-case basis. The site shall be landscaped so as to require a minimum of maintenance. Wherever possible, lift stations shall be hidden from view of nearby neighbors and roads. If necessary, lift stations shall be hidden through the use of tree/shrub plantings or privacy fencing. Quantity and type of tree/shrub must be approved by MUPB and meet the requirements set forth by MRCP&Z. Required buffers shall comply with MRCP&Z.

F. A 12-foot wide, paved access road with gravel shoulders shall be provided to the station. The minimum road section will consist of a compacted sub-grade, 8 inches of DGA stone and 3 inches of bituminous pavement. The gradient of the roadway centerline shall not exceed 5 percent. Unrestricted ingress and egress will be granted to MUPB from a public right of way to the lift station. On all access roads, a locking gate shall be provided at the entrance to the access road from the public right of way.

G. An unrestricted, all weather access road to the station will be maintained by the CONTRACTOR/DEVELOPER until the permanent access road is complete and accepted by MUPB. MUPB must have access to the station at all times.

H. A 6-foot high, chain link security fence topped with angle arms pointing out and 3 strands of barbed wire shall be provided around the lift station lot. The total height of this assembly is 7 feet. The fence shall be equipped with a top rail and a bottom tension wire. Access into the station will be through a minimum 16-foot wide, lockable gate. Depending upon the location of the lift station an alternative fencing system may be required by MUPB.

I. OWNER/DEVELOPER shall have all door locks and padlocks in the station will be keyed to MUPB's standard keys. All padlocks will be provided by MUPB.

J. Adequate provisions will be made for parking and turning large vehicles around at the station.

K. The project specifications will specify a paint or other protective coating for all corrodible materials not otherwise protected. The type, color and thickness of the paint or other protective coating are subject to the approval of MUPB.

8.7. LIFT STATION DESIGN CRITERIA

The following parameters have been established by MUPB to ensure that future lift stations and modifications made to existing lift stations meet a minimum standard. The parameters listed in the following paragraphs are not a complete listing of all situations that may be encountered but is a minimum standard to be met. Any variance from these parameters requires MUPB approval.

8.7.1. PUMP SIZING

A. All pump openings and passages shall be large enough to pass a sphere 3-inch in diameter and any debris that can pass through a 4-inch lateral connection, unless a grinder pump is being specified.

B. All pumps shall be warranted against defects in workmanship and material for 5,000 hours of operation under normal operation, use and service. The warranty shall begin upon final acceptance of the station by MUPB.

C. New lift stations and force mains shall have a hydraulic model constructed in PIPE2020 or other approved software package. Hydraulic models shall include all potential force main connections, including residential grinders. Roughness factor (Hazen-Williams C factor) for new force mains shall be equal to 120. For existing pump upgrades, field determination of actual C factor is required.

D. In certain applications, a force main may flow by gravity when the hydraulic grade line is below the ground elevation. This can occur when a force main pumps across high elevation and then discharge to a point significantly below the high point.

8.7.2. WET WELL SIZING

A. Wet well shall be designed for a minimum pump cycles (on/off) of 2 times per hourwith a maximum pump cycles (on/off) of 6 times per hour.

B. Wet wells shall be designed such that the distance between alarm points is not less than 1-foot, unless otherwise authorized by MUPB. Wet wells

shall have a 2-foot free board above alarm level from inlet for future expansion.

C. Wet well filets shall be sloped at 1:1 to the hopper bottom. Hopper bottom shall be no larger than necessary per manufacturers recommendations.

8.7.3. TWO-HOUR STORAGE

Two-hour storage is required of all lift stations without a backup generator or secondary power source.

8.7.4. BACKUP POWER

A. Certain lift stations will require on-site backup power via generator or engine driven motor. All backup power shall be designed to handle full load application with all ancillary items operating. Automatic transfer switches are required for all pumps where generator and/or engine driven motors are on-site.

B. Standby generators shall be diesel driven with fuel storage on the underside of the generator in a double-walled containment tank. The tank shall be sized for 48 hours of continuous use at full load, if possible. Skid mounted tanks are not acceptable. A fuel storage level indicator will be provided for the generator. Fuel tank shall be refilled after all startup and testing is complete by OWNER/CONTRACTOR.

C. The generator will be equipped with an alarm indicator and output contacts to display the cause of a generator failure, both locally and remotely. The means for starting an emergency generator shall be completely independent of the normal electric power source. The starting system shall be sufficient to start the generator a minimum of 3 times without recharging. The starting system shall be alarmed and instrumented to indicate a loss of readiness.

D. Generator to be located as far away as possible from any corrosive gases that will be discharged on a regular basis.

8.7.5. VALVES & PIPING

A. Isolation valves shall be located on the discharge lines of each pump to allow the pump to be isolated. A check valve shall be installed on each discharge line, between the pump and the isolation valve. Isolation and check valves may be located either inside the lift station building or in a separate valve vault but shall not be located in the wet well under any circumstances. Isolation valves for pumps in wet well shall be full port plug valves.

B. Valves shall be installed on each side of the flow meter.

C. The velocity in the suction line shall not exceed 4 fps. The velocity in the discharge line shall not exceed 6 fps. Pressure gauges with isolation valves will be installed on the pump side of the check valve. Gauge taps with valves will be installed on the suction side of each pump for suction lift pumps. Pressure gauge shall have a range with the operating pressure between 1/3 to 2/3 of the maximum gauge pressure. All pressure gauges shall be 4" in diameter.

D. Flexible, watertight connections shall be provided for all below grade pipe and conduit connections to wet wells and valve vaults.

8.7.6. LIGHTING

Adequate lighting shall be provided throughout the lift station. All lighting fixtures shall be rated for the environment in which they are installed. Where applicable LED fixtures shall be installed in accordance with the manufacturer's recommendations to provide adequate heat dissipation and maximize the life expectancy of the fixture. LED fixtures shall have a 0º F start ballast and have a plastic lens to protect the lamps.. All lighting shall have a HOA switch.

8.7.7. FLOW METERING

All lift stations with flow rate in excess of 500 gpm shall be provided with a magnetic type flow meter, equipped for wastewater service, with a bypass line and valves to enable lift station to operate when meter is being serviced. ENGINEER shall submit proposed flow meter manufacturer, model, size, and literature to MUPB for approval.

Range of flow meter shall be half (0.5x) to twice (2x) the designed pump output. All flow meters shall have an adequate length of straight pipe both upstream and downstream of the meter in accordance with manufacturer's recommendations. Provide a totalizer and indicator/transmitter in units of gpm. Flow metering equipment except for the sensor will be located in the building/control panel.

8.7.8. CONTROLS

A. Control panel shall be installed via a strut mounted system not located on top of the wet well. A junction box shall be located on top of wet well for connection of power cords. All efforts shall be made to make control panel air tight from any and all sewer gas entry into the panel.

B. The pumps shall be controlled by means of a pressure transducer. The pressure transducer shall be programmed to turn the pumps on or off at various levels in the wet well. A spare transducer shall be provided for each lift station wet well.

C. The transmitter sensor shall be mounted near the top of the wet well and

be removable without entering the wet well. The transmitter shall also report the level in the wet well on an indicator located inside the building or in the control panel for Class B or C.

D. The lift station shall also have a back-up pressure transducer control system with transducers or a back-up float control system (minimum of two floats) for turning the individual pumps on and off if the primary pressure transducer malfunctions. Back-up transducers or floats shall be wired to individual pump motor starters.

E. Where variable speed pumps are specified, the most recent model of a DANFOSS (preferred) variable frequency controller shall be used in addition to the pump controller specified. Older VFD models or discontinued VFD models will not be allowed.

F. Check valve limit switch circuitry shall be used for pump failure logic (Class A & B only).

G. An elapsed run time indicator shall be provided for each pump.

H. A press-to-test circuit shall be provided for the control panel indicator lights.

I. All control wiring and interface wiring shall be number coordinated with schematic. All panel and field wiring shall be identified with non-repeating numbers. All instrumentation and control devices shall be wired with stranded copper conductors.

J. All motor controls shall be equipped with a motor overload indicator light for each motor equipped with a thermal overload protection device.

K. Provide an uninterruptible power supply (UPS) with 2-hour battery for the control system.

8.7.9. TELEMETRY

MUPB shall specify the method of communications and specific brands of hardware and software to be used. MUPB may require additional telemetry at a particular lift station. The following minimum signals are required:

Description	Submersible PS	
	Monitor	Required Signals
Pump Run for each pump	Yes	Per # of pumps
Pump Failure	Yes	Per # of pumps
Power Failure	Yes	1
Generator or Backup Power Run	Yes	1
Generator or Backup Power Failure	Yes	1
High Level	Yes	1
Telemetry Failure	Yes	1
Building Intrusion	No	0
Control Panel Intrusion	Yes	1
Overflow	Yes	1

Telemetry equipment shall be housed in a NEMA 4X Stainless Steel enclosure for outdoor use. Costs to modify the master station will be borne by OWNER/DEVELOPER.

8.7.10. POTABLE WATER SUPPLY

All lift stations shall have access to potable water for wash down purposes. Not all of MUPB sewer service area is served by MUPB water service area. If the lift station is within MUPB water service area, then OWNER/CONTRACTOR is to install service line, tap of existing water main, yard hydrant and meter box. MUPB will provide the actual meter. For lift stations located within service areas other than MUPB's, the provider of potable water (Rowan Water, Inc, Bath County Water District or others) shall be contacted for their specific requirements. A yard hydrant shall be provided per MUPB Standard Details – Sewer.

8.7.11. VAULTS

A. Access hatches shall be located in the vault so as to facilitate the removal of the equipment in the vault without disrupting the operation of the facility. A minimum size hatch shall be 36" x 36" but shall be sized to allow for removal of valves and piping for Class "A" and "B". Class "C" lift stations hatch to be determined per wet well manufacturer and MUPB.

B. All hatches shall be aluminum with stainless steel hardware. All hatches shall have locking hasps and automatic hold-open arms with safety grates

for fall protection.

C. The valve vault and flow meter vault shall have floor drains, minimum of 6-inch drain lines. The floor drain will have a "P" trap and isolation valve and will discharge into the wet well. The floor drain shall be installed with a flapper valve on the end to prevent sewage from entering the structures if the wet well floods.

8.7.12. ODOR CONTROL

A. Odor control measures must be designed and installed as part of the station, as determined by MUPB.

B. Lift stations shall be provided with an odor control system designed to mitigate odors from the wet well and influent manhole via carbon absorption (air scrubbing).

C. Lift stations should be designed to minimize the possible formation of odors by limiting wet well retention times and avoiding high drops for influent sewers, which cause odors to be released.

8.7.13. ELECTRICAL

A. All lift stations will be reliability Class I. Electric power shall be provided to the station by distribution lines and by a standby generator. Both power sources shall be sufficient to operate all pumps, critical lighting and ventilation systems during peak flow conditions.

B. The electrical distribution lines and generator shall have a means of being disconnected before the transfer switch. The generator will automatically switch sources in the event of a power failure. The transfer switch will be fully automatic with the ability to sense a single-phase power condition and switch to the generator power system with a minimum time delay. Both power sources shall be protected by fuses or breakers prior to the transfer switch. The transfer switch shall be capable of being operated manually.

C. The lift station's power supply shall be protected from lightning (ie lightning arrestor).

D. A final step-down transformer shall be provided on each electric feed line with adequate physical separation between them to prevent a common mode failure. Separate fuses shall be provided for each power source.

E. The electric distribution line and the standby generator will remain separate and form separate distributions up to the internal fuse system to preclude a common mode failure of both sources.

F. Breaker settings or fuse ratings shall be coordinated to effect sequential tripping such that the breaker or fuse nearest the fault will clear the fault prior to activations of other breakers or fuses to the degree practical.

G. The load distribution panel shall not be an internal part of the transformer.

H. All motors and control enclosures will be adequately protected from moisture, the weather, and water under pressure.

I. All equipment shall be installed in accordance with the manufacturer's recommendations. When laying out the location of the equipment in the control and generator building, the engineer will consider the necessary separation between devices to provide adequate ventilation and the location of doors, hatches, and panel covers to avoid conflicts between these items when they are opened and closed. Also, housekeeping pads shall be provided to keep all equipment off of the floor.

J. Provide arc flash study and rating for the facility, with design of corresponding safety features. Design system to Class 2 or lower rating for arc flash. Arc flash study shall be performed on the design, and again at the substantial completion of the station.

8.8. CONSTRUCTION PLAN REQUIREMENTS

Construction Plans are to prepared by licensed Professional Engineer with a valid and current license in the Commonwealth of Kentucky per KRS Chapter 322. Plans shall be submitted per Section 2, of this MANUAL.

SECTION 9: CONSTRUCTION OF SANITARY SEWER FACILITIES

9.1. PURPOSE

The purpose of this SECTION is to outline requirements for construction, inspection, and final acceptance of sanitary sewer mains (gravity/pressure) and appurtenances, LPS service connections, and manholes.

9.2. REQUIREMENTS

Sanitary Sewer system IMPROVEMENTS shall be installed in public rights-of-way or, upon MUPB approval, in a utility easement granted to MUPB. All easement information must be submitted as outlined in SECTION 1. Sanitary sewer mains shall not be closer than ten (10) to any permanent structures.

The CONTRACTOR shall install a force main marker post at the ends of all force mains, at the intersection(s) of roads, and as directed by MUPB. The location posts shall be white in color with a green sticker and marked so as to identify the line as a sanitary sewer pipe.

Sewage combination air valves shall be provided at all high points in the force main. Long horizontal runs and increases in slope may also require combination air valves. Clean-outs shall be provided at all low points and at additional critical locations. The design ENGINEER shall consider and review with MUPB the location of all sewage combination air valves and clean-outs. Thrust restraints and blocks shall be provided at bends. For slopes of 20 percent and greater, anchors shall be provided at each joint (at a minimum). A flexible through-wall connector shall be used at pipe penetrations through structures to allow for differential settlement.

Sanitary sewer mains under pressure (force mains) are to be installed between a pump station or laid for grinder pumps to be connected to the force main to transport sewage to the final discharge point. Force mains shall be designed for ultimate peak flow conditions. After installation, the force mains shall be field verified for initial operating conditions and initial ultimate peak flow conditions to insure the velocity ranges.

Force mains shall be a minimum of 4-inch diameter for applications with non-grinding pumps. Force mains incorporated into a low-pressure sewer system (LPS) or application with a grinding pump may be a minimum of 2-inch diameter. Any departure from minimum requirements shall be justified by hydraulic analysis and will only be considered in special circumstances.

Sanitary sewer mains that flow by gravity are to be installed at uniform grade and in straight alignment between manholes. Gravity sanitary sewer mains shall be laid to minimum grades as outlined in SECTION 6.

All gravity sanitary sewer pipe shall be PVC or D.I. unless a variance is requested at the sole discretion of MUPB.

9.3. PIPE MATERIALS

Force mains 18" and less in diameter shall be constructed of ductile iron, HDPE or polyvinyl chloride (PVC) pipe, unless otherwise approved by MUPB. Force mains larger than 18" in diameter shall be reviewed on a case-by-case basis by MUPB for the determination of the appropriate material.

Gravity sewer mains 18" and less in diameter shall be constructed of ductile iron (DI) or polyvinyl chloride (PVC) pipe, unless otherwise approved by MUPB. Gravity sewer mains larger than 18" in diameter shall be reviewed on a case-by-case basis by MUPB for the determination of the appropriate material. For gravity sanitary sewer pipes laid at depths in excess of 15 feet, all pipe shall be D.I.

9.3.1 POLYVINYL CHLORIDE PIPE (PVC), FITTINGS & JOINTS – GRAVITY

PVC pipe shall be extruded from Type 1, Grade 1, and polyvinyl chloride material designated as PVC 1120, meeting ASTM Specifications D 3034, Type PSM, and a standard dimension ratio of SDR 35.

The pipe shall be homogenous throughout and free from cracks, holes, foreign inclusions or other defects. The pipe shall be as uniform as commercially practical in color.

The pipe shall have a bell on one end. Spigot ends of pipe must be beveled on the outside. Pipe shall have a ring painted around the male end or ends in such a manner as to allow field checking of setting depth of pipe in the socket.

Pipe must be delivered to the job site by means which will adequately support it and not subject it to undue stresses. In particular, the load shall be so supported that the bottom rows of pipe are not damaged by crushing. Pipe shall be unloaded carefully and strung or stored as close to the final point of placement as is practical. Pipe must not be exposed to the direct rays of the sun for an extended period of time. If the pipe is not to be installed shortly after delivery to the job site, it must be in a shaded location or covered.

All buried force main sewer pipe shall have a non-metallic locator tape laid within two feet (2') from finished grade. The locator tape shall have the word "CAUTION – BURIED SEWER LINE BELOW" printed on it, green in color, and shall identify the pipe as a sewer pipe. The tape shall be a product manufactured for the purpose of warning of buried pipelines.

9.3.2. DUCTILE IRON PIPE (D.I.), FITTINGS AND JOINTS – GRAVITY

Ductile iron pipe shall conform to ASTM A746. Ductile iron pipe and fittings shall be bituminous coated exterior and receive an interior ceramic epoxy coating, Protecto 401 or equal. Thickness of the lining shall be as recommended by the

manufacturer. Fittings for ductile iron pipe shall be mechanical joint Class 250 gray iron conforming to ANSI A21.10 and AWWA C110 for short body ductile iron fittings.

Each piece of pipe shall bear the manufacturer's name or trademark, the year in which it was produced and the letters "D.I." or word "DUCTILE". Shop inspection and testing shall be in accordance with the ASTM specifications.

Where ductile iron pipe is to be installed in corrosive soil conditions the pipe shall be protected by an 8-mil thick polyethylene encasement meeting the requirements of ANSI A21.5. Such corrosive soils include, but are not limited to salt marshes, saturated alkaline soils; cinder fills, areas of decaying vegetation, and waste dumps. It is the responsibility of the ENGINEER to determine if corrosive soils are present in the scope of the proposed DEVELOPMENT. The ENGINEER shall note the presence or absence of corrosive soils on the DEVELOPMENT plans.

9.3.3. POLYVINYL CHLORIDE PIPE (PVC), FITTINGS AND JOINTS – PRESSURE

PVC pressure pipe shall conform, at a minimum to ASTM Specifications D-2241, and shall be pressure Class 200 (SDR 21) at minimum. Fittings for PVC pipe shall be mechanical joint Class 250 ductile iron conforming to ANSI A21.10 and AWWA C110 for short body ductile iron fittings. Fittings shall be bituminous coated exterior and shall receive Protect 401 or equal ceramic epoxy lining on the interior as specified herein.
Pipe joints shall be of the rubber gasketed type, conforming to ASTM D3139 and ASTM F477. All jointing material and lubricants shall be non-toxic.

All buried pipe shall have copper tracer wire taped to the line for the purpose of pipe location. See paragraph 9.4.5. for specifics of tracer wire requirements.

9.3.4. DUCTILE IRON PIPE (D.I.), FITTINGS AND JOINTS – PRESSURE

Ductile iron pipe shall conform to ASTM A746. Ductile iron pipe and fittings shall be receiving an interior ceramic epoxy coating, Protecto 401 or equal. Thickness of the lining shall be as recommended by the manufacturer. Pipe and fittings shall have a standard coal tar or asphalt based bituminous outside coating and minimum of 1 mil thick.

Each piece of pipe shall bear the manufacturer's name or trademark, the year in which it was produced and the letters "D.I." or word "DUCTILE". Shop inspection and testing shall be in accordance with the AWWA Specifications.

Fittings for ductile iron pipe shall be mechanical joint Class 250 gray iron conforming to ANSI A21.10 and AWWA C110 for short body ductile iron fittings. Fittings for ductile iron pipe shall be mechanical joint Class 250 gray iron conforming to ANSI A21.10 and AWWA C110 for short body iron fittings. Fittings

shall be bituminous coated exterior and shall receive Protect 401 or equal ceramic epoxy lining on the interior as specified herein.

Where ductile iron pipe is to be installed in corrosive soil conditions the pipe shall be protected by an 8-mil thick polyethylene encasement meeting the requirements of ANSI A21.5. Such corrosive soils include, but are not limited to salt marshes, saturated alkaline soils; cinder filled areas of decaying vegetation, and waste dumps. It is the responsibility of the ENGINEER to determine if corrosive soils are present in the scope of the proposed IMPROVEMENTS. The ENGINEER shall note the presence or absence of corrosive soils on the IMPROVEMENT plans.

9.3.5 HIGH DENSITY POLYETHYLENE PIPE (HDPE) FITTINGS & PIPE – PRESSURE

HDPE pipe shall conform, as a minimum to AWWA C906 and shall be of a pressure class to provide a 2.5 safety factor of normal working pressure. Higher pressure rated HDPE pipe shall be considered on a case-by-case basis and the pipe material and classification shall be determined by MUPB.

Fittings shall be HDPE butt fused fittings, mechanical joint adapters, flanges, unions, grooved-couplers, transition fittings and some mechanical couplings conforming to AWWA Specifications and manufacturer recommendations. Pipe joints shall be butt fused.

All buried pipe shall have copper tracer wire taped to the line for the purpose of pipe location. See paragraph 9.4.5. for specifics of tracer wire requirements.

9.3.6. ENCASEMENT PIPE

Encasement pipe shall be steel, plain end, uncoated and unwrapped, have minimum yield point strength of 35,000 PSI and conform to ASTM Grade 2 of ASTM A130 Grade B without hydrostatic tests. The steel pipe shall have welded joints and be in at least 18-foot lengths.

The wall thickness of the pipe shall be a minimum of 0.375 inches for highway crossings and for railroad crossings. Refer to MUPB Standard Details for wall thickness and diameter requirements. The diameter of the pipe shall conform to the requirements of American Railway Engineering Association for railroad crossings, and the requirements of the Kentucky Department of Transportation, Bureau of Highways for highway crossings.

9.4. SANITARY SEWER MAIN APPURTENANCES – FORCE MAIN

9.4.1. GATE VALVES

All gate valves shall be resilient seat wedge, iron body, non-rising stem, fully bronze mounted and suitable for working pressures of 200 PSI. Valves shall be of

standard manufacture and of the highest quality both as to material and workmanship.

All gate valves shall have the name or monogram of the manufacture, the year the valve casting was made, the size of the valve, and the working pressure cast on the body of the valve.

Gate valves set with valve boxes shall be provided with a two-inch square operating nut and shall open by turning to the left (counterclockwise) and be marked “SEWER” on the lid. Gate valves for installation in meter vaults shall be flanged ANSI B16.1 Class 125 and hand wheel operated.

All valves shall conform to the latest revision of AWWA Standard for Gate Valves for Ordinary Water Works Service, AWWA C500.

9.4.2. TAPPING SLEEVES AND VALVES

Tapping sleeves for connection of new force mains to existing force mains shall be stainless steel and shall have a reduction of pipe diameter size. See MUPB approved manufacturers list. Tapping sleeves shall be tested according to the manufacturer’s recommendations.

9.4.3. VALVE BOXES

Valve boxes shall be of 5.25-inch standard cast iron, two pieces, and screw type valve box with drop cover marked "SEWER". For force mains with cover greater than 5’, 8” PVC pipe may be used to raise the valve box to grade. Valve boxes shall be accurately centered over valve operating nut, and backfill thoroughly tamped about them.

Valve box bases shall not rest on the valves but shall be supported on crushed stone fill. They shall be set vertically and properly cut and/or adjusted so that the tops of boxes will be at grade in any paving, walk or road surface. In non-paved areas an 18” round or 18” square concrete valve marker shall be installed around the valve box, minimum of 4” thickness.

9.4.4. COMBINATION AIR RELEASE VALVES AND BOXES

Combination air release valves shall be installed at the high point on the force mains as shown on the approved plans, unless directed by MUPB. The inlet pipe to the combination air release valve shall be ASTM B43 extra strong stainless-steel pipe with I.P.S. male threaded ends and full port ball valve.

Combination air release valves shall be per the approved equal manufacturer list of water and sewer parts and supplies. Valve shall have a threaded inlet and be suitable for 150 PSI normal working pressure.

The combination air release valve shall be installed as shown in MUPB Standard Details.

9.4.5. TRACING WIRE

A. Direct Burial

Tracer Wire shall be #12 AWG solid copper insulated with a 30 mil, high-density, high molecular weight polyethylene (HDPE) insulation and rated for direct burial use at 30 volts. Insulation color shall meet the APWA color code standard for identification of buried utilities. Insulated copper trace wire shall be attached to the top of the pipe with adhesive tape or other suitable devices. At each combination air release valve, curb box, flushing connection and end of new pipe installation, the trace wire shall be daylighted and the ends connected together with waterproof connectors covered with waterproof connectors. For long runs of pipe, the maximum length between tracing stations (above or below grade) shall be 500 feet. Underground splicing shall be made using waterproof connectors designed for direct bury and covered with waterproof tape or wrap.

B. Directional Drilled

Tracer wire shall be a #12 AWG (0.0808" diameter) fully annealed, high carbon 1055 grade steel, high strength solid copper clad steel conductor (HS-CCS), insulated with a 30 mil, high-density, high molecular weight polyethylene (HDPE) insulation, and rated for direct burial use at 30 volts. HS-CCS conductor must be at 21% conductivity for locate purposes. Break load of 452 lbs. HDPE insulation shall be RoHS compliant and utilize virgin grade material. Insulation color shall meet the APWA color code standard for identification of buried utilities. Manufacturers supplying copper clad steel tracer wire must have available detailed performance data including 5 years of underground testing in terms of durability related to damage of protective insulation and effects of potential corrosion of the specific copper clad steel used. Origin of copper clad steel manufacturer is required and steel core must be manufactured in the United States. If manufacturer has not completed 5-year corrosion testing, a 5-year warranty must be provided. Tracer wire shall be Copperhead® High Strength HS-CCS HDPE 30 mil or district pre-approved equal and made in the USA.

Use Copperhead High Strength Tracer Wire - Part # 1230*-HS-**

* = Color: B=Blue Water, G=Green Sewer, P=Purple Reclaim Water R=Red Electric, N=Orange Communications, K=Black

** = Spool Size: 500', 1000', 2500'

9.5. SANITARY SEWER MAIN APPURTENANCES – GRAVITY

9.5.1. MANHOLES

Manholes shall be installed in accordance with standards herein and as shown in MUPB Standard Details. Type II cement shall be used except as otherwise permitted. In addition, all precast reinforced concrete manholes shall include the sidewall rings and base. At points of pipe inlet, the precast base manhole shall contain a pipe to manhole gasket or approved equal, which is sufficiently flexible to prevent shear of the pipe due to differential settling. Grouted joints alone between sections and cast in place bases are not acceptable. The tapping of house connections into manholes on newly constructed sewers will not be permitted, except as approved by MUPB.

The minimum diameter of manholes shall be 48-inches for pipe sizes 12-inch or less and 60-inches for pipe sizes 18-inch and larger than 12-inch. A minimum access opening of 21 inch shall be provided. The flow channel through manholes should be made to conform in shape, slope and smoothness to that of the sewers.

The base of the manhole shall have openings for the sewer pipe cast to the alignment and elevations as part of the base openings, so as to form a watertight connection. The channel and bench shall be integrally cast or formed as part of the manhole base. The manhole base shall be set on a six-inch (6") stone leveling pad. The stone material shall be the same as required for pipe bedding as specified elsewhere in this manual. All manholes shall be pre-cast with the exception of manholes for connections at existing sanitary sewer mains. Other types of manholes, cones, castings, steps, and bases may be used only after permission has been granted in writing by MUPB.

Manholes shall be installed at the end of each line; at all changes in grade, size or alignment; at all intersections; and at distances not greater than 400 feet. Manholes of the form and dimensions shown on the approved plans shall be built as directed. The manhole casting shall be raised via grade rings as specified per MUPB Standard Drawings. Manholes and lines shall be located in the street when possible. Locating manholes in sidewalks shall be avoided wherever possible. Manholes located in streets shall have the casting and cover installed at the street's final grade.

Manhole covers shall have “MUPB SANITARY SEWER” stamped on the lid. Manhole covers must sit flush with the frames, with contact edges machined for even bearing and the cover sit neatly and flush with the frame edge. The covers shall have two (2) concealed pick holes for removal. Lids shall be solid and no perforated lids will be permitted for sanitary sewers. Manhole frames and lids shall be Model 350 as manufactured by J.R. Hoe & Sons, CAP ONE Model-24 as manufactured by Composite Access Products or approved by MUPB. Manholes located within or below 100-year flood, shall be water tight manhole castings as described above with the addition of gasketed seals and bolted lids.

A. STANDARD MANHOLES

The standard manholes shall be four feet or more in depth, measured from, the top of the cover frame to the top of the concrete footing and shall be of eccentric cone-type construction.

B. SHALLOW MANHOLES

Manholes that are four feet of less are considered a shallow manhole, as measured from the top of the cover frame to the top of the concrete footing and shall be of flat top construction.

C. EXTERNAL DROP MANHOLES

External drop manholes shall be avoided, wherever possible. Where required, a drop pipe shall provide for a sewer entering a manhole at an elevation of 24 inches or more above the manhole invert. Drop manholes shall be constructed with an outside drop connection.

A drop pipe shall be provided for a sewer entering a manhole at an elevation of 24 inches or more above the manhole invert and shall be built as a part of the standard manhole. The pipe shall be laid in the manhole as shown on the plans and encased with concrete. The pipe which is laid to the drop portion of the manhole shall be supported with 3,500 psi concrete extending from the drop stack to the reinforced base of the manhole.

D. INTERNAL DROP MANHOLES

Internal drops shall only be used when connecting to an existing sewer main and upon approval of MUPB. Where the difference in elevation between the incoming sewer and the manhole invert is less than 24 inches, the invert should be filleted (45°) to prevent solids deposition.

9.5.2. TEES & WYES FOR LATERAL CONNECTION

Lateral connections to the sanitary sewer main shall only be located at existing "Y" or "T" connections on the main. When none exist on the main, an approved manufactured saddle wye with stainless steel bands shall be installed on the main and the connection rendered watertight by means of mastic seat. Concrete encasement shall only be permitted by special written authorization.

All connections between the sewer service lateral and the building connection shall be inspected by MUPB inspector prior to backfilling.

9.5.3. CLEANOUTS

Cleanouts of the sewer laterals shall be built at all horizontal or vertical changes of direction of sewer laterals. Cleanouts shall be a minimum of 4" and located at the right-of-way edge or permanent easement edge. A pipe lateral shall be connected to the building clean out by a commercial fitting; cement and grout shall not be used.

9.6. TRENCH EXCAVATION

Unless specifically directed otherwise by MUPB, not more than 50 feet of trench shall be opened ahead of gravity sanitary sewer pipe laying work of any one crew and not more than 50 feet of open trench shall be left behind the pipe laying work of any one crew.

Trenches in which pipes are to be laid shall be excavated in open cut to the depths shown on the approved plans.

Unless specifically authorized by MUPB, trenches shall in no case be excavated or permitted to become wider than two feet six inches (2'-6"), plus the nominal diameter of the pipe at the level of or below the top of the pipe. If the trench becomes wider than two feet six inches (2'-6") below the top of the compacted granular fill at top of the pipe, pipe material may need to be changed to account for soil loadings as determined by MUPB. This determination shall take into account the actual trench loads that may result and the strength of the pipe being used.

Trenches shall be kept free of water during the installation of pipe and until the pipeline has been backfilled. Backfilling shall be as specified herein.

9.6.1 OBSTRUCTIONS

In cases where storm sewers, sanitary sewers, gas lines, water lines, telephone lines, and other utilities, or other underground structures are encountered, they shall not be displaced. All precautions shall be made to not damage any other utility. In the event that a utility is damaged (as defined by the owner of the said utility) all fines/repairs/damage fees associated with these damages will be incurred at the expense of CONTRACTOR/OWNER. See KY PSC rules on Natural Gas/Hazardous Liquids pipeline incidents.

The CONTRACTOR shall notify KY 811 prior to beginning construction work.

9.6.2. SHORING SHEETING AND BRACING

The shoring, sheeting, and bracing of excavation shall be performed by the CONTRACTOR in compliance with applicable codes and OSHA requirements. MUPB shall not be held responsible for job site safety. Safety is the responsibility of the OWNER/DEVELOPER and CONTRACTOR.

9.7. PIPE BEDDING

In all cases the foundation for pipes shall be prepared so that the entire load of the backfill on top of this pipe will be carried on the barrel of the pipe and, insofar as possible, where bell and spigot pipe are involved so that none of the load will be carried on the bells.

When undercutting and granular bedding are involved, the depth at the bottom of the bells of the pipe will be at least four inches above the bottom of the trench as excavated.

Supporting of the pipe shall be as set out hereinbefore, and in no case shall the supporting of pipe on blocks be permitted.

9.7.1. EARTH FOUNDATION

All gravity sewer main pipes shall be supported on a bed of No. 9 or No. 68 crushed stone as defined by KYTC-KDHSS. Bedding material shall be free from rock and be acceptable to MUPB. In no case shall pipe be supported directly on rock. Force main sewer pipe may be supported on excavated earth, if acceptable by MUPB.

9.7.2 ROCK FOUNDATION

If the trench bottom is in rock, the excavation shall be undercut to a minimum depth of six inches below the bottom of the pipe. The pipe shall be laid on a bed of granular material to provide continuous support for the lower section of the pipe. Granular bedding shall be size No. 9 or No. 68 crushed stone as defined by KYTC-KDHSS.

9.7.3. SPECIAL BEDDING

In wet, yielding, mucky locations, where pipe is in danger of sinking below grade or floating out of line or grade, or where backfill materials are of such fluid nature that such movements of the pipe might take place during the placing of the backfill, the pipe must be weighted or secured permanently in place by such means as will prove effective. When ordered by MUPB, yielding and mucky material in sub-grades shall be removed below ordinary trench depth in order to prepare a proper bed for the pipe. No. 9, No. 68 or No. 57 crushed stone or approved equal shall be used to replace poor subgrade material and shall be classified as "Special Pipe Bedding."

9.8. INSTALLATION OF PIPE

All pipes shall be laid with ends abutting a true to line and grade as shown on the plans. Supporting of pipe shall be as specified under "Pipe Bedding" specified herein and in no case, shall be supported on blocks.

Fittings for the sanitary sewer force mains shall be provided and placed as shown on the plans. All open ends of pipes and of branches shall be sealed or plugged.

Before each piece of pipe is lowered into the trench, it shall be thoroughly cleaned and inspected for defects. Any piece of pipe or fitting which is known to be defective shall not be laid or placed in the lines. Any defective pipe or fitting discovered after the pipe is laid shall be removed and replaced with a satisfactory pipe or fitting. In case a length of pipe is cut to fit in a line, it shall be so cut as to leave a smooth and at right angles to the horizontal axis of the pipe.

Granular bedding material as specified herein, shall be used to correct irregularities in the earth trench sub-grade.

The interior of the pipe shall be maintained clean. Pipe shall be stored in a location where dirt, mud and debris cannot easily enter and contaminate the pipe. When laying of any pipe is stopped for any reason, the exposed end of such pipe shall be closed with a proper plug fitted into the pipe, so as to exclude earth or other material.

No backfilling (except for securing pipe in place) over pipe will be allowed until MUPB or their representative has made an inspection of the joints, alignment and grade in the section laid, but such inspection shall not relieve the CONTRACTOR of further liability in case of defective joints, misalignment caused by backfilling and other such deficiencies that are identified later.

9.8.1. PIPE INSTALLATION WITHIN FILL AREAS

Any gravity sewer main, force main or lateral to be installed in fill areas shall require the OWNER/DEVELOPER to provide inspection and testing services by a Registered Geotechnical Engineer to ensure that each lift in the proposed trench area was constructed and compacted to 95% Standard Proctor density from bottom of fill to 30” above top of pipe. Copies of all test reports shall be certified by the Geotechnical Engineer and submitted to MUPB prior to pipe installation.

9.9. BACKFILLING OF PIPELINE TRENCH

All backfilling shall be accomplished in accordance with the pipe manufacturer's published recommended installation and backfilling method for the pipe being buried and with the requirements of this SECTION. Any variances must be approved in writing by MUPB.

When directed by MUPB, the CONTRACTOR shall add water to the backfill material or dry out the material when needed to attain a condition near optimum moisture content for a maximum density of the material when it is tamped. The CONTRACTOR shall obtain a compaction of the backfill of at least 95 percent of standard Proctor density per ASTM D698 where mechanical tamping of backfill is required.

In all cases walking or working on the completed pipelines except as may be necessary in tamping or backfilling will not be permitted until the trench has been backfilled to a point

one foot above the top of the pipe. The filling of the trench and the tamping of the backfill shall be carried on simultaneously on both sides of the pipe in such a manner that the completed pipeline will not be disturbed and injurious side pressures do not occur.

Whenever sanitary sewer lines are installed, the OWNER/DEVELOPER shall be responsible for any trench settlement which occurs within these right-of ways/easements within one year from the time of final acceptance of the work. If paving shall require replacement because of trench settlement within this time, it shall be replaced by the OWNER/DEVELOPER. Repair of settlement damage shall meet the approval of MUPB.

All backfilling shall be accomplished in accordance with the details shown on the Standard Drawings, manufacturers recommendations and the requirements of this SECTION. Any variances must be approved in writing by MUPB.

9.9.1. GRAVITY SEWER

There are three (3) types of trench backfill conditions where the method of final backfilling varies. The various types and trench situations are as follows:

1. PIPE LAID IN ROCK OR EARTH TRENCH: Areas not subject to vehicular traffic, no pavement including gravel.

2. ORIGINAL GRAVEL SURFACE: Gravel areas subject to light vehicular traffic such as residential driveways; church and commercial parking lots and entrances; and farm drives.

3. ORIGINAL BITUMINOUS or CONCRETE SURFACE: City, County and state roads; bituminous road shoulders; all bituminous surface areas such as residential driveways, church and commercial parking lots, and entrances.

See MUPB Standard Details (SS-001) for specific details for each case.

9.9.2. FORCE MAIN

There are three (3) types of trench backfill conditions where the method of final backfilling varies. The various types and trench situations are as follows:

1. PIPE LAID IN ROCK OR EARTH TRENCH: Areas not subject to vehicular traffic, no pavement including gravel.

2. ORIGINAL GRAVEL SURFACE: Gravel areas subject to light vehicular traffic such as residential driveways; church and commercial parking lots and entrances; and farm drives.

3. ORIGINAL BITUMINOUS or CONCRETE SURFACE: City, County and state roads; bituminous road shoulders; all bituminous surface areas such

as residential driveways, church and commercial parking lots, and entrances.

See MUPB Standard Details (GP-001) for specific details for each case.

9.10. CONCRETE CRADLE, ANCHORS, THRUST BLOCK OR ENCASEMENT

Concrete cradle, anchors, thrust block or encasement of sanitary sewer lines and/or fittings shall be placed as shown on the plans. Concrete cradle shall be utilized for areas of unsuitable subsurface. Concrete thrust blocks shall be utilized at all fittings of sanitary sewer pipe under pressure (force mains and low-pressure sewers). Concrete encasement shall be utilized in areas of less than minimum cover (with MUPB written approval), at creek crossings and drainage crossings and when 10’ of horizontal separation is not available for potable water lines.

Concrete shall be 3,500 psi and shall be mixed sufficiently wet to permit it to flow under the pipe to form a continuous bed. In tamping concrete, care shall be taken not to disturb the grade or line of the pipe or injure the joints.

Concrete anchors shall be utilized for sanitary sewer pipe protection on slopes greater than 15%. Anchors shall be formed on site at distances per MUPB Standard Specifications or as required by MUPB.

Concrete thrust block shall be utilized at all fittings for pressure piping, a polyethylene (plastic) sheet having a minimum thickness of 8 mil, shall be wrapped around the fitting to prevent the concrete from coming in contact with the fitting's bolts and nuts. Volume of concrete shall be derived from MUPB Standard Details.

Concrete encasement provides additional field supporting strength. Wherever the strength of the pipe is not sufficient to support the external loads, the encasement should be designed to provide the necessary additional strength. Concrete encasement shall completely surround the pipe and shall have a minimum thickness at any point of one fourth (1/4) of the outside diameter of the pipe or four inches (4") whichever is greater. In addition, four (4) reinforcing bars of a size selected by the MUPB shall be evenly spaced around the pipe and have a length equal to the length of the encasement.

Sanitary sewer mains constructed under creeks or drainage waterways shall be constructed of ductile iron pipe to a point at least ten feet (10') beyond the edge of the creek of drainage waterway and shall be encased in concrete.

9.11. HIGHWAY & RAILROAD CROSSINGS

Steel encasement pipe for road and railroad crossings shall be bored and/or jacked in place to the elevations shown on the plans. All joints between lengths shall be solidly welded with a smooth non-obstructing joint inside. The encasement pipe shall be installed without bends. The water line pipe shall be installed after the encasement pipe is in place.

Installation of the sewer pipe in the encasement pipe shall be as per MUPB's recommendations and shall include manufactured casing spacers. After the sewer main has been installed, inspected, and tested as specified, both ends of the casing pipe shall be closed with proper fitting plug or cap in a manner acceptable to MUPB.

All street cutting, street boring, highway boring, or railroad boring permits will be the responsibility of the CONTRACTOR. All necessary permits must be approved by KDOH and/or Railroad companies prior to construction commencing.

9.12. PIPELINE CLEANING (PIGGING) PROCEDURES

After installation and prior to testing, the complete pressure system (including all mains, services laterals, blow-offs, air release valves and all other appurtenances) shall be thoroughly cleaned to remove all foreign matter. MUPB shall be notified at least 48 hours prior to cleaning activities. The cleaning of the piping system shall be accomplished by the controlled and pressurized passage through the system of a series of hydraulic or pneumatic polyurethane plugs.

A poly-pigging plan shall be approved by MUPB and all pigging of lines must be witnessed by MUPB inspector. The poly pigs shall be removed and discharged from the system at a point near to the end of the system. The contractor must demonstrate to MUPB that this work will be performed by experienced supervisors and personnel who have provided the cleaning service of comparable systems.

9.13. TESTING OF SANITARY SEWER LINES - GRAVITY

The intent of these specifications is to secure a sanitary sewer system with a minimum amount of infiltration. Sanitary sewer pipe joints shall be tight and all visible leakage shall be repaired in a manner approved by MUPB. All sanitary sewer mains constructed as part of the IMPROVEMENTS shall be tested for leakage by air testing and for pipe deflection. MUPB may require the CONTRACTOR to perform additional infiltration and/or exfiltration tests to demonstrate the quality of the sanitary sewer line IMPROVEMENTS.

After the IMPROVEMENTS have been completed but prior to performing any test herein specified, the CONTRACTOR shall clean the sanitary sewer line constructed in the IMPROVEMENTS by jetting, high pressure flushing or other approved method. All water utilized to clean sanitary sewer lines & lift stations shall not be discharged into the existing sanitary sewer collection system and shall be disposed of in accordance with Federal, State and Local regulations.

Prior to testing, the ENGINEER and MUPB representatives shall inspect each individual line, from manhole to manhole, via CCTV camera, laser and target and survey grade survey equipment (if available) or other means at their disposal to determine whether the completed lines are true to line and grade as laid out or shown on the plans.

All lines or sections of lines that are found to be laid improperly with respect to line or grade, that are found to contain broken or leaking sections of pipe, or are obstructed in

such a manner that they cannot be satisfactorily corrected otherwise, shall be removed and replaced.

9.13.1. PIPE DEFLECTION TEST

After the sanitary sewer line has been installed and backfilled for not less than 30 days, but prior to Final Inspection, the sewer pipe shall be checked for pipe deflection per ASTM D-21227 test procedure for sewer pipe deflection testing. If in the opinion of MUPB, sufficient rainfall has not occurred to allow for full settlement of the trench, then this time period may be extended, at MUPB's discretion. All deflection tests shall be conducted without mechanical pulling devices. Pipe having a deflection greater than 5% shall be rejected and the CONTRACTOR at their own cost shall perform repairs as required so that the maximum pipe deflection is not greater than 5% after burial for 30 days. All repairs shall be made in accordance with this MANUAL and retested in the manner specified herein.

9.13.2. AIR TEST

All air tests shall be done prior to Final Inspection and in the presence of MUPB's inspector who will determine if the tested pipe span is acceptable. The air test is conducted between two consecutive manholes. All pipe outlets must be plugged in the section being tested using suitable test plugs. Low pressure air tests shall be in accordance with ASTM F 1417, except as specified otherwise herein. Air shall be slowly supplied until the internal pressure of the test section reaches four (4) psi over the back pressure on the sewer line that would be caused by ground water. In no case shall air pressure exceed 8 psi. After stabilization period of two minutes, the low-pressure air supply hose shall be disconnected from control panel and timing shall begin.

At the time of the test, each manhole shall be inspected by MUPB inspector to determine possible leaks. Manholes which are questionable shall be water tested.

The air test shall, as a minimum, conform to the test procedure described in ASTM C-828-76T. The air test will be made after backfilling has been completed and compacted.

All ties and end of sewer services shall be plugged with flexible joint plugs or caps securely fastened to withstand the internal test pressures. Such plugs or caps shall be readily removable, shall provide a socket suitable for making a flexible jointed lateral connection or extension.

The test shall be passed provided that the time required, in seconds, for the pressure to decrease from 4.0 to 3.0 pounds per square inch greater than the average back pressure of any ground water that may submerge the pipe is not less than shown in the " Minimum Holding Time for Low Pressure Air Test" listed below. Pipe failing the air test shall be rejected and the CONTRACTOR, at their own cost,

shall perform repairs as required so that the pipe passes the air test as herein defined. All repairs shall be retested in the manner specified herein.

Minimum Holding Time for Low Pressure Air Test

Nominal Pipe Size (inches)	Time per 100 ft (seconds)
8	72
10	90
12	108
15	126
18	144
21	180
24	216

9.13.3. EXFILTRATION/INFILTRATION TEST

Sewer line exfiltration and/or infiltration test shall be conducted to ensure that the water tightness of the gravity sanitary sewer main to keep out/in wastewater being transported. Sewer line exfiltration and/or infiltration shall not exceed 50 gallons per inch of pipe diameter per mile per 24 hours for any section of the system. As exfiltration or infiltration test shall be performed with a minimum positive head of 2 feet.

9.14. TESTING OF SANITARY SEWER – FORCE MAINS

Upon completion of the construction of force mains but prior to FINAL INSPECTION, all force mains and appurtenances shall be tested for leaks as specified herein. MUPB shall be notified at least 48 hours in advanced of the scheduled test time and, at its own discretion, have an inspector present during the performance of the test.

Where practicable, pipelines shall be tested between line valves, temporary valves or temporary plugs in lengths of not more than 1,500 feet or between isolation valves. The CONTRACTOR may request, in writing, the testing of a section of line greater than 1,500 feet with MUPB's approval. Testing shall proceed from the source of discharge toward the lift station or termination of the line. The line shall be tested upon the completion of the first 1,500 feet or the first isolation valve.

9.14.1. TEST RESTRICTIONS

Force mains shall be tested at a minimum of 150 pounds per square inch in compliance with AWWA C600/C605 but not less than the pressure specified in the sub-paragraphs below. The CONTRACTOR shall furnish a recording pressure gauge which shall be used for the continuous measurement and recording of test pressures and test time.

Test pressure shall not be less than 1.5 times the working pressure at the point of testing or 150 psi, whichever is the greater, but not less than 1.25 times the normal working pressure at the highest elevation along the test section. Test pressure shall not exceed pipe or thrust-restraint design pressures. The hydrostatic test shall be at least a 4-hour duration. Test pressure shall not vary by more than ±5 psi for the duration of the test. Test pressure shall not exceed the rated pressure of the valves when the pressure boundary of the test section includes closed, resilient-seated gate valves.

Valves shall not be operated in either direction at differential pressure exceeding the rated valve working pressure. For test pressures, the test setup should include provision, independent of the valve, to reduce the line pressure to the rated valve pressure on completion of the test. The valve can then be opened enough to equalize the trapped pressure with the line pressure, or fully opened if desired.

9.14.2. PRESSURIZATION

Each valved section of pipe shall be slowly filled with water, and the specified test pressure. Valves shall not be operated in either the opening or closing direction at differential pressures above the rated pressure. It is good practice to allow the system to stabilize at the test pressure before conducting the leakage test.

Before applying the specified test pressure, air shall be expelled completely from the pipe and valves. If permanent air vents are not located at all high points, the Contractor shall install corporation stops at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation stops shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation stops shall be removed and plugged or left in place at the discretion of MUPB.

Any exposed pipe, fittings, valves and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, valves, hydrants or joints that are discovered following the pressure test shall be repaired or replaced with sound material, and the test shall be repeated until it is satisfactory to MUPB.

Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 psi of the specified test pressure after the pipe has been filled with water and the air has been expelled. Leakage shall not be measured by a drop-in pressure in a test section over a period of time.

Loss of water pressure during the test shall not exceed 10 psi in a 24-hour time period or 5 psi in a two (2) hour time period. Duration of test shall be not less than two (2) hours. Where leaks are visible at exposed joints and/or evident on the surface where joints are covered, the joints shall be recaulked, repoured, bolts retightened or re-laid, and leakage minimized, regardless of total pressure drop shown by the test.

9.14.3. ALLOWABLE LEAKAGE

Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 psi of the specified test pressure after the pipe has been filled with water and the air has been expelled. Leakage shall not be measured by a drop-in pressure in a test section over a period of time.

Only after the water main has successfully passed the hydrostatic pressure test, shall the leakage test be used to determine if the water main has passed. No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

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

Where:

L = Allowable leakage, in gallons per hour
S = Length of pipe tested, in feet
D = Nominal diameter of the pipe, in inches
P = Average test pressure during the leakage test, in pounds per square inch (gauge)

If loss exceeds L, the Contractor shall locate and repair to MUPB's satisfaction all leaks until the pipe section will pass another leakage test.

For the pipe line to be accepted, the following will be required:

1. Pass the pressure test.

2. Pass the leakage test, unless waived under the pressure test.

3. All evidence of leakage identified and repaired.

Should the sections under test fail to meet the requirements, the Contractor shall do all work of locating and repairing the leaks and retesting as MUPB may require without additional compensation.

If in the judgment of MUPB, it is impracticable to follow the foregoing procedures for any reason, modifications in the procedures shall be made as required and as acceptable to MUPB, but in any event, the Contractor shall be responsible for the ultimate tightness of the line within the above test requirements.

9.14.4. PRESSURE GAUGES

Pressure gages shall be sized accordingly to normal operating pressures (average pressures). Gauge ranges shall be no more than twice the operating pressure. Gauge assemblies shall be furnished with shutoff stops diaphragm seals and pulsation dampers, which shall be constructed of brass or stainless steel. Gauges shall be 4 ½-inch in diameter. Gages shall have the following graduations:

Pressure Gauges (psi)

Maximum *Indications*	*Figure Intervals*	Intermediate Graduations	Minor Graduations
15	1	0.5	0.1
30	5	1	0.2
60	5	1	0.5
100	10	5	1
160	20	5	1
200	20	10	2
300	30	10	2

9.15. CONNECTING TO SANITARY SEWER SYSTEM

Connections to the existing sanitary sewer system shall be directed by MUPB, to the location of connection point. Gravity sanitary sewer connection shall be made at an existing manhole. Existing manhole shall be cored with a flexible connector and manhole bench and channel shall be shaped for positive flow from new sanitary sewer line.

New force main connection to an existing force main shall be made via a D.I. mechanical fitting “tee” or a stainless-steel tapping sleeve and valve with isolation valves located on all sides of the connection. New connections of force mains may be made at existing manholes, wet wells or force mains, at the discretion of MUPB. New force main connections to existing manholes or wet wells, shall be made by coring structure (manhole/wet well) with a water tight connection. CONTRACTOR is responsible for all labor, materials & equipment for connecting to the existing wastewater system.

The CONTRACTOR shall notify MUPB when the connection is to be made so that representatives of MUPB may operate existing valves and witness the connection. A minimum notice of at least 48 hours in advance of the connection shall be given to MUPB.

9.16. RESPONSIBILITY FOR MAINTENANCE

Prior to formal acceptance of the IMPROVEMENTS by MUPB, the CONTRACTOR and/or OWNER/DEVELOPER shall be responsible for the maintenance and repair of the IMPROVEMENTS in compliance with this manual, which shall include routine maintenance, cleaning, flushing, debris removal and general operation of force main(s), grinder(s), gravity sewer(s), lift stations and appurtenances.

After formal acceptance of the IMPROVEMENTS by MUPB, MUPB will maintain and repair the sanitary sewer mains and appurtenances. The limit of MUPB maintenance and repair responsibilities is at the sanitary sewer main. The property owner is responsible for the maintenance and repair of the property's service lateral or building sewer.

9.17. PLACEMENT OF TRACING WIRE

9.17.1. Direct Burial

Tracer wire shall be #12 AWG solid copper insulated with a 30 mil, high-density, high molecular weight polyethylene (HDPE) insulation and rated for direct burial use at 30 volts. Insulation color shall meet the APWA color code standard for identification of buried utilities. Detectable underground copper tracing wire shall be installed with all sanitary sewer pressure lines. Tracer wire shall be attached to the top of the pipe with adhesive tape or other suitable devices. At each lateral, service force main, and end of new pipe installation, the trace wire shall be daylighted and the ends connected together with waterproof connectors. For long runs of pipe, the maximum length between tracing stations (above or below grade) shall be 500 feet. Underground splicing shall be made using waterproof connectors designed for direct bury and covered with waterproof tape or wrap.

9.17.2. Directional Drilled

Tracer wire shall be a #12 AWG (0.0808” diameter) fully annealed, high carbon 1055 grade steel, high strength solid copper clad steel conductor (HS-CCS), insulated with a 30 mil, high-density, high molecular weight polyethylene (HDPE) insulation, and rated for direct burial use at 30 volts. HS-CCS conductor must be at 21% conductivity for locate purposes. Break load of 452 lbs. HDPE insulation shall be RoHS compliant and utilize virgin grade material. Insulation color shall meet the APWA color code standard for identification of buried utilities. Manufacturers supplying copper clad steel tracer wire must have available detailed performance data including 5 years of underground testing in terms of durability related to damage of protective insulation and effects of potential corrosion of the specific copper clad steel used. Origin of copper clad steel manufacturer is required and steel core must be manufactured in the United States. If manufacturer has not completed 5-year corrosion testing, a 5-year warranty must be provided. Tracer wire shall be Copperhead® High Strength HS-CCS HDPE 30 mil or district pre-approved equal and made in the USA.

Use Copperhead High Strength Tracer Wire - Part # 1230*-HS-**

* = Color: B=Blue Water, G=Green Sewer, P=Purple Reclaim Water R=Red Electric, N=Orange Communications, K=Black

** = Spool Size: 500’, 1000’, 2500’

9.18. SECOND HAND & SALVAGED MATERIALS

The use of second hand or salvaged materials will not be permitted unless authorized by MUPB. All materials and/or equipment specified to be salvaged from existing structures shall remain the property of the MUPB. Such materials and/or equipment shall be delivered by the CONTRACTOR and stored on sites as directed by MUPB.

9.19. CONTRACTORS GUARANTEE & UNDERSTANDING

All work that has been rejected shall be repaired, or if it cannot be repaired satisfactorily, it shall be removed and replaced at the CONTRACTOR's expense. Defective materials shall be immediately removed from the site of the work. Work done without line and grade having been given, work done beyond the lines or not in conformity with the grades shown on the plans or as given, same as herein provided, work done without written authority and prior agreement in writing as to process, shall be done at the CONTRACTOR's risk and shall be considered unauthorized and, at the option of the Engineer and MUPB, may be ordered removed at the CONTRACTOR's expense.

9.20. PROTECTION OF WORK, PERSONS & PROPERTY

During performance and up to the date of final acceptance, the CONTRACTOR shall be under the absolute obligation to protect the finished work against any damage, loss or injury. All risk of loss or damage to the work shall be borne solely by the CONTRACTOR until completion and acceptance of all work by the Engineer and MUPB, as evidenced by the MUPB's issuance of a Letter of Acceptance.

The CONTRACTOR shall have the full responsibility to provide and maintain all warning devices and take all precautionary measures required by law or otherwise to protect persons and property. Minimum standards for safeguarding pedestrian and vehicular traffic are contained in the "Manual of Uniform Traffic Control Devices," Federal Highway Administration of the U.S. Department of Transportation, and the "Kentucky Manual of Uniform Traffic Control Devices," Kentucky Transportation Cabinet. The CONTRACTOR shall be responsible for complying with state laws and federal regulations relating to trench safety.

The OWNER/DEVELOPER shall provide normal routine maintenance on all items including booster stations, flushing and fire hydrants prior to formal acceptance. Maintenance shall be documented and provided to MUPB prior to final acceptance of IMPROVEMENTS.

9.21. MATERIALS & WORKMANSHIP

The work shall be performed according to the best modern practice with materials and construction of the highest quality and suitable for the purpose. The Engineer and MUPB shall judge and determine the CONTRACTOR's compliance with these requirements. The CONTRACTOR shall promptly correct or replace all work rejected by the Engineer or MUPB as defective or as failing to conform to the construction documents. If a defective

material(s) or workmanship within one year of final acceptance by MUPB, as evidenced by the final Certificate of Acceptance or within such longer or shorter period as may be prescribed by law or by the terms of any other applicable special warranty on designed equipment or portions of work as required by the construction documents, the CONTRACTOR shall correct it promptly after receipt of a written notice from MUPB or the ENGINEER to do so. The MUPB shall give notice promptly after discovery of such condition. The CONTRACTOR shall remove from the site all portions of the work that are defective or nonconforming which have not been corrected unless removal is waived in writing by the MUPB.

9.22. SUBSTITUTIONS

Whenever materials or equipment are specified or described in this Manual by using the name of a proprietary item or the name of a particular supplier, the naming of the item is to be intended to establish the type, function and quality desired. Unless the name is followed by words “or Equal” indicating that a substitution is permitted, materials and equipment of other suppliers will not be accepted by the MUPB. Request for review of substitute items or material and equipment will not be accepted by the MUPB from anyone other than the ENGINEER. If the ENGINEER wishes to furnish or use a substitute item of material or equipment, the ENGINEER shall make written application to the MUPB General Manager and/or Designee for acceptance thereof, certifying that the proposed substitute will perform adequately the functions and achieve the results called for by the general design, be similar and of equal substance to that specified and be suited to the same use as that specified. MUPB will be the sole judge of acceptability, and no substitute will be ordered, installed, or used without MUPB’s prior written acceptance.

9.23. LIFT STATION STARTUP

9.23.1. Successful test shall include the confirmation of the following:

A. All major equipment operated, as specified.

B. The control systems worked, as specified.

C. The SCADA systems worked, as specified.

D. Adjustments of control settings within the normal operating parameters are allowed as long as the lift station remains operational and no unplanned alarm signals are generated.

9.23.2. Substantial Completion

A. All successful start-up tests shall be performed by the Contractor, certified by the Engineer, and accepted by the Owner prior to the Certificate of Substantial Completion.

B. MUPB shall be provided with sufficient spare parts for all major

equipment. See MUPB's Spare Parts Checklist, APPENDIX K. Special tools may also be required for a given station that uses special (non-standard) equipment, that has been preapproved by MUPB. Special tools shall be specified during the review of the lift station plans by MUPB.

C. Five copies of the approved Operations and Maintenance Manual and one digital copy on CD will be supplied to MUPB prior to completion of the station. The Operations and Maintenance Manual will contain a reduced set of the lift station plans, including as-built electrical and control schematics, equipment model and serial numbers, installation instructions, maintenance schedules, names, and telephone numbers for local representative for each item of equipment.

9.24. FINAL INSPECTION & ACCEPTANCE

The CONTRACTOR shall furnish MUPB with every reasonable facility for ascertaining whether or not the work performed was according to the requirements and intent of the construction documents. Any work done or materials used without suitable inspection by MUPB may be ordered removed and replaced at the CONTRACTOR's expense. The OWNER/CONTRACTOR and MUPB shall make final inspection of all work included in the construction documents, and provisions provided in the Division of Water approval letter when practicable after the work is completed and ready for acceptance. If the work is not acceptable to MUPB at the time of such inspection, MUPB shall inform the OWNER/DEVELOPER/CONTRACTOR as to the particular defects to be remedied before final acceptance shall be made.

When the project is completed, the ENGINEER shall submit a written certification to the Division of Water that the project has been constructed and tested according to the approved construction plans and specifications, and the provisions listed in the Division of Water approval letter. The certification must be sealed, signed, and dated by a Professional Engineer licensed in the Commonwealth of Kentucky. One (1) digital and Two (2) original copy of the certification shall be submitted to MUPB General Manager and/or Designee.

APPENDIX A

DEFINITIONS

APPENDIX A: DEFINITIONS

Abandoned – To remove from service for all functional use.

American Association of State Highway Transportation Officials (AASHTO) Standards – The latest edition of applicable standards as approved and published by AASHTO.

American Concrete Institute (ACI) Standards – The latest edition of applicable standards as approved and published by ACI.

American National Standards Institute (ANSI) Standards – The latest edition of applicable standards as approved and published by the American National Standards Institute, Inc.

American Society of Mechanical Engineers (ASME) Standards – The latest edition of applicable standards as approved and published by the American Society of Mechanical Engineers.

American Society for Testing and Materials (ASTM) Standards – The latest edition of applicable standards as approved and published by the American Society for Testing and Materials.

AMERICAN WATER WORKS ASSOCIATION (AWWA) - an organization which develops, adopts and publishes standards for the construction, operation and maintenance of improvements to water systems.

Apartment – A dwelling unit in an apartment building.

Apartment Building – A building or any portion thereof, which contains three or more dwelling units, located in the same building lot. An apartment building is a multi-family dwelling.

APPROVED - Material, equipment, workmanship, process, or method that has been accepted by MUPB as suitable for the proposed use.

AS-BUILT - A certification by the OWNER/DEVELOPER whose stamp appears on the plans that the measurements, depths, materials, and facilities that are shown on the plans are true and correct and are constructed in accordance with the DESIGN and CONSTRUCTION MANUAL for WATER, SANITARY SEWER & LIFT STATIONS of the MUPB.

Average Daily Demand (ADD) – The arithmetic average of all daily flow determinations taken within a period of 24 consecutive hours.

American Water Works Association (AWWA) Standards – The latest edition of applicable standards as approved and published by the American Water Works Association.

Barriers – Railroads, arterial and collector roadways, divided thoroughfares, highways, buildings, man-made or natural obstacles, etc. which restrict Fire Department operations.

Backfill – (a) The refilling of an excavation after a structure has been placed therein. (b) The material placed in an excavation in process of backfilling.

Bacteria – Single-celled microorganisms that lack chlorophyll. Some bacteria can cause human, animal, or plant diseases; others are essential in pollution control because they break down organic matter in the air and in the water.

Barrel, Manhole – The vertical portion of a manhole used to gain access to a sewer or sewer structure.

Base Manhole – The bottom or supporting structure on which the manhole barrel rests.

Bedding – The earth or other materials, on which a sewer of other structure is supported.

Bell – The recessed, over enlarged, female end of a pipe into which the male or spigot end fits.

Blow Off – A waste gate or device for discharging accumulated solids or for emptying a depressed sewer. A device for flushing a water main.

Blueline Stream – A natural surface drainage structure shown on USGS topographic maps as a solid blue line. Also, classified by Kentucky Division of Water as a natural drainage structure having continuous flow during normal weather conditions.

Booster Station – A station at which potable water is pumped via the water distribution: often to a storage tank or via constant pressure system.

Borings – Surface investigation performed to classify the types of soils.

Branch, Y (Wye) – A pipe joined to another pipe (usually at 60 degrees with alignment of the other) molded together and manufactured as a whole unit.

Capacity – The amount of flow in terms of cubic feet per second that a conduit can or will discharge. Capacity depends on factors such as velocity, coefficient of roughness, size, shape, and slope of the conduit.
Carrier Pipe – A pipe used to carry water or wastewater, as opposed to an exterior protective casing pipe.

Casing Pipe/Casing - Encasement pipe, usually steel, that is most commonly used in underground construction to protect utility lines of various types from getting damaged.

Castings – Metallic objects (normally cast iron) formed of molten in a mold. Examples are: manhole lids; manhole rims; valve and meter boxes; etc.

cfs – Cubic feet per second, a measure of the amount of flow in a pipe or in a stream.

Chamfer – A flat surface created by slicing off a square edge or corner.

Chlorination – The application of chlorine to drinking water or sewer for disinfection or the oxidation of undesirable compounds or microorganisms.

Chlorine – An element ordinarily existing as a greenish-yellow gas about 2.5 times as heavy as air. At atmospheric pressure and a temperature of -30.1 degrees Fahrenheit, the gas becomes an amber liquid about 1.5 times as heavy as water. The chemical symbol of chlorine is Cl. Its atomic weight is 35.457, and its molecular weight is 70.914.

Coefficient – A numerical quantity interposed in a formula which expresses the relationship between two or more variables, which may be derived by theoretical or experimental methods.

Coefficient, Roughness – A factor, “n”, in the Kutter, Manning, Hazen-Williams, and other formulae that represent the effect of roughness of the confining channel or conduit material upon the energy losses in the flowing water.

Collar – (a) A cylindrical ring of either brick or precast concrete, secured upon the cone or barrel of a manhole upon which the frame will rest.
(b) A cylindrical monolithic concrete encasement for securing a joint and preventing shear by movement.

Collector – A pipe that is generally between 8 inches and less than 15 inches that collects sewage from neighborhoods and groups of businesses and delivers sewage to a single, larger interceptor pipe.

Collector System – A network of lateral and branch sewers in a defined area, which collects and transports sewerage to a larger sewer.

Combined Sewer – A sewer intended to receive both wastewater and storm water.

Conduit – A continuous piping or passage system for transporting water or sewerage underground. Also, used for containing wires and cables of other utilities.

Connection, House – See Property Service Connection.

Construction Documents – The Standards Manual, Construction Plans, and Special Provisions, with all amendments, modifications and supplements.

Construction Plans – The approved plans, profiles, typical cross sections, working drawings and supplemental drawings, or exact reproductions thereof, which show the location, character, dimensions, and details of the work to be done.

Contamination – The presence of any foreign substance (organic, inorganic, radiological, or biological) in water which tends to degrade its quality so as to constitute a health hazard or impair the usefulness of the water.

Contractor – The individual, firm, corporation or any acceptable combination thereof, or joint venture, contracting with a Developer or MUPB for performance of prescribed work.

Cradle – Type of bedding, usually of gravel or concrete, being laid upwards from the trench bottom to the spring line of the pipe.

Crown – The highest inside part of a conduit; the inner top of a conduit.

Cul-de-sac – An alley or street having no outlet at one end, usually having an area at its dead end for turning around.

Culvert – A closed conduit, typically of pre-cast or monolithic structure of sufficient length for the passage of water.

Dechlorination – Removal of residual chlorine in water by a chemical or physical process.

Dimension Ratio (DR) [Pressure Flow] – The outside pipe diameter divided by the pipe wall minimum thickness. The DR provides a method of specifying product dimensions to maintain mechanical properties regardless of size. For a given dimension ratio the pipe stiffness remains constant for all pipe sizes.

Discharge – (a) As applied to a sewer or stream, the rate of flow, or volume of water flowing therein at a given place and within a given time. (b) The act, in water or other liquid, of passing through an opening or along a conduit or channel. (c) The water or other liquid that emerges from an opening or passes along a conduit or channel.

Disinfectant – Any oxidant, including but not limited to chlorine, chlorine dioxide, chloramines, and ozone that may be added to the water in any part of the treatment or distribution process that is intended to kill or inactivate pathogenic microorganisms.

Disinfection – A process which inactivates pathogenic organism in the water by chemical oxidants or equivalent agents. The term includes lift stations, ground and elevated storage tanks, potable water mains, potable water service lines, and all associated valves, fittings, and meters, but excludes potable water customer service lines.

Division of Water (DOW) – See Kentucky Division of Water.

Drainage Area – A tributary area that is generally limited by a topographic area, but may be also limited by political boundary or economic factors.

Duplex – Two single family dwelling units per lot.

Dwelling – A building or portion thereof designed and used exclusively for residential occupancy, including one- and two-family dwellings but not including hotels, motels, or lodging houses.

Dwelling Unit – A single unit providing complete independent living facilities for one of more persons including permanent provisions for living, sleeping, eating, cooking, and sanitation.

Dynamic Head – In pumping water, a head usually expressed in pounds per square inch (p.s.i.) representing both the pressure due to the elevation to which the water is pumped and that due to friction of the water in the pipe; the head against which a pump works.

Effluent – The water or wastewater that flows from a basin, treatment process or treatment plant.

Encasement – Usually monolithic concrete used to enclose the periphery of a conduit.

Encasement Pipe – A smooth protective steel pipe which encases a carrier pipe for various types of crossings including roadways, creeks, and railroads.

Engineer of Record – professional engineer, licensed in the State of Texas responsible for the sealing of construction plans, studies, calculations, and/or any other engineering documents.

ENGINEER – A Licensed Professional Engineer, registered in the Commonwealth of Kentucky as set out in KRS Chapter 322.

Equivalent Residential Unit (ERU) – being equal in measurement to a single-family residential unit. Used to create a hypothetical number to represent flow to residential units.

FINAL INSPECTION – Final Inspection shall mean the final review of the construction activities in the field prior to MUPB's acceptance of operation.

Firm pumping capacity – The pumping capacity of the station handling the expected peak flow or the maximum hourly demand with the largest pump out of service.

Flap Gate – A gate that opens and closes by rotation around a hinge or hinges at the top of the gate permitting the fluid to pass only in one direction.

Flood Level – The stage of a stream at the time of a flood.

Flood Plain – The land contained within the perimeter of the probable limiting flood.

Flood Frequency – The frequency with which the maximum flood may be expected to occur at a site an any average interval of years. Frequency analysis defines the "N-year flood" as the flood that will, over a long period of time, be equaled or exceeded once every N years.

Flow, Dry-Weather (Sanitary) – The flow of wastewater in a sewer during dry weather. Such flow consists mainly of sewerage and wastes with no stormwater or groundwater included.

Flow, Wet Weather (Sanitary) – The flow of wastewater in a sewer during wet weather. Such flow consists of sewerage, stormwater and/or groundwater.

Flushing Duration – The minimum amount of time required to provide a complete changeover of water volume within the dead-end section of pipeline.

fps – Velocity expressed in Feet per Second

Force Main (FM) – A pipe under internal pressure created by beingon the discharge side of a lift station.

FULL-TIME RESIDENT INSPECTOR - The OWNER/DEVELOPER, or his representative, who is required to be on the job site during any construction of facilities that are to become part of the MUPB to ensure that the proposed improvements are constructed in accordance with approved plans and the Design & Construction Manual for Water, Sanitary Sewer & Lift Stations.. **OWNER/DEVELOPER shall submit to MUPB for approval prior to construction a resume of inspector prior to construction commencing. Inspector shall have water and sewer experience and be familiar with MUPB WATER, SANITARY SEWER AND LIFT STATION MANUAL.**

Gas – Gas shall refer to the Natural Gas Distribution where natural gas is consumed by any one customer and is measured by on-site meters, which essentially keep track of the volume of natural gas consumed at that location.

General Manager – the person employed by MUPB board to oversee all of the operations of MUPB.

gpad – Gallons per acre per day.

gpd – Gallons per day.

gpcd – Gallons per capita per day.

gpm – Gallons per minute.

Grade – (a) The inclination or slope of a stream channel, conduit or natural ground surface, usually expressed as the ratio or percentage of vertical rise or fall per 100 feet of

horizontal distance. See Slope. (b) The elevation of the invert of the bottom of a pipe line, culvert, sewer, etc.

Grade, Hydraulic – In a closed conduit under pressure, a line joining the elevation to which water would rise in pipes freely vented and under atmospheric pressure. See Gradient, Hydraulic; also, Line, Hydraulic Grade.

Gradient – The rate of change of any characteristic per unit of length or slope. The term is usually applied to such things as elevations, velocity, pressure, etc. See Slope.

Gradient, Hydraulic – The slope of the hydraulic grade line, the rate of change of pressure head, the ratio of the loss in the sum of the pressure head, and positive head of the flow distance.

Groundwater – Subsurface water occupying the zone of saturation. In a strict sense, the term applies only to water below the water table.

Head – The height of the free surface above any point in a hydraulic system; a measure of the pressure or force exerted by the fluid.

Head, Friction – The head lost by water flowing in a conduit as the result of intermolecular friction or disturbances setup by the contact between the moving water and its containing conduit.

Head, Loss of – The vertical distance or height through which a body must fall freely under the force of gravity to acquire the velocity that it possesses. It si equal to the square of the velocity divided by twice the acceleration of gravity.

Hydraulic Grade Line – A hydraulic profile of the piezometric level of water at all points along the line. The term is usually applied to water moving in a conduit, open channel, stream, etc. In an open channel it is the free water surface.

IMPROVEMENTS – Construction work, including materials and workmanship, to the water and/or sewer utility systems which are part of, will become part of, or be connected to the MUPB system. Water improvements include, but are not limited to, water mains, valves, fire hydrants, service lines, pumps, etc. Sewer improvements include, but are not limited to, sewer mains, manholes, lift stations, service laterals, etc.

Inflow and Infiltration (I&I) - Inflow and infiltration are terms used to describe the ways that stormwater and groundwater enter into dedicated wastewater systems.

Infiltration – Refers to groundwater that enters a sewer system through such sources as defective pipes, pipe joints, connections, or manholes.

Inflow – Refers to water other than wastewater that enters a sewer system from means such as roof gutters, yard drains, area drains, springs, openings in manhole covers, cross

connections runoff and/or any other source that directs rainwater directly into the sewer system.

Interceptor – A pipe that gathers wastewater flow from several smaller collector pipes.

International Fire Code (IFC) – The latest edition adopted by the City Council of the City of Morehead, Kentucky for the purpose of prescribing regulations governing conditions hazardous to life and property.

Intruder-Resistant Fence – A fence at least 6 feet high, constructed of wood, concrete, masonry, or metal with 3 strands of barbed wire extending outward from the top of the fence at a 45° angle with the smooth side of the fence on the outside wall. In lieu of barbed wire, the fence must be at least 8 feet high. These fences must be in good working order and close enough to the ground to prevent intruder passage beneath the fence.

Invert – The floor, bottom or lowest point of the internal cross-section of a sewer or other conduit.

KAR – Kentucky Administrative Regulations

Kentucky Energy and Environment Cabinet (KEEC) – The environmental agency for the Commonwealth of Kentucky which serves the public by enforcing laws relating to natural resources and the environment. It keeps citizens safe and healthy, while supporting a positive business climate.

Kentucky Division of Water (KDOW) – The Division of Water manages, protects, and enhances the quality and quantity of the Commonwealth's water resources for present and future generations through voluntary, regulatory, and educational programs.

Kentucky Transportation Cabinet (KTC) – The state's transportation department that is responsible for planning, designing, building, operating, and maintaining the state's transportation system.

Lamp Hole – 8" diameter clean out on the end of a long 8" sanitary stub.

Lathes – Wooden 1" x 2" survey stakes.

Life Cycle Costs – estimating the entire costs associated with the assest from initial capital costs to the end of its useful life.

Lift Station – a station at which wastewater is pumped via a force main.

Manhole – An opening by which a man may enter or leave a sewer, conduit, or other closed structure for inspection, cleaning, and other maintenance operations, closed by a removable cover.

Manual on Uniform Traffic Control Devices (MUTCD) – The manual defines the standards used by road managers nationwide to install and maintain traffic control devices on all public streets, highways, bikeways, and private roads open to public travel. The MUTCD is published by the Federal Highway Administration (FHWA) under 23 Code of Federal Regulations (CFR), Part 655, Subpart F.

MGD – Million gallons per day.

Maximum Daily Demand (MDD) – The total amount of water used during the day of heaviest consumption in any given year and the minimum rate, which the high service pumps must be capable of pumping. Water must be supplied to the pumps at this rate.

Maximum/Peak Hourly Demand (PHD) – The rate at which water is drawn from the entire system during the hour of maximum consumption on the day of maximum demand. This rate is generally of a short duration and is most economically provided for by the use of elevated storage in addition to water supplied to the system by pumps. The distribution system, including storage and pumping capacity, must be able to satisfy this demand.

Milligrams per liter (mg/L) – A measure of the concentration by weight of a substance per unit volume. One mg/L is equivalent to one part per million (ppm).

Mils – A unit of length equal to one thousandth of an inch.

Minimum Hourly Demand – This is the rate at which water is drawn from the distribution system during the hour of minimum demand on the day of maximum demand. This demand rate is used in the water distribution analysis to determine the adequacies of the system to replenish elevated storage.

Monolithic – Cast-in-place, rather than precast.

Multi-family – Three or more dwelling units per lot.

National Fire Protection Association (NFPA) Standards – The latest edition of applicable standards as approved and published by the National Fire Protection Association.

NEMA – An abbreviation for National Electrical Manufacturers Association.

NREPC – The Commonwealth of Kentucky's Natural Resource and Environmental Protection Cabinet.

Outfall – The conduit leading to the discharge stream, through which, the effluent flows.

OWNER / DEVELOPER - An individual, group of individuals, partnership, firm, association, or corporation that is constructing, or is having constructed, water and/or sewer improvements that are to become a part of, or be connected to, the Morehead Utility Plant Board.

Peak – A maximum quantity that occurs over a relatively short period of time, such as an hour or day.

Peak Demand – The maximum load placed on a water plant or booster station.

Peak Flow – The maximum load placed on a wastewater plant or lift station.

Peak, Instantaneous – The maximum rate that ever occurs, possibly for only a moment.

Peaking Factor – The maximum flow to average flow ratio used in water/wastewater flow calculations.

Peak Flow – The highest 2-hour wet weather wastewater flow expected under any operational condition.

Potable Water – Water suitable for dirnking or cooking purposes from health and aesthetic considerations.

Precast – That which is formed in a mold or form and distributed by the manufacturer as a complete unit.

Property Service Connection – That portion of a sewer system located within an easement or right-of-way which transports sewerage from private property to the main line.

Proposed – That which is to have immediate consideration for construction.

psi – Pounds per square inch.

ppm – measurement of the concentration by weight of a substance per unit volume.

Sanitary Sewers – Sewers intended to carry wastewater from houses, business, industries, commercial and institutional customers to the WWTP.

Service Area – A defined geographic area in which MUPB provides water, sanitary, storm and/or gas service.

Sewer Lateral – A sewerthat receives wastewater from a single connection (house, business, etc.)

Sewer Line – A pipe utilized to collect and transport wastewater to a downstream lift station or the WWTP. Sewer line can mean force main or gravity line.

Sewer Line Extension (SLE) – A proposed construction project which extends a sewer system: it may include gravity sewer lines, manholes, force main(s), lift station and/or grinders.

Sewer Outfall – A sewer that receives wastewater and/or stormwater and carries it to a point of final discharge.

Sewer System – A network of sewer lines and lift stations that collect wastewater that discharge at a common WWTP.

SHALL – means a mandatory requirement.

Single family dwelling [attached] – A dwelling unit that is joined to another dwelling at one or more sides by a party wall or abutting separate wall, which is designed for occupancy by one family and is located on a separately platted lot, delineated by front, side and rear lot lines and is served by separate utility connections and meters as a single family dwelling (e.g. town homes, condos, etc.).

Single family dwelling [detached] – A dwelling unit designed and constructed for occupancy by not more than one family, located on a lot or separate building tract and having no physical connection to a building located on any other lot or tract, and occupied by only one family.

Slope – The incline of the invert of a pipe expressed as a decimal or as feet per stated length measured horizontally in feet.

Special Provisions – Additions and revisions to the Standards Manual covering conditions peculiar to an individual project.

Specifications – A general term applied to all directions, provisions, and requirements pertaining to the performance of the work.

Standard Dimension Ratio (SDR) [Gravity Flow] – The pipe diameter divided by the pipe wall thickness and provides a method of specifying product dimensions to maintain mechanical properties regardless of size. For a given dimension ratio the pipe stiffness remains constant for all pipe sizes.

Standard Drawings – Drawings approved for repetitive use, showing details to be used where appropriate. Individual standard drawings attached to, or cited in, the plans become a part of the Construction Documents.

Storm Sewer – A separate sewer that carries runoff from storms, surface drainage and street, and does not include domestic or industrial wastes.

Subgrade – The bottom of a trench or other excavation that is somehow below the predetermined elevation of the bottom of the final excavation or structure, the intervening space being backfilled with some special material such as gravel, broken stone, or tamped earth, or impervious lining. The term is also applied to the elevation of such bottom.

Sump – A depression that serves as a receptacle for liquids to be pumped.

Surface Water – Water on the earth's surface open to the atmosphere, such as rivers, streams, and oceans.

TCP – Traffic control plan.

TEN STATES STANDARDS – As applicable for either water supply or sanitary sewer, reference shall refer to the Recommended Standards for Water Works (Latest Edition, Policies for the Review and Approval of Plans and Specifications for Public Water Supplies or the Recommended Standards for Wastewater Facilities (Latest Edition), Policies for the Design, Review, and Approval of Plans and Specifications for Wastewater Collection and Treatment Facilities.

Topography – The configuration of a surface area including its relief, or relative elevations, and the location of its natural and constructed features.

Transition – A short section of a conduit used as a conversion section to unite two conduits having different hydraulic elements.

Tributary – Flowing into another; A river or stream flowing into a larger river or stream.

Trunk Sewer – A sewer that receives many tributary branches which serves a large area.

UL – An abbreviation for Underwriter's Laboratory

USGS – Abbreviation for United States Geological Survey.

Velocity, Self-Cleaning - The minimum velocity in sewers necessary to keep solids in suspension and prevent their deposition and the subsequent nuisances from stoppages and odors on decomposition.

VFD – A variable frequency drive (VFD) is a type of adjustable-speed drive used in electro-mechanical drive systems to control AC motor speed and torque by varying motor input frequency and voltage.

UTILITY – The Morehead Utility Plant Board (MUPB) or authorized representative thereof.

Water Age – Water age or residence time is the amount of time water spends in the distribution system between the treatment plant and the consumer and is a function of flow rate, distance from the treatment plant, storage, system demand and distribution system network, and other factors.

Watershed – The area drained by a given stream or segment of a stream.

WTP – Water Treatment Plant.

WWTP – Wastewater Treatment Plant.

APPENDIX B

UTILITY AVAILABILITY APPLICATION

MOREHEAD UTILITY PLANT BOARD

UTILITY AVAILABILITY APPLICATION

Check applicatble:

___ First Submission
___ Re-Submission
___ Revision to Approved Plan

Water _____
Sewer _____
Natural Gas _____
Stormwater _____

Date:
Project Id #

Project Name: _____

Description of Proposed Work: _____

Project Location: _____

Parcel Identification: _____

Owner/Developer

Company: _____

Contact Person: _____

Telephone: _____ Fax: _____ Email: _____

City, State, Zip Code: _____

Engineer

Company: _____

Contact Person: _____

Telephone: _____ Fax: _____ Email: _____

City, State, Zip Code: _____

Development

Type of Devlopment (Circle) Residential Commercial Institutional

Utility Service

Water _____ Natural Gas _____

Sewer _____ Storm Water _____

Residential

Type of Residential Development

Apartment - 1 BR	_____	x	250	= _____
Apartment - 2 BR	_____	x	300	= _____
Apartment - 3 BR	_____	x	350	= _____
Single Family	_____	x	400	= _____
Duplex	_____	x	800	= _____
Condo	_____	x	350	= _____
Mobile Homes	_____	x	300	= _____
Total Demand - Residential				_____

Commercial

Description							
Bars (w. Food Service)	_____	seats	x	20	=	_____	per 8 hours
Bars (wo Food Service)	_____	seats	x	2	=	_____	per 8 hours
Bowling Alleys (Food)	_____	lanes	x	75	=	_____	per 8 hours
Bowling Alleys (wo Food)	_____	lanes	x	25	=	_____	per 8 hours
Motels	_____	rooms	x	100	=	_____	per day
Factory (w Showers)	_____	person	x	35	=	_____	per 8 hours
Factory (Showers)	_____	person	x	25	=	_____	per 8 hours
Industrial	_____	acres	x	2000	=	_____	per 8 hours
Industrial - Light	_____	acres	x	1000	=	_____	per 8 hours
Shopping Center	_____	SF	x	0.1	=	_____	per 8 hours
Shopping Center (Grocery)	_____	SF	x	0.2	=	_____	per 8 hours
General Commercial	_____	acres	x	5000	=	_____	per 8 hours
Coin Laundries	_____	machines	x	400	=	_____	per 8 hours
Service Station	_____	bays	x	500	=	_____	per 8 hours
Total Demand - Commercial						_____	
Equilivant Residential Units - Commercial						_____	

Institutional

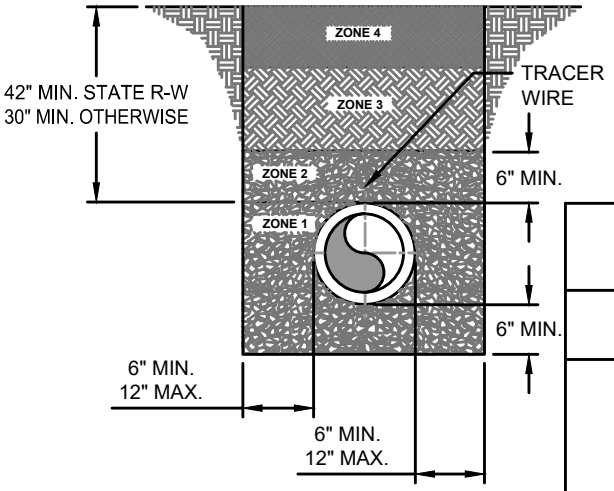
Hospital	_____	beds	x	200	=	_____	
Institutions	_____	person	x	100	=	_____	
Nursing Homes	_____	person	x	100	=	_____	
Youth Camps	_____	camper	x	50	=	_____	
RV Camps	_____	site	x	100	=	_____	
Schools (Elem. & Middle)	_____	person	x	15	=	_____	
Schools (High)	_____	person	x	20	=	_____	
Church	_____	seat	x	7	=	_____	per 2 hours
Total Demand - Institutional						_____	
Equilivant Residential Units - Institutional						_____	

Development Total Demand

Total Demand - Residential	_____	Equivalent Residential Units - Residential	_____
Total Demand - Commercial	_____	Equilivant Residential Units - Commercial	_____
Total Demand - Institutional	_____	Equivilant Residential Units - Institutional	_____
Total Demand	_____	**Total ERUs**	_____

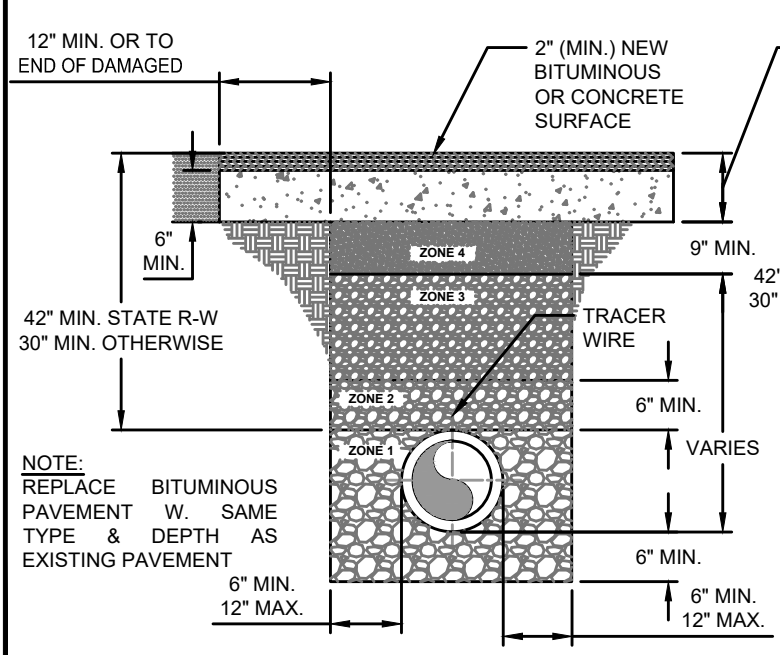
APPENDIX C

STANDARD DETAILS

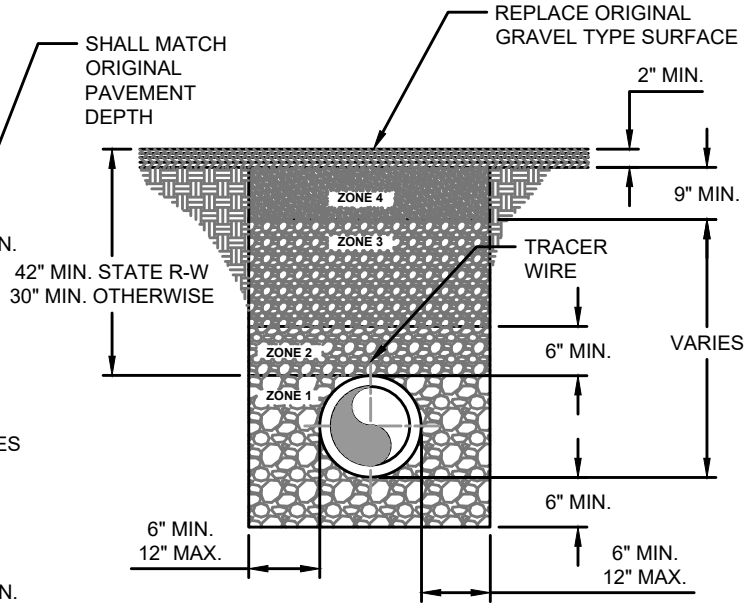


PIPE LAID IN ROCK OR EARTH TRENCH

BACKFILL NOTES				
SURFACE TYPE	ZONE 1	ZONE 2	ZONE 3	ZONE 4
EARTH TRENCH	CLEAN EARTH OR No. 9 OR 68 CRUSHED STONE	CLEAN EARTH OR NO. 9 OR 68 CRUSHED STONE	COMPACTED SOIL FREE OF ROCK	TOP SOIL
BITUMNOUS SERFACE > 2" THICK	NO. 9 OR 68 CRUSHED STONE	NO. 9 OR 68 CRUSHED STONE	NO. 9 OR 68 CRUSHED STONE	COMPACTED DGA
BITUMNOUS SURFACE < 2" THICK	NO. 9 OR 68 CRUSHED STONE	NO. 9 OR 68 CRUSHED STONE	NO. 9 OR 68 CRUSHED STONE	COMPACTED DGA



ORIGINAL BITUMINOUS OR CONCRETE SURFACE



ORIGINAL GRAVEL SURFACE

TRENCH BACKFILL - DETAIL

NOT TO SCALE

MOREHEAD UTILITY PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

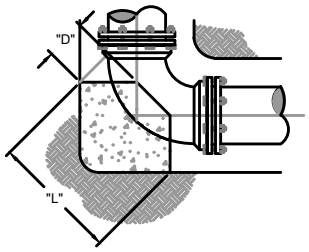
GENERAL PIPE STANDARD DETAIL
TRENCH BACKFILL

Date	07/06/2021
Revision Date	01/14/2022
Dwg. No.	GP-001

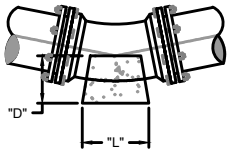
THRUST BLOCK SCHEDULE

SOIL TYPE - SAND & GRAVEL
BEARING STRENGTH = 3000 PSF

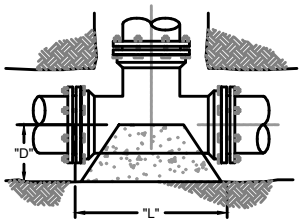
PIPE SIZE	90° BEND					45° BEND					22 ½° BEND					11 ¼° BEND					TEE & DEAD ENDS				
	BEARING AREA	YDS OF CONCRETE	D	W	L	BEARING AREA	YDS OF CONCRETE	D	W	L	BEARING AREA	YDS OF CONCRETE	D	W	L	BEARING AREA	YDS OF CONCRETE	D	W	L	BEARING AREA	YDS OF CONCRETE	D	W	L
4"	3.750	.21	18	30	18	1.750	.10	18	18	14	1.000	.06	18	12	12	.500	.02	12	12	6	2.250	.13	18	18	18
6"	7.000	.39	18	42	24	3.750	.21	18	30	18	2.000	.11	18	24	12	1.000	.04	12	12	12	5.000	.28	18	30	24
8"	12.250	.91	24	42	42	7.500	.56	24	36	30	4.000	.30	24	24	24	2.000	.11	18	24	12	9.000	.67	24	36	36
10"	20.000	1.48	24	60	48	10.500	.78	24	42	36	6.000	.44	24	36	24	3.000	.17	18	24	18	14.000	1.04	24	48	42
12"	30.000	2.78	30	72	60	15.750	1.46	30	54	42	7.500	.69	30	36	30	4.000	.30	24	24	24	20.000	1.85	30	60	48
14"	39.000	4.33	36	78	72	20.000	2.22	36	60	48	10.500	1.17	36	42	36	6.000	.56	30	36	24	27.500	3.06	36	66	60
16"	49.000	6.35	42	84	84	27.500	3.56	42	66	60	14.000	1.81	42	48	42	7.500	.83	36	36	30	37.750	4.63	42	78	66

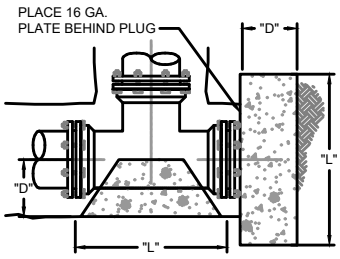


90° & 45° BENDS

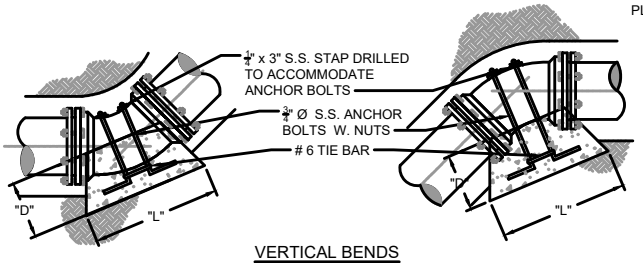


22.5° & 11.25° BENDS

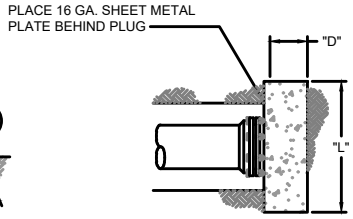




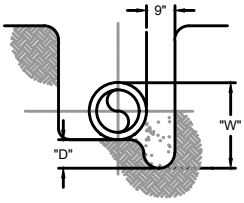
TEES



VERTICAL BENDS



END OF MAIN



TYP. SECTION

NOTE:

- ALL CONCRETE SHALL BE A MIN. OF 3,000 PSI
- SEE PLAN SHEETS FOR SIZE, MATERIAL & LOCATION OF PIPE.
- SIDES OF ALL TRENCHES TO BE UNDISTURBED SOIL.
- SEE DWG # GP-001 FOR TRENCH BACKFILL DETAIL.
- DEPTH "D: MAY NOT BE SMALLER THAN SPECIFIED.
- PIERS SHALL BE PLACED AGAINST UNDISTURBED SOIL.
- PLACE CONCRETE ANCHORS 25' C/C.
- M.J. FITTING(S) SHALL BE WRAPPED IN PLASTIC WRAP
- GRIP RINGS SHALL BE USED ON ALL FITTINGS

CONCRETE THRUST BLOCK - DETAIL

NOT TO SCALE

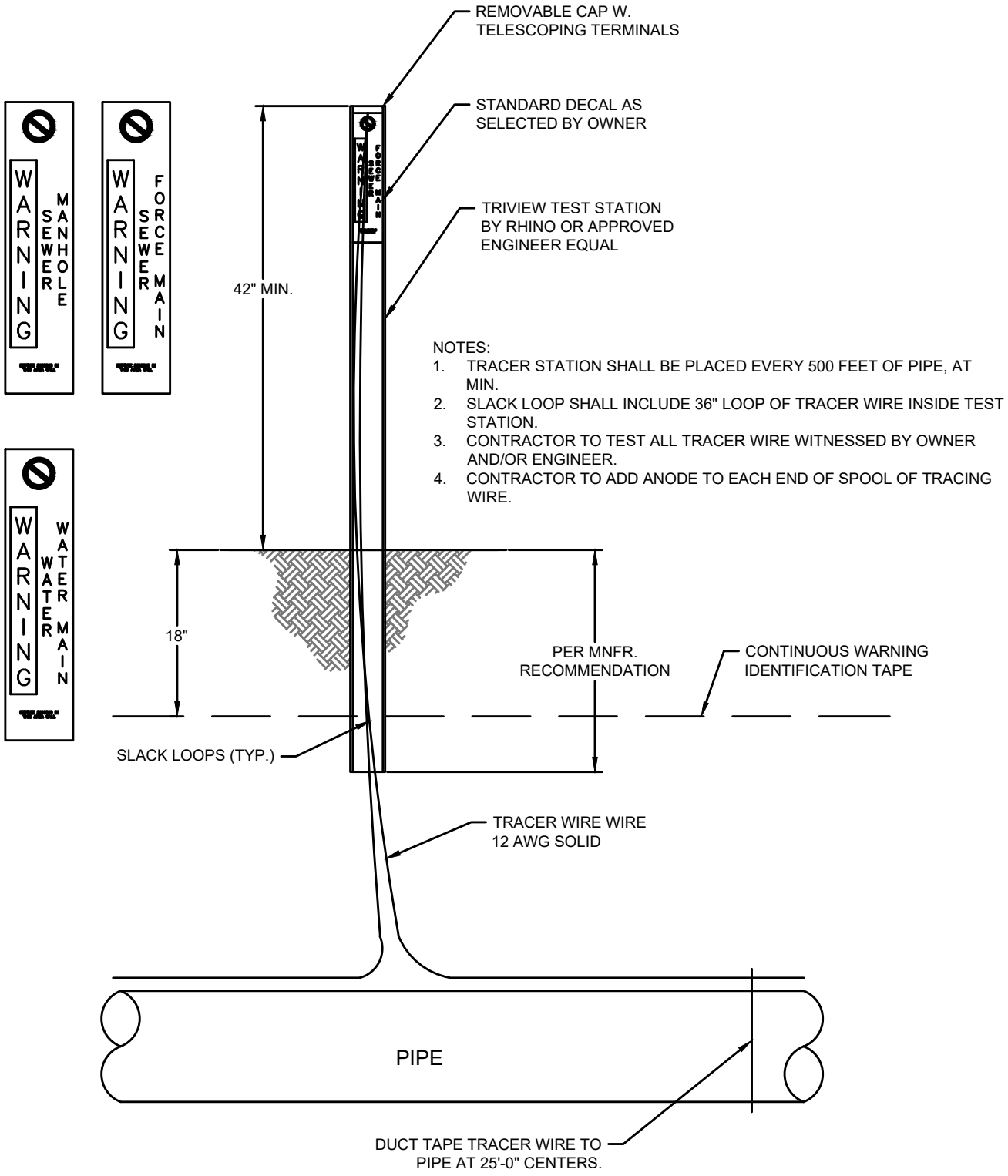
MOREHEAD UTILITY PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

GENERAL PIPE STANDARD DETAIL
CONCRETE THRUST BLOCK

Date
02/03/2021

Revision Date
01/14/2022

Dwg. No.
GP-002



ABOVE GRADE TRACER STATION

NOT TO SCALE

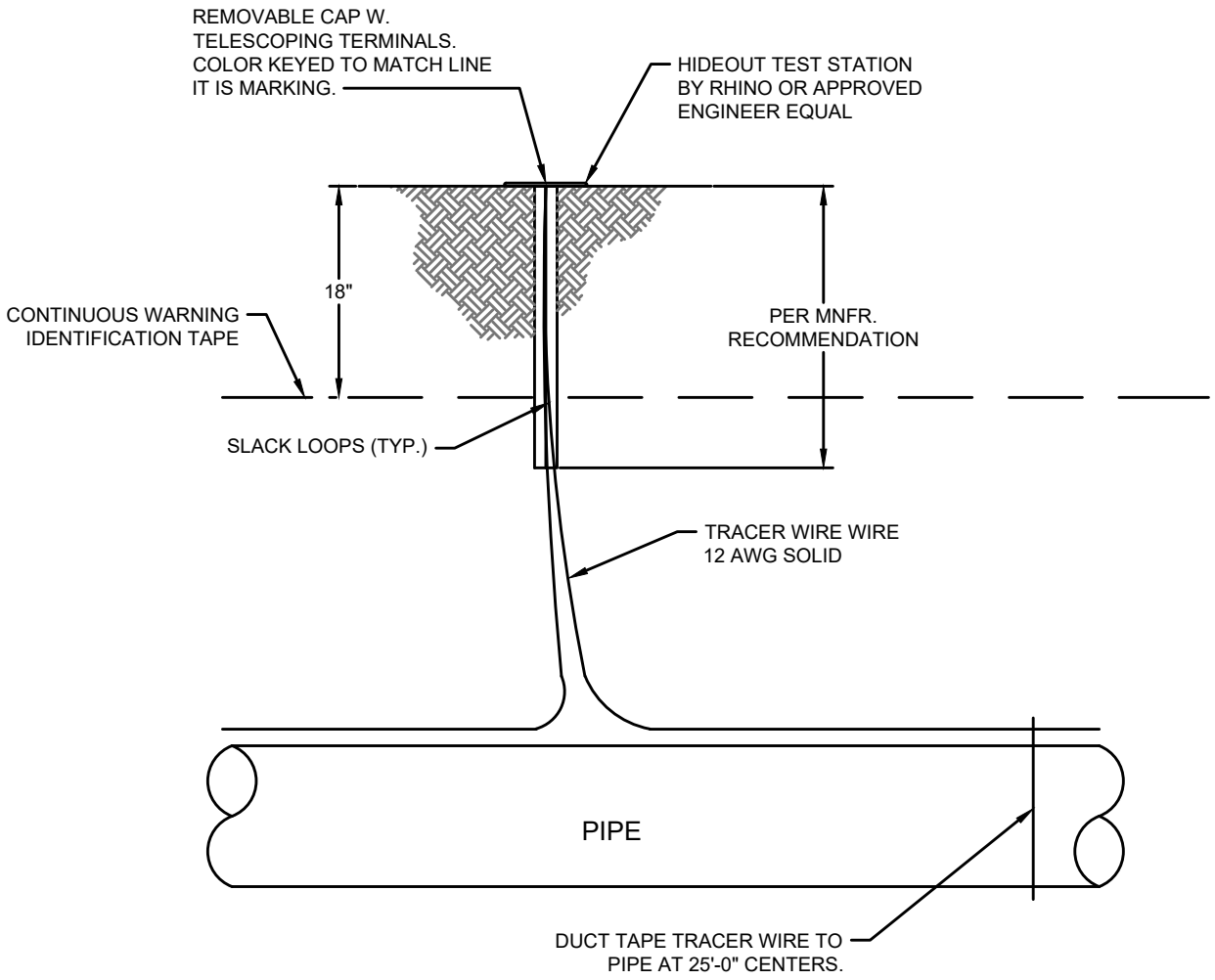
MOREHEAD UTILITY PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

SANITARY SEWER STANDARD DETAIL
ABOVE GRADE TRACER STATION

Date	02/03/2021
Revision Date	01/14/2022
Dwg. No.	GP-003

NOTES:

1. TRACER STATION SHALL BE PLACED EVERY 500 FEET OF PIPE, LOCATED AT ALL ROAD OR CREEK CROSSINGS. BELOW GROUND MARKERS SHALL NOT BE PLACED IN TRAFFIC OR PARKING LANES WITHOUT OWNER APPROVAL.
2. SLACK LOOP SHALL INCLUDE 36" LOOP OF TRACER WIRE INSIDE TEST STATION.
3. CONTRACTOR TO TEST ALL TRACER WIRE WITNESSED BY OWNER AND/OR ENGINEER.
4. CONTRACTOR TO ADD ANODE TO EACH END OF SPOOL OF TRACING WIRE.



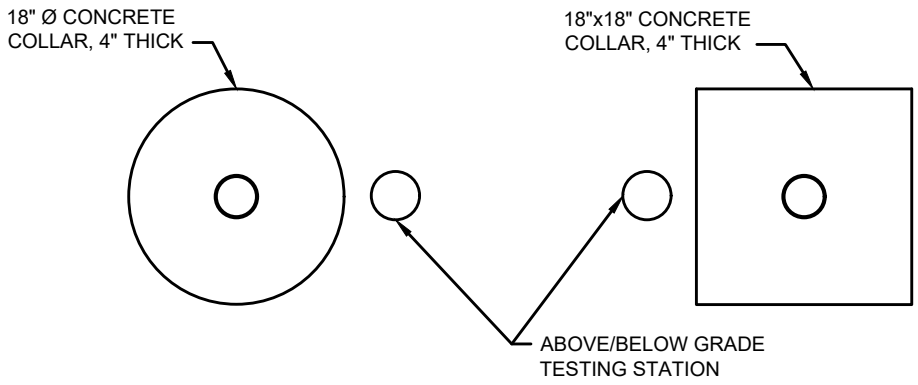
BELOW GRADE TRACER STATION

NOT TO SCALE

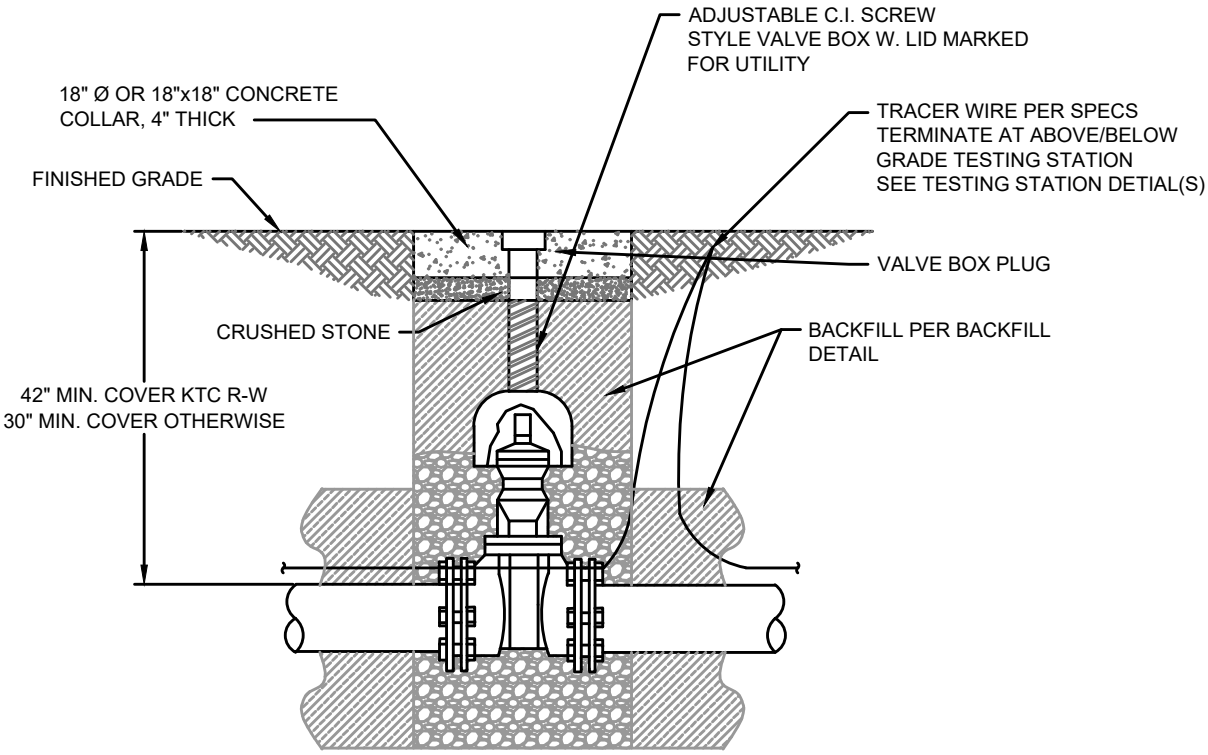
MOREHEAD UTILITY PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

SANITARY SEWER STANDARD DETAIL
BELOW GRADE TRACER STATION

Date	02/03/2021
Revision Date	01/14/2022
Dwg. No.	GP-004



PLAN - CIRCULAR **PLAN - SQUARE**



GATE VALVE BOX ASSEMBLY

NOT TO SCALE

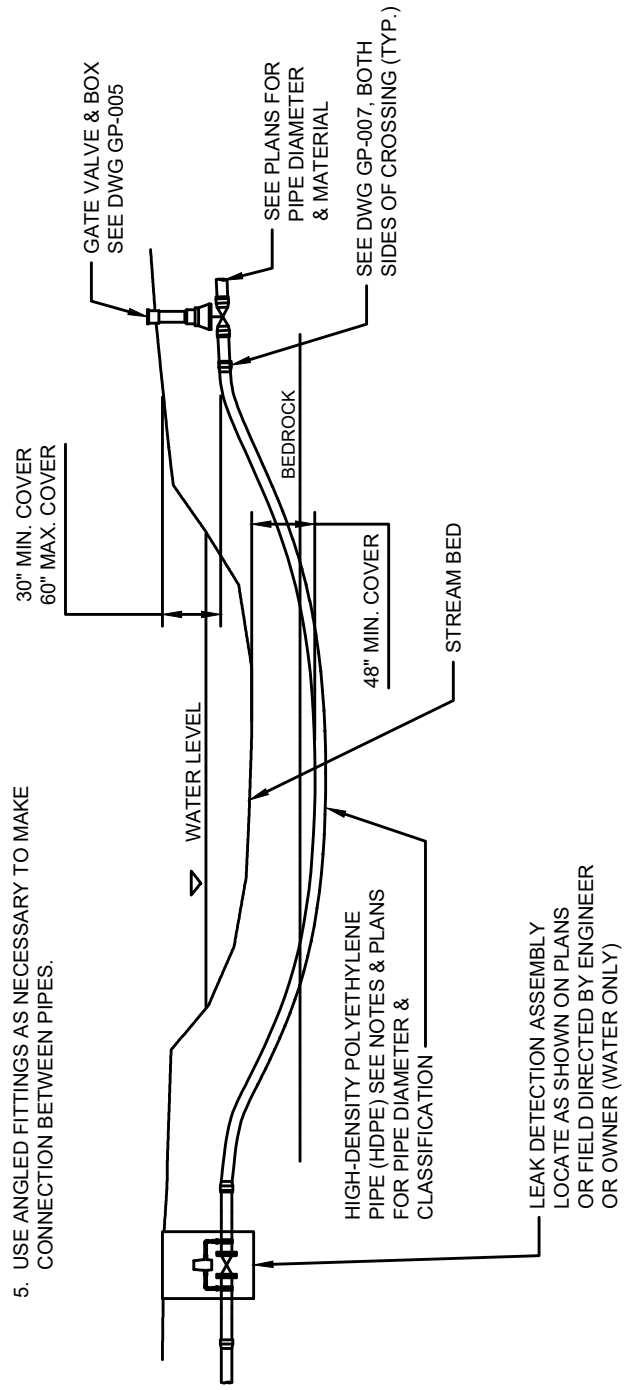
MOREHEAD UTILITY
PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

GENERAL PIPE STANDARD DETAIL
GATE VALVE & BOX ASSEMBLY

Date	02/03/2021
Revision Date	01/14/2022
Dwg. No.	GP-005

NOTES:

1. CONNECTION OF THE HDPE TO THE PVC OR DUCTILE IRON PIPE SHALL BE NO DEEPER THAN 5 FEET FROM THE GROUND ELEVATION.
2. DIRECTIONAL BORE SHALL BE MADE IN BED ROCK WITH A MIN DEPTH OF 36".
3. WHEN USING HDPE THE PIPE SHALL BE SIZED UP ONE PIPE SIZE TO ALLOW THE I.D. OF THE HDPE TO EQUAL THE I.D. OF THE CONNECTING PIPE.
4. SEE PLANS FOR PIPE LOCATION, MATERIAL & SIZE.
5. USE ANGLED FITTINGS AS NECESSARY TO MAKE CONNECTION BETWEEN PIPES.



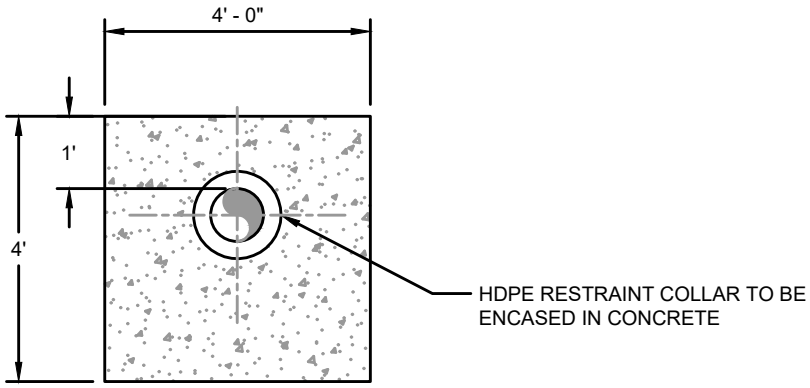
DIRECTIONAL DRILLED CREEK CROSSING - DETAIL

NOT TO SCALE

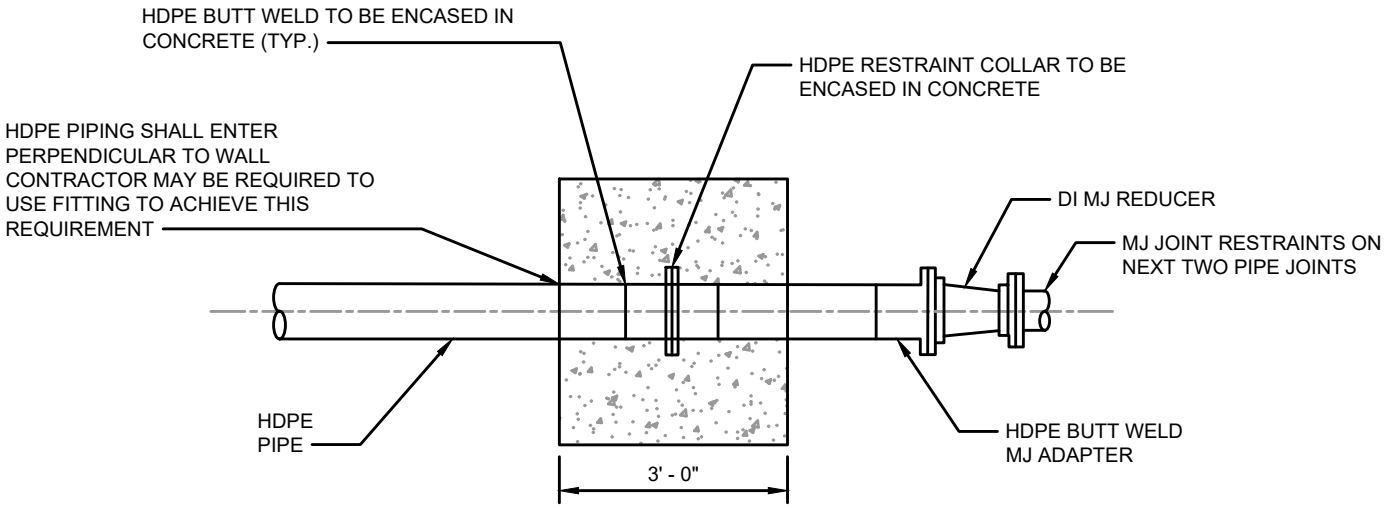
MOREHEAD UTILITY PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

GENERAL PIPE STANDARD DETAIL
DIRECTION DRILL CREEK CROSSING

Date	02/03/2021
Revision Date	01/14/2022
Dwg. No.	GP-006



SECTION



ELEVATION

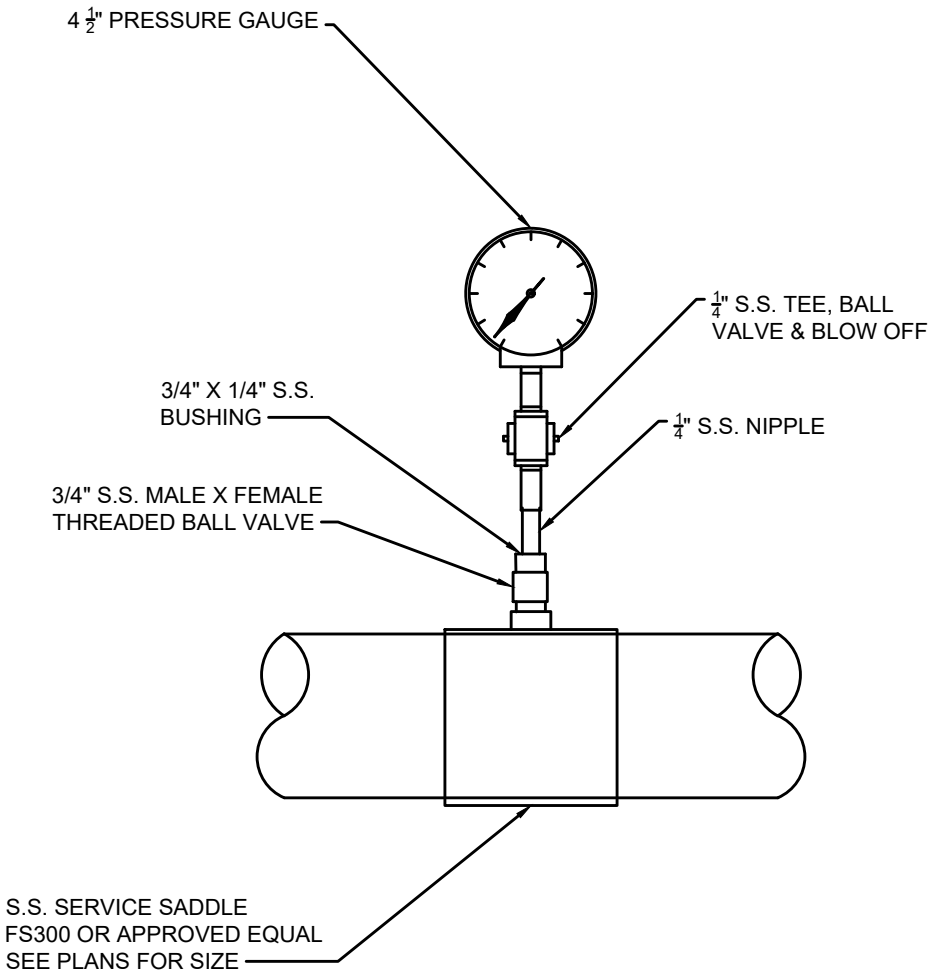
DIRECTIONAL DRILLED CREEK CROSSING CONNECTION - DETAIL

NOT TO SCALE

MOREHEAD UTILITY PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

GENERAL PRESSURE PIPE STANDARD DETAIL
DIRECTION DRILL CREEK CROSSING
CONNECTION DETAIL

Date	02/03/2021
Revision Date	01/14/2022
Dwg. No.	GP-007



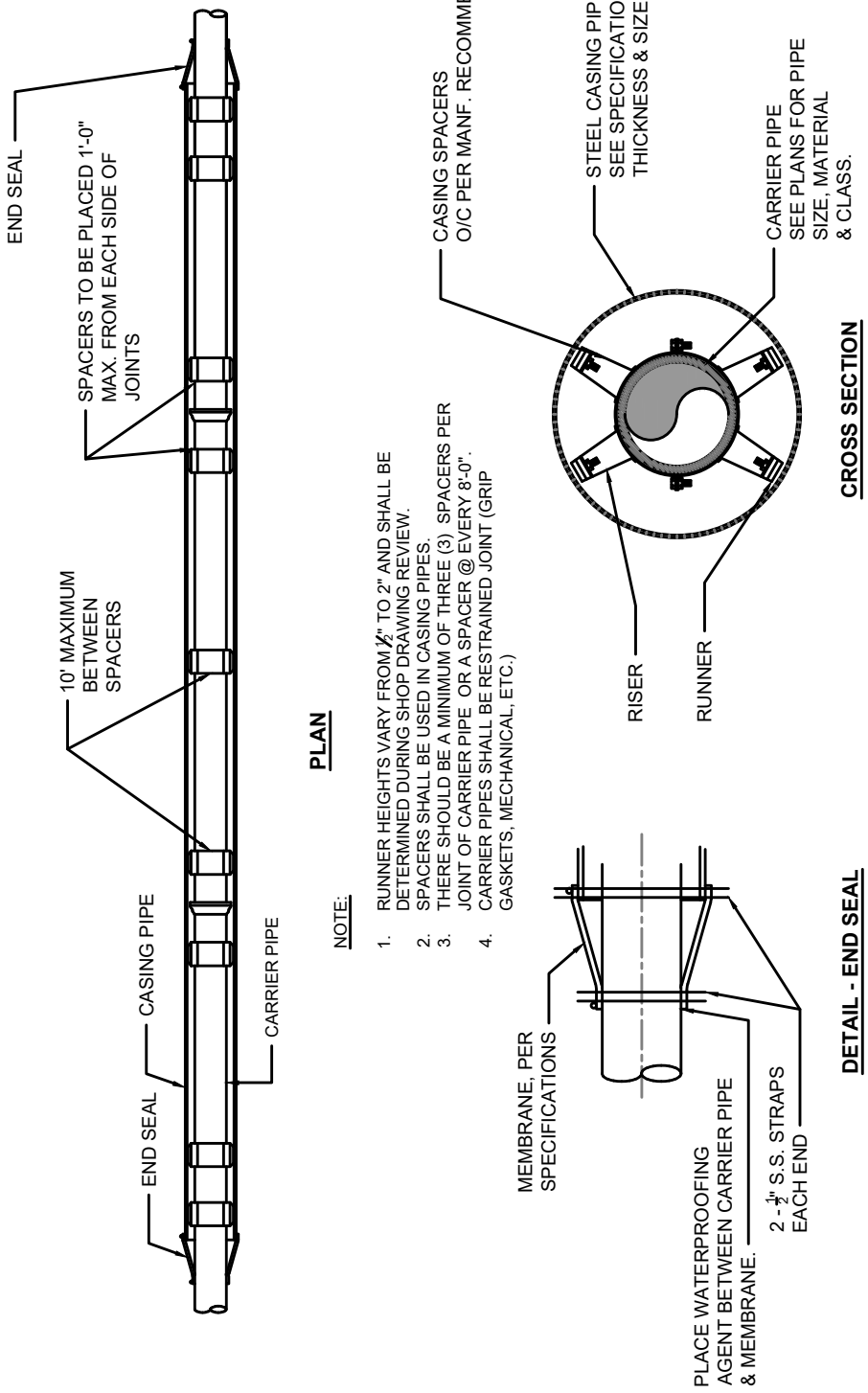
PRESSURE GAUGE ASSEMBLY - DETAIL

NOT TO SCALE

MOREHEAD UTILITY PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

GENERAL PRESSURE PIPE STANDARD DETAIL
PRESSURE GAGE ASSEMBLY

Date	02/03/2021
Revision Date	01/14/2022
Dwg. No.	GP-008



STEEL CASING BORE & JACK - DETAIL

NOT TO SCALE

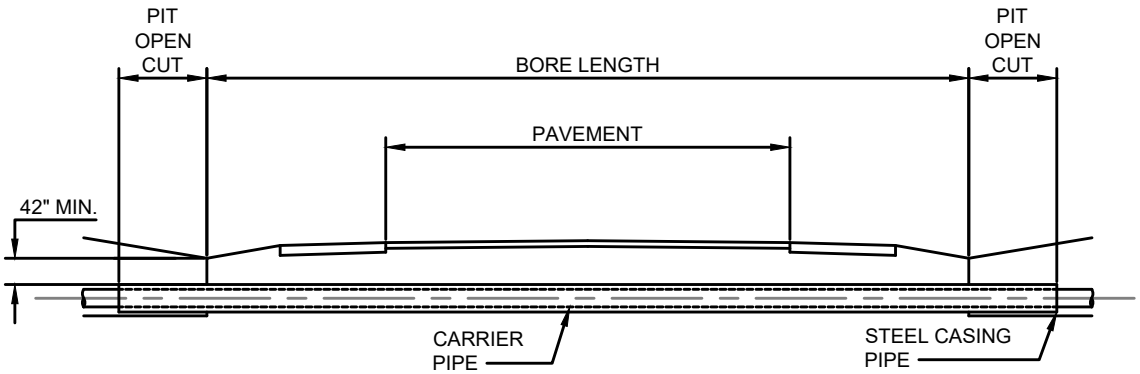
MOREHEAD UTILITY PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

GENERAL PRESSURE PIPE STANDARD DETAIL
STEEL CASING, BORE & JACK

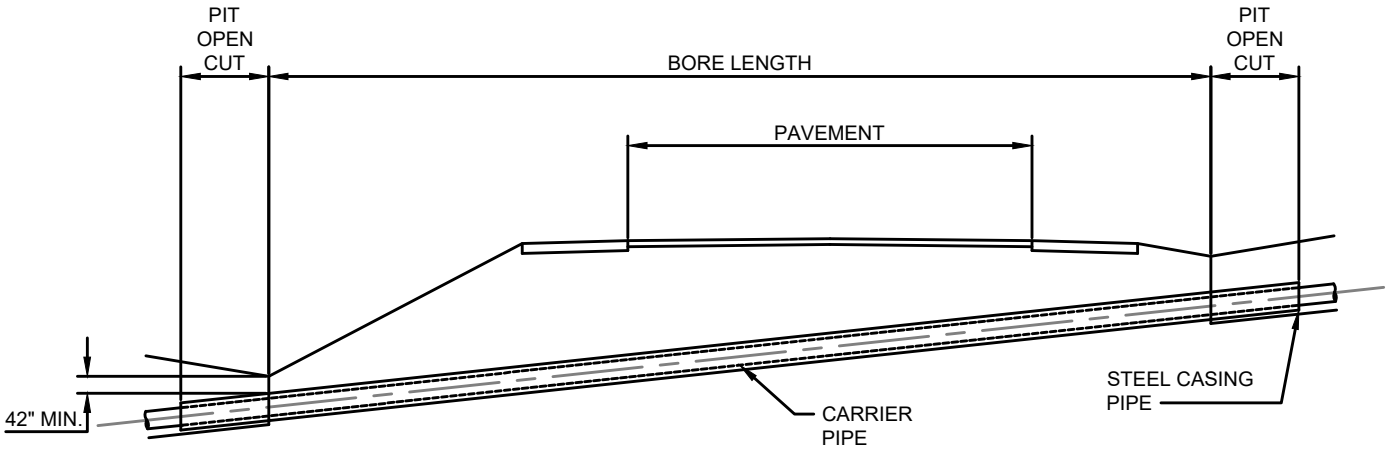
Date	02/03/2021
Revision Date	01/14/2022
Dwg. No.	GP-009

NOTE:

1. ALL JOINTS OF STEEL CASING SHALL BE SOLIDLY WELDED. END OF CASING SHALL BE SEALED AFTER LINE HAS BEEN INSTALLED.
2. MINIMUM DEPTHS MAY INCREASE IN AREAS WHICH REQUIRE MINIMUM SEPARATION WITH OTHER FACILITIES.
3. OPEN TRENCH NO CLOSER THAN THE DITCHLINE OR TOE OF FILL FROM THE EGDE OF THE PAVEMENT OR AS DIRECTED BY THE SPECIFICATIONS.
4. HIGHWAY CROSSINGS SHALL UTILIZE STEEL CASING PIPE. STEEL CASING PIPES WALL THICKNESS & DIAMETER PER SPECIFICATIONS. ALL BORED AND JACKED ENCASEMENT PIPE SHALL BE INSTALLED IN BORE HOLES NO LARGER THEN THE OUTSIDE DIA-METER OF THE ENCASEMENT PIPE.
5. SEE DWG GP-009 FOR STEEL CASING REQUIREMENTS.



OFFSET FROM EDGE OF PAVEMENT



FROM TOE OF SLOPE

KTC ENCROACHMENT REQUIREMENTS - DETAIL

NOT TO SCALE

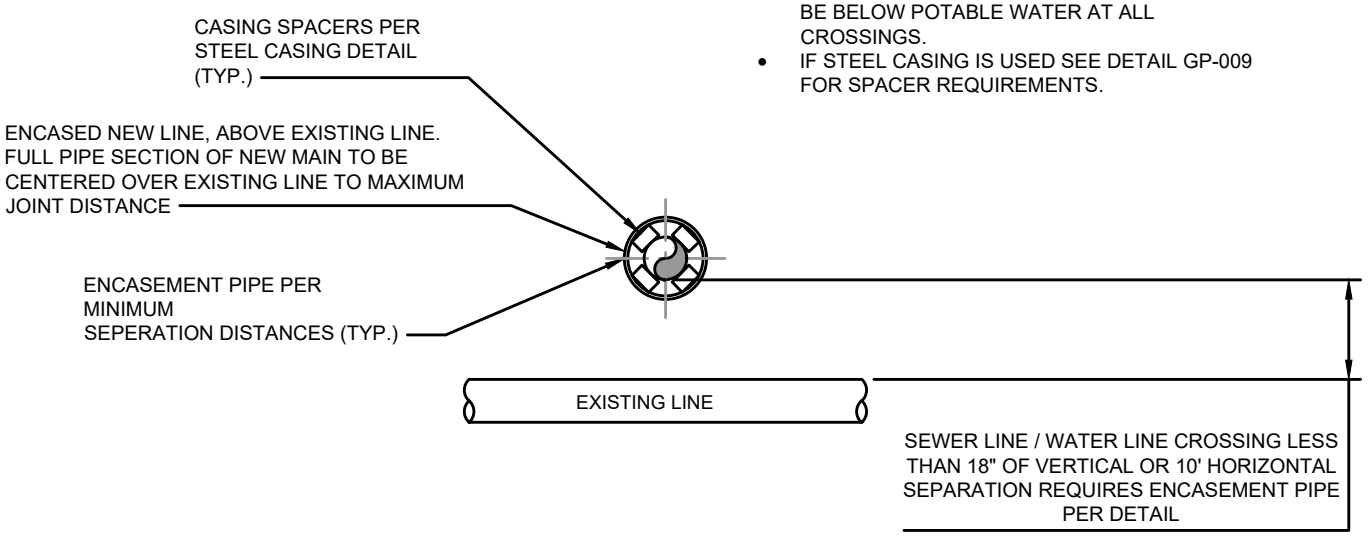
MOREHEAD UTILITY PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

GENERAL PRESSURE PIPE STANDARD DETAIL
KTC ENCROACHMENT REQUIREMENTS

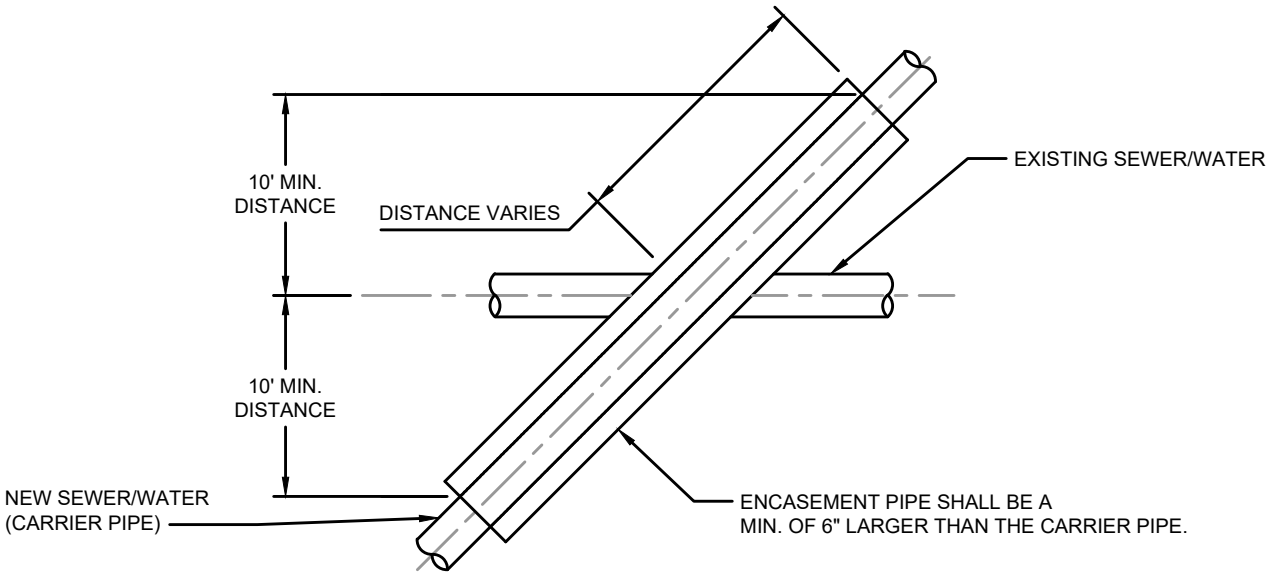
Date	02/03/2021
Revision Date	01/14/2022
Dwg. No.	GP-010

NOTE:

- IF 10' HORIZONTAL SEPARATION IS NOT AVAILABLE, THEN THE WATER/SEWER BEING INSTALLED SHALL BE ENCASED IN EITHER CASING PIPE (PVC) FOR THE REQUIRED LENGTH TO OBTAIN 10' HORIZONTAL SEPARATION.
- IT IS PREFERRED FOR SANITARY SEWER TO BE BELOW POTABLE WATER AT ALL CROSSINGS.
- IF STEEL CASING IS USED SEE DETAIL GP-009 FOR SPACER REQUIREMENTS.



SECTION



PLAN

WATER - SEWER CROSSING - DETAIL

NOT TO SCALE

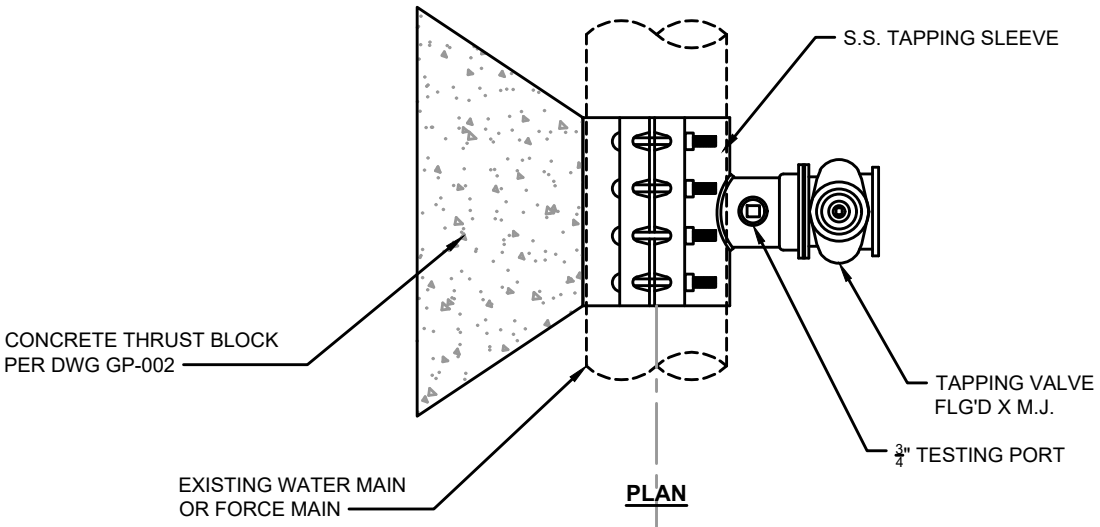
MOREHEAD UTILITY PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

GENERAL PRESSURE PIPE STANDARD DETAIL
WATER - SEWER CROSSING

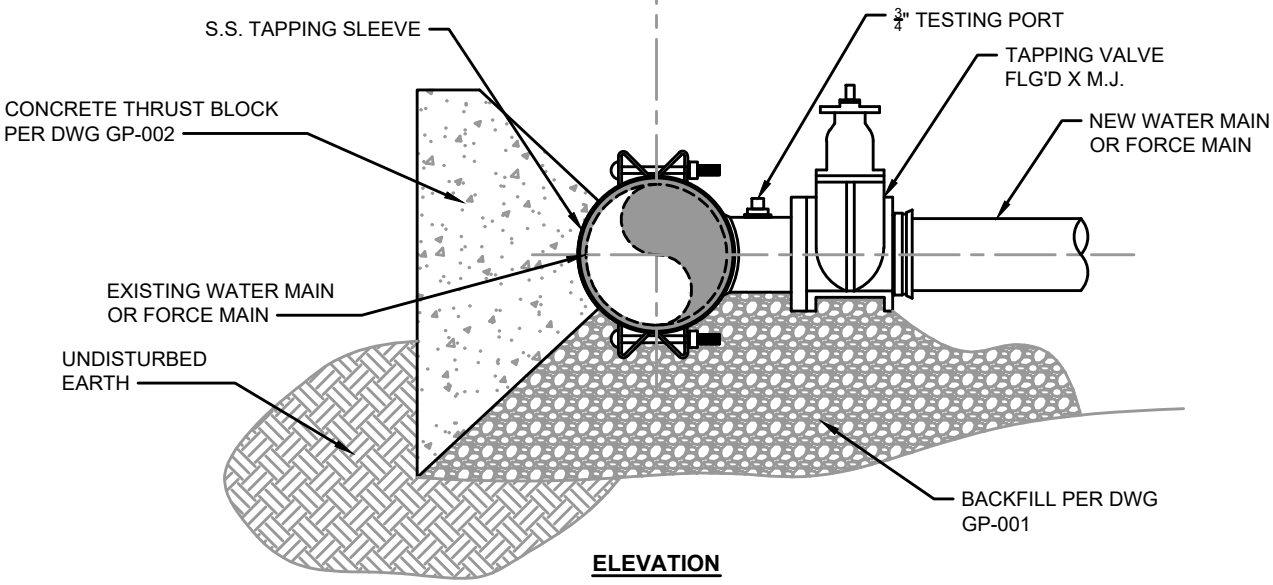
Date	02/03/2021
Revision Date	01/14/2022
Dwg. No.	GP-011

NOTE:

- TAPPING SLEEVE & VALVE TO BE TESTED PER MANUFACTURERS RECOMMENDATIONS
- NO SIZE FOR SIZE TAPPING SLEEVE ALLOWED WITHOUT WRITTEN APPROVAL OF MUPB.



PLAN



ELEVATION

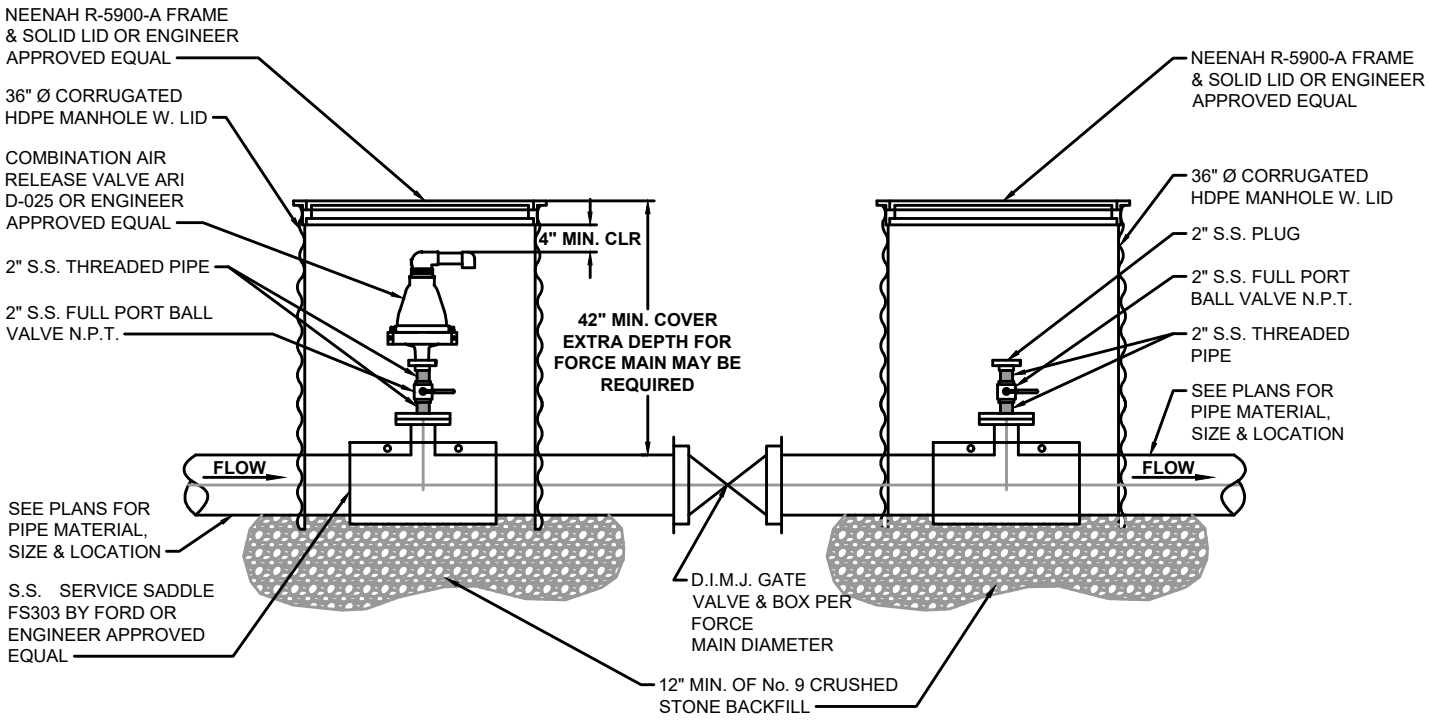
TAPPING SLEEVE & VALVE ASSEMBLY - DETAIL

NOT TO SCALE

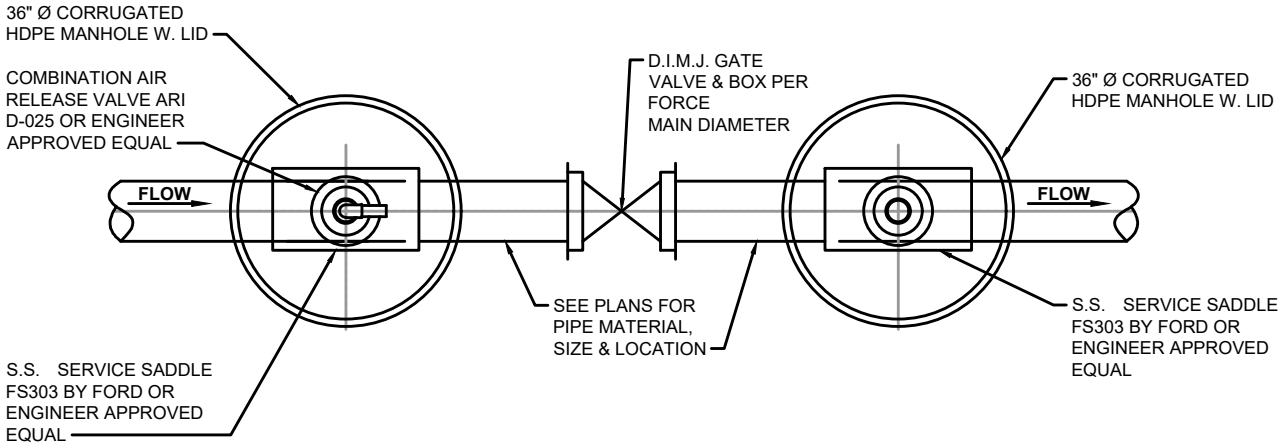
MOREHEAD UTILITY PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

GENERAL PRESSURE PIPE STANDARD DETAIL
TAPPING SLEEVE & VALVE ASSEMBLY

Date	02/12/2021
Revision Date	01/14/2022
Dwg. No.	GP-012



CARV ASSEMBLY - ELEVATION **FLUSHING ASSEMBLY - ELEVATION**



PLAN

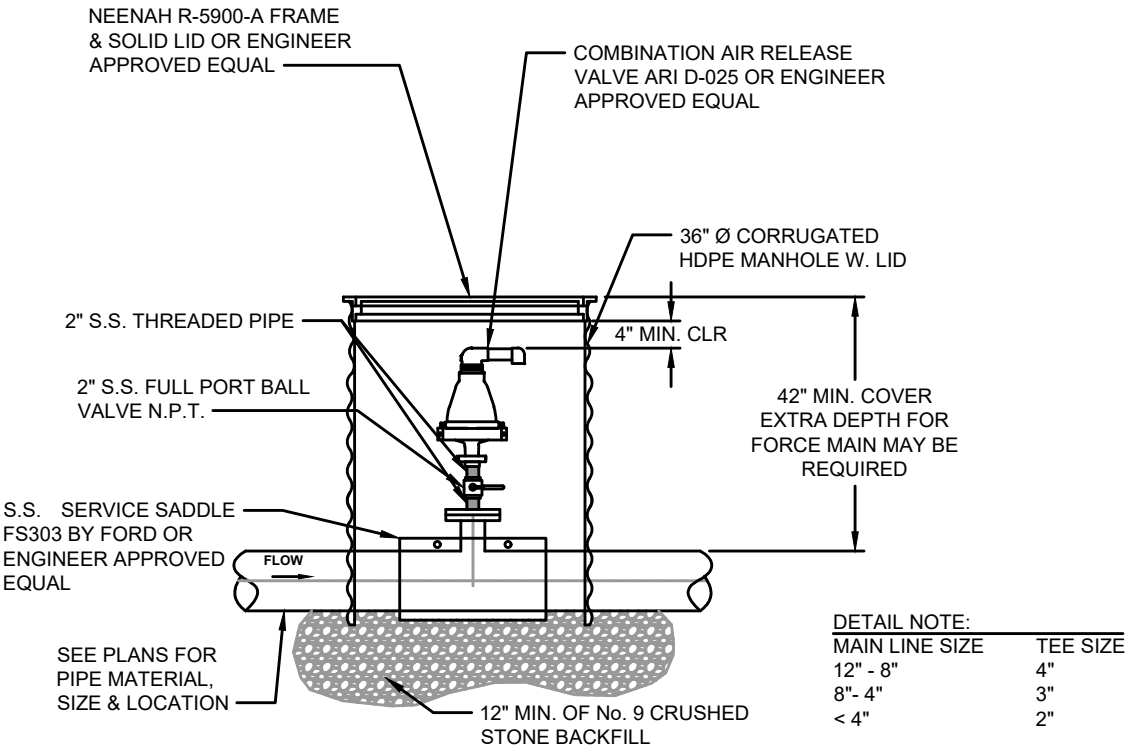
CARV & FLUSHING CONNECTION - DETAIL

NOT TO SCALE

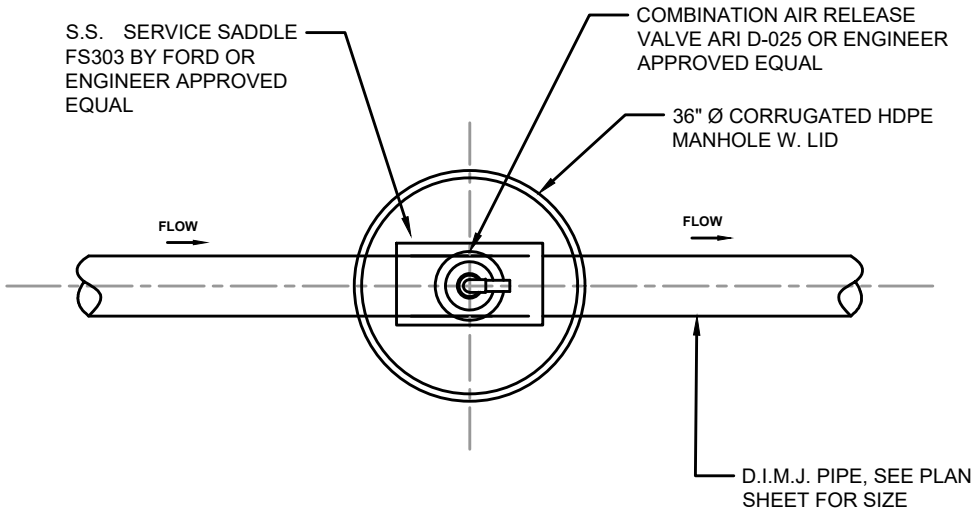
MOREHEAD UTILITY PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

GENERAL PRESSURE PIPE STANDARD DETAIL
CARV & FLUSHING CONNECTION

Date	02/03/2021
Revision Date	01/14/2022
Dwg. No.	GP-101



CARV ASSEMBLY - ELEVATION



PLAN

CARV ASSEMBLY - DETAIL

NOT TO SCALE

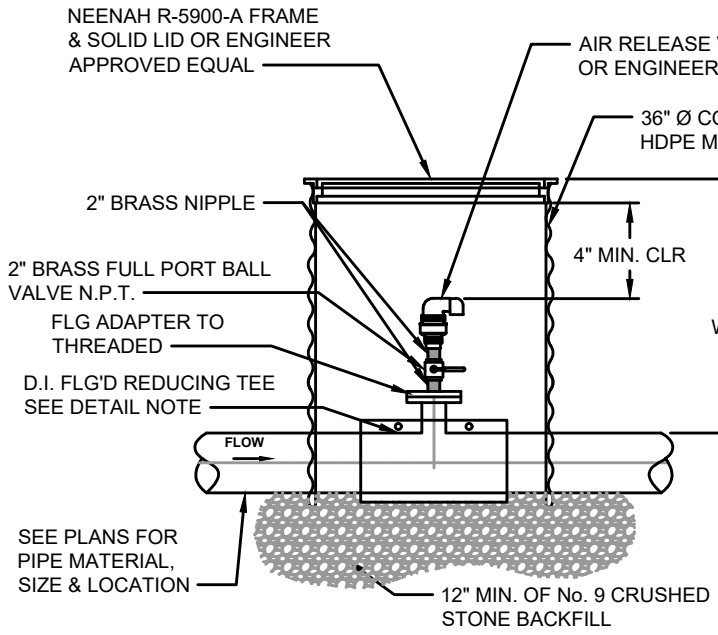
MOREHEAD UTILITY PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

GENERAL PRESSURE PIPE STANDARD DETAIL
CARV ASSEMBLY

Date
02/03/2021

Revision Date
01/14/2022

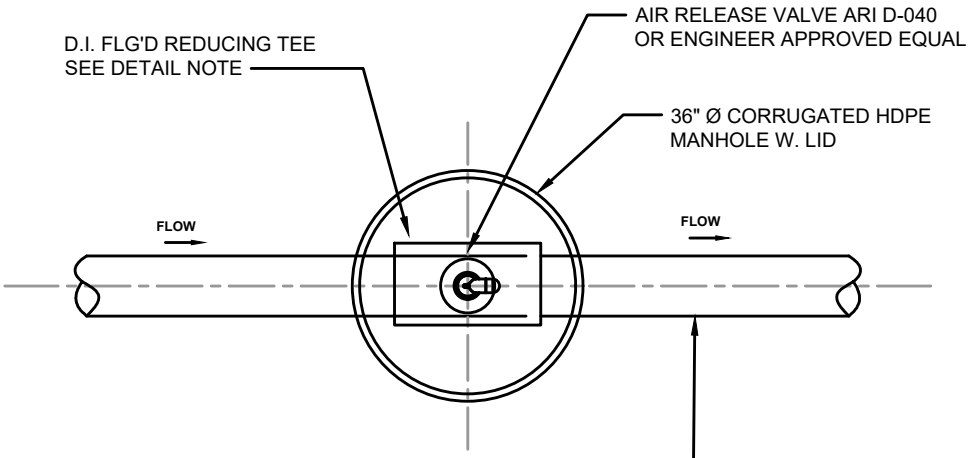
Dwg. No.
GP-102



DETAIL NOTE:

MAIN LINE SIZE	TEE SIZE
12" - 8"	4"
8"- 4"	3"
< 4"	2"

ARV ASSEMBLY - ELEVATION



PLAN

ARV ASSEMBLY (WATER ONLY) - DETAIL

NOT TO SCALE

MOREHEAD UTILITY
PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

GENERAL PRESSURE PIPE STANDARD DETAIL
ARV ASSEMBLY (WATER ONLY)

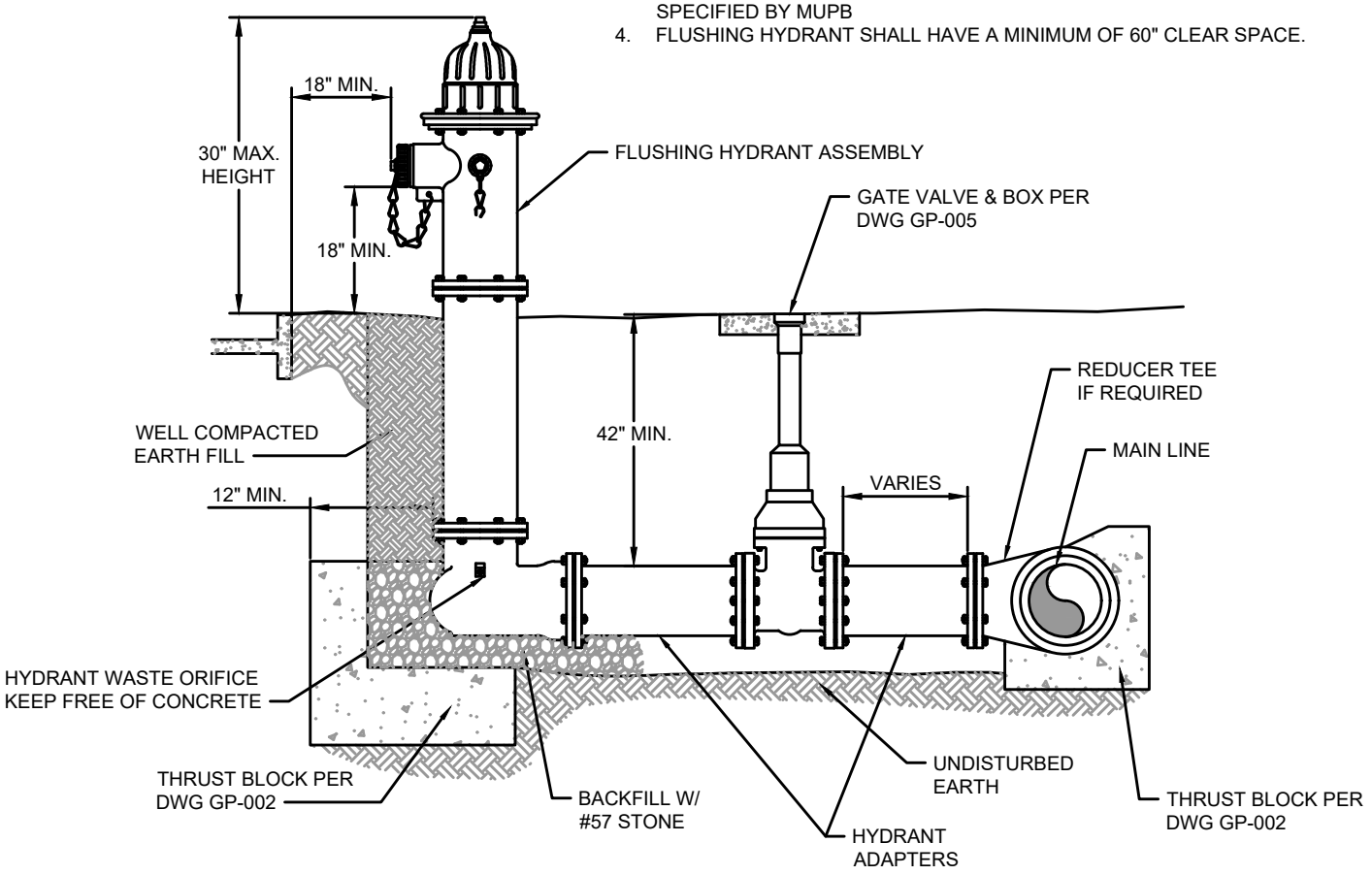
Date
02/03/2021

Revision Date
01/14/2022

Dwg. No.
GP-201

NOTE:
TYPE 1 FLUSHING HYDRANT
TWO (2) 2½" CONNECTIONS AND ONE (1) 4½" CONNECTION

NOTE: BEFORE FINAL INSPECTION
1. ENSURE ADEQUATE VOLUME OF OIL AS SHIPPED BY THE MANUFACTURER
2. HYDRANT SHALL BE CLEANED, WIRE BRUSHED AND TOUCHED UP WITH "KROMIK PRIMER E4INI" OR ENGINEER APPROVED EQUAL
3. HYDRANT SHALL RECEIVE TWO FINISHING COATS OF SONNEBORN'S HYDRANT ENAMEL PAINT, COLOR TO MATCH EXISTING HYDRANTS OR AS SPECIFIED BY MUPB
4. FLUSHING HYDRANT SHALL HAVE A MINIMUM OF 60" CLEAR SPACE.



FLUSHING HYDRANT ASSEMBLY TYPE 1 - DETAIL

NOT TO SCALE

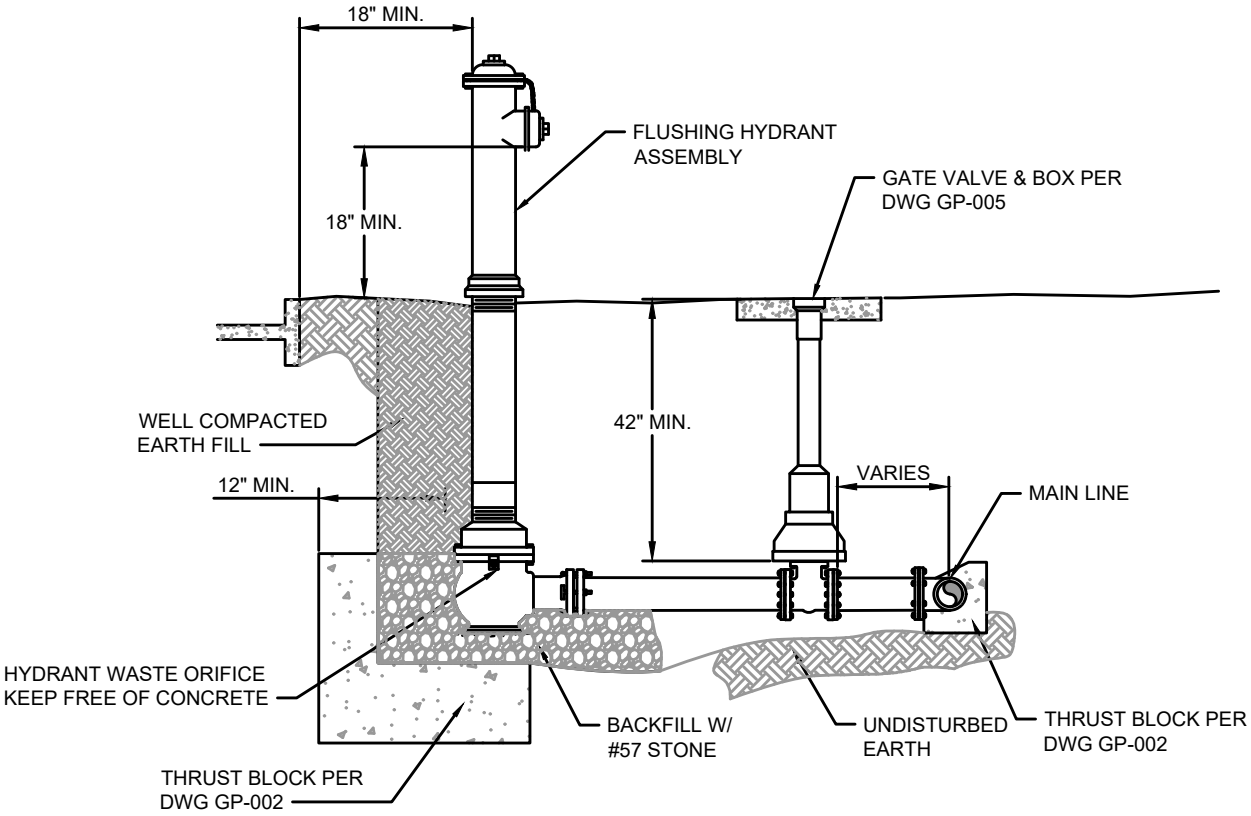
MOREHEAD UTILITY PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

GENERAL PRESSURE PIPE STANDARD DETAIL
FLUSHING HYDRANT ASSEMBLY, TYPE 1

Date	02/03/2021
Revision Date	01/14/2022
Dwg. No.	GP-202

NOTE: BEFORE FINAL INSPECTION

1. ENSURE ADEQUATE VOLUME OF OIL AS SHIPPED BY THE MANUFACTURER
2. HYDRANT SHALL BE CLEANED, WIRE BRUSHED AND TOUCHED UP WITH "KROMIK PRIMER E4INI" OR ENGINEER APPROVED EQUAL
3. HYDRANT SHALL RECEIVE TWO FINISHING COATS OF SONNEBORN'S HYDRANT ENAMEL PAINT, COLOR TO MATCH EXISTING HYDRANTS OR AS SPECIFIED BY MUPB



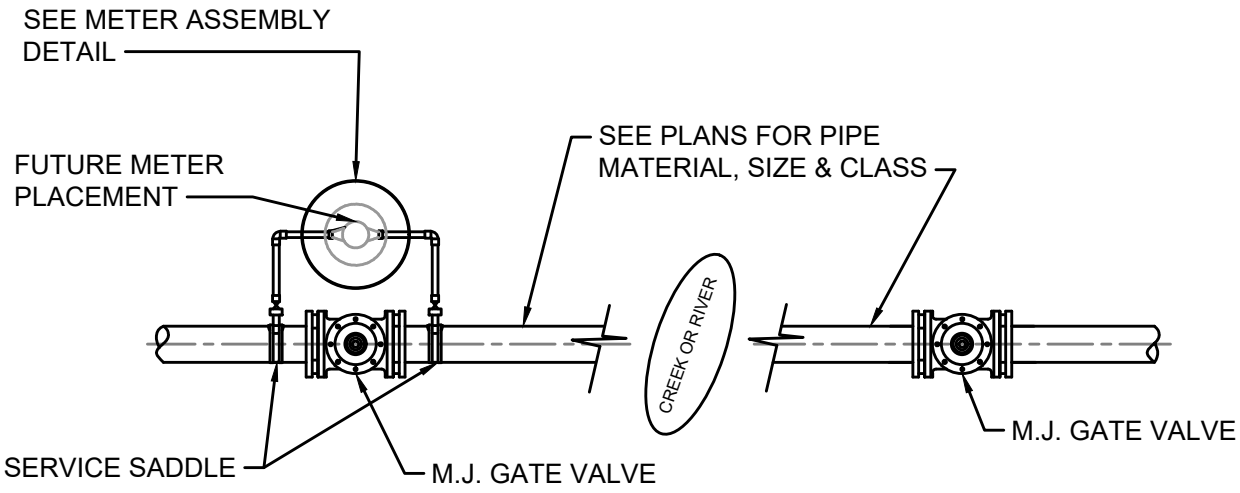
FLUSHING HYDRANT ASSEMBLY TYPE 2 - DETAIL

NOT TO SCALE

MOREHEAD UTILITY PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

GENERAL PRESSURE PIPE STANDARD DETAIL
FLUSHING HYDRANT ASSEMBLY, TYPE 2

Date	02/03/2021
Revision Date	01/14/2022
Dwg. No.	GP-203



LEAK DETECTION ASSEMBLY - DETAIL

NOT TO SCALE

MOREHEAD UTILITY PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

GENERAL PRESSURE PIPE STANDARD DETAIL
LEAK DETECTION ASSEMBLY

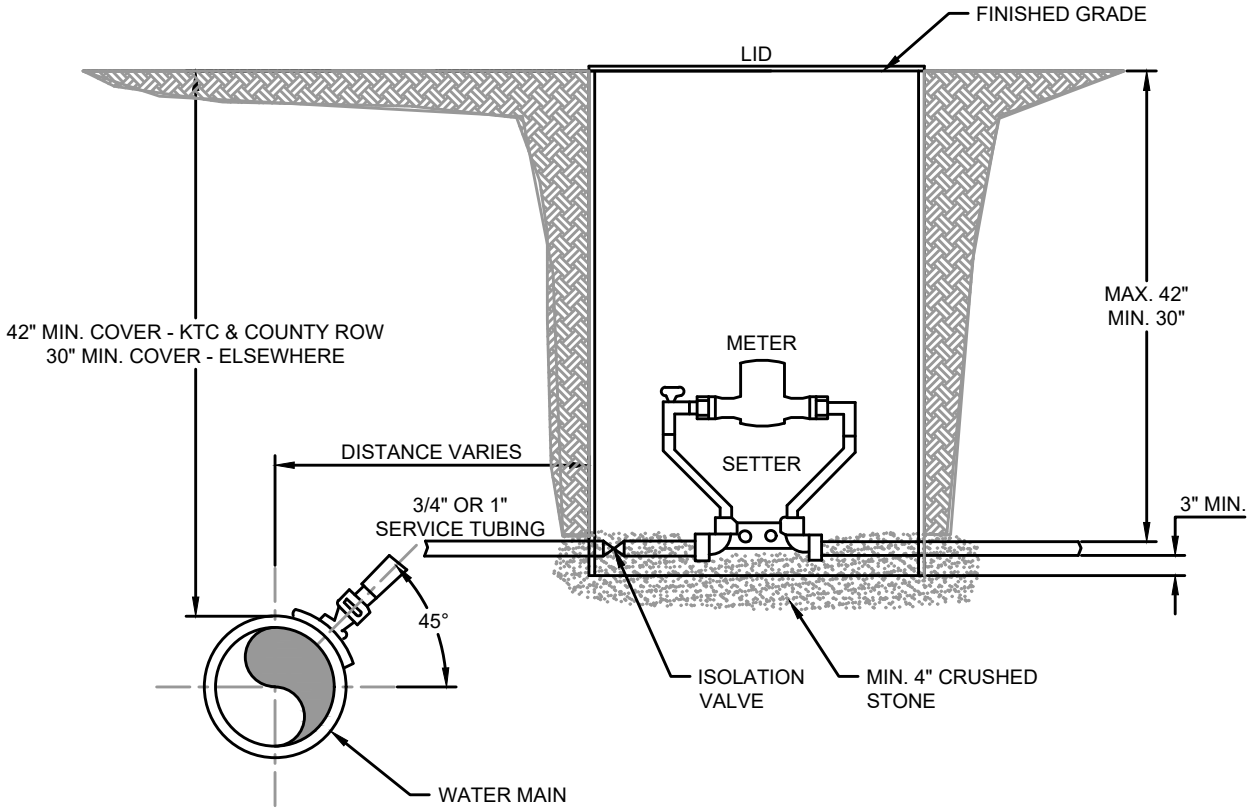
Date	02/03/2021
Revision Date	01/14/2022
Dwg. No.	GP-204

METER MATERIAL SCHEDULE

1. SETTER-SEE SPECIFICATIONS
2. METER BOX-SEE SPECIFICATIONS
3. COVER-SEE SPECIFICATIONS
4. METER-SEE SPECIFICATIONS
5. INDIVIDUAL PRESSURE REDUCING VALVE (IPRV)-SEE SPECIFICATIONS
6. CORPORATION STOP-SEE SPECIFICATION
7. SERVICE SADDLE-SEE SPECIFICATION

NOTE:

1. CONTRACTOR IS RESPONSIBLE FOR ALL PLUMBING PERMITS & ASSOCIATED COSTS.
2. INDIVIDUAL PRESSURE REDUCING VALVES REQUIRED ON ALL METERS WHERE PRESSURE EXCEEDS 90 PSI, ON MUPB SIDE OF METER.
3. TRACER WIRE TO BE CONNECTED TO WATER MAIN TRACER WIRE AND RAN ON NEW SERVICE TUBING AND TERMINATING IN THE METER BOX.



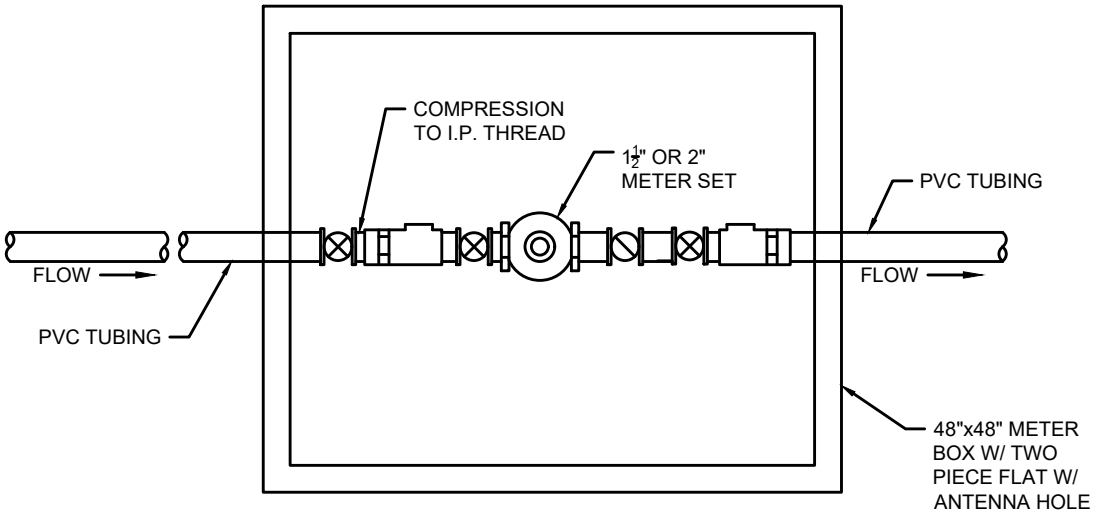
RESIDENTIAL METER ASSEMBLY - DETAIL

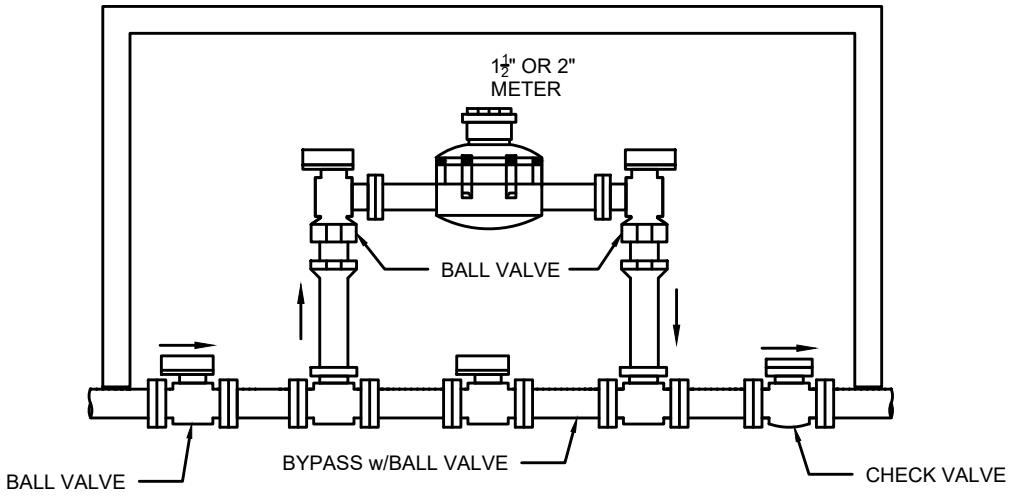
NOT TO SCALE

MOREHEAD UTILITY PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

GENERAL PRESSURE PIPE STANDARD DETAIL
RESIDENTIAL METER ASSEMBLY

Date	02/03/2021
Revision Date	01/14/2022
Dwg. No.	GP-205





2" WATER METER SET

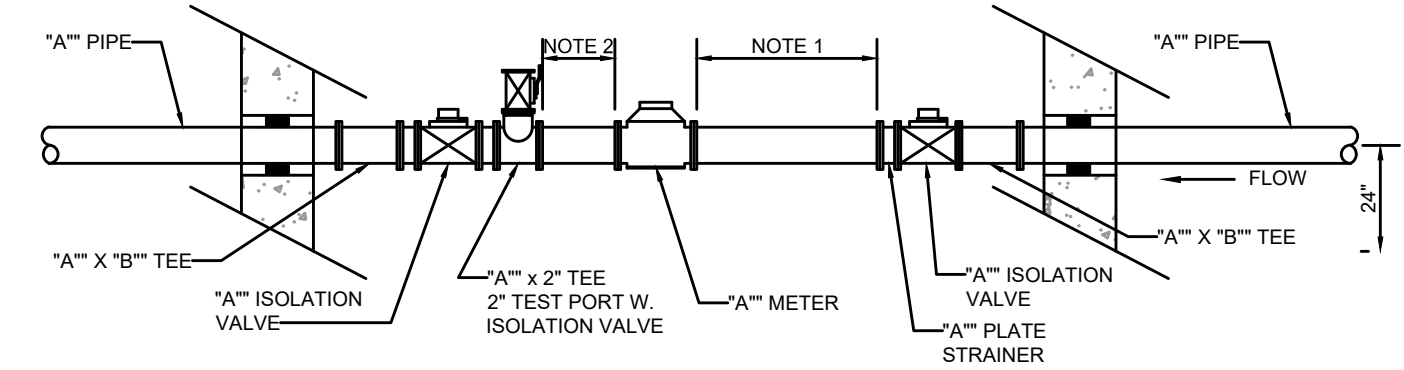
1 1/2" & 2" METER ASSEMBLY - DETAIL

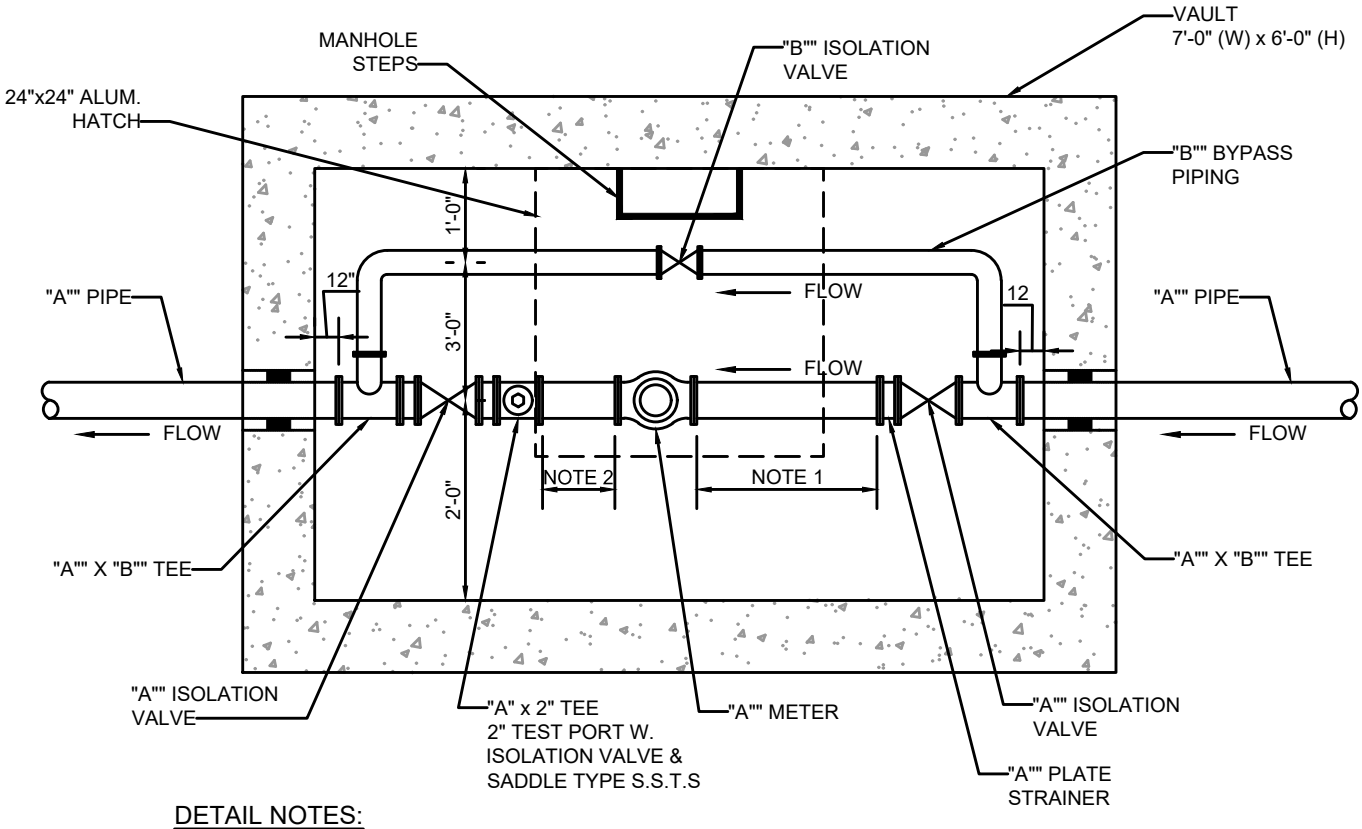
NOT TO SCALE

MOREHEAD UTILITY
PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

GENERAL PIPE STANDARD DETAIL
1½" & 2" METER ASSEMBLY

Date	02/03/2021
Revision Date	01/14/2022
Dwg. No.	GP-206





DETAIL NOTES:

1. METER SIZE (INCHES) X 5
2. METER SIZE (INCHES) X 2

NOTE:

A PRV SHALL BE PLACED BETWEEN THE STRAINER AND ISOLATION VALVE

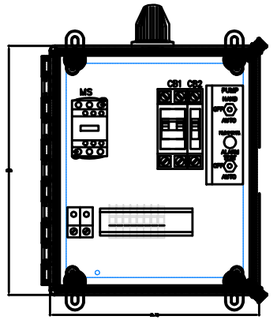
3" OR LARGER METER ASSEMBLY VALVE VAULT- DETAIL

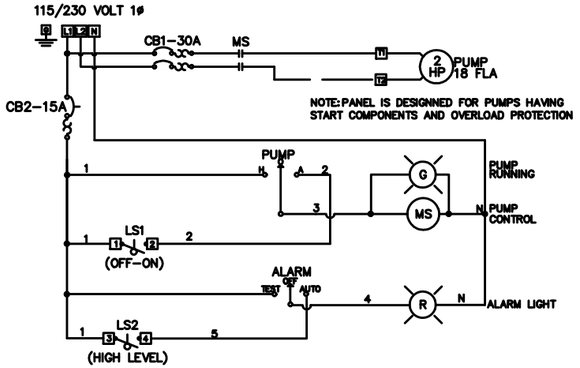
NOT TO SCALE

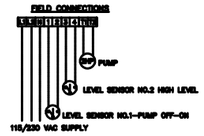
MOREHEAD UTILITY PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

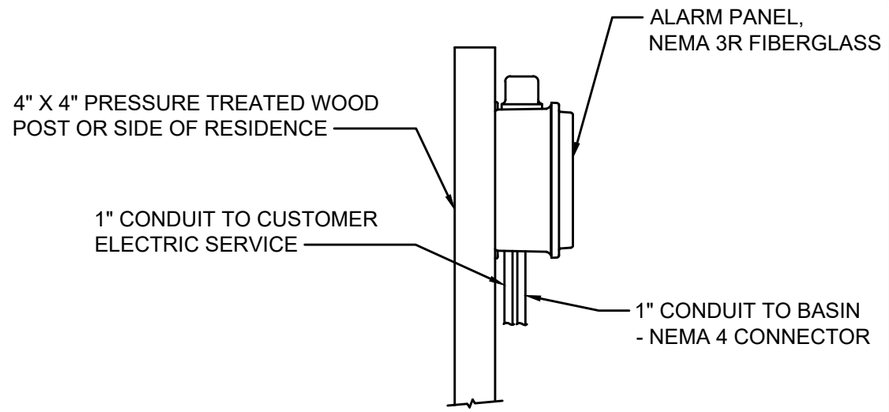
GENERAL PIPE STANDARD DETAIL
3" OR LARGER METER ASSEMBLY VALVE VAULT

Date	07/26/2021
Revision Date	01/14/2022
Dwg. No.	GP-207

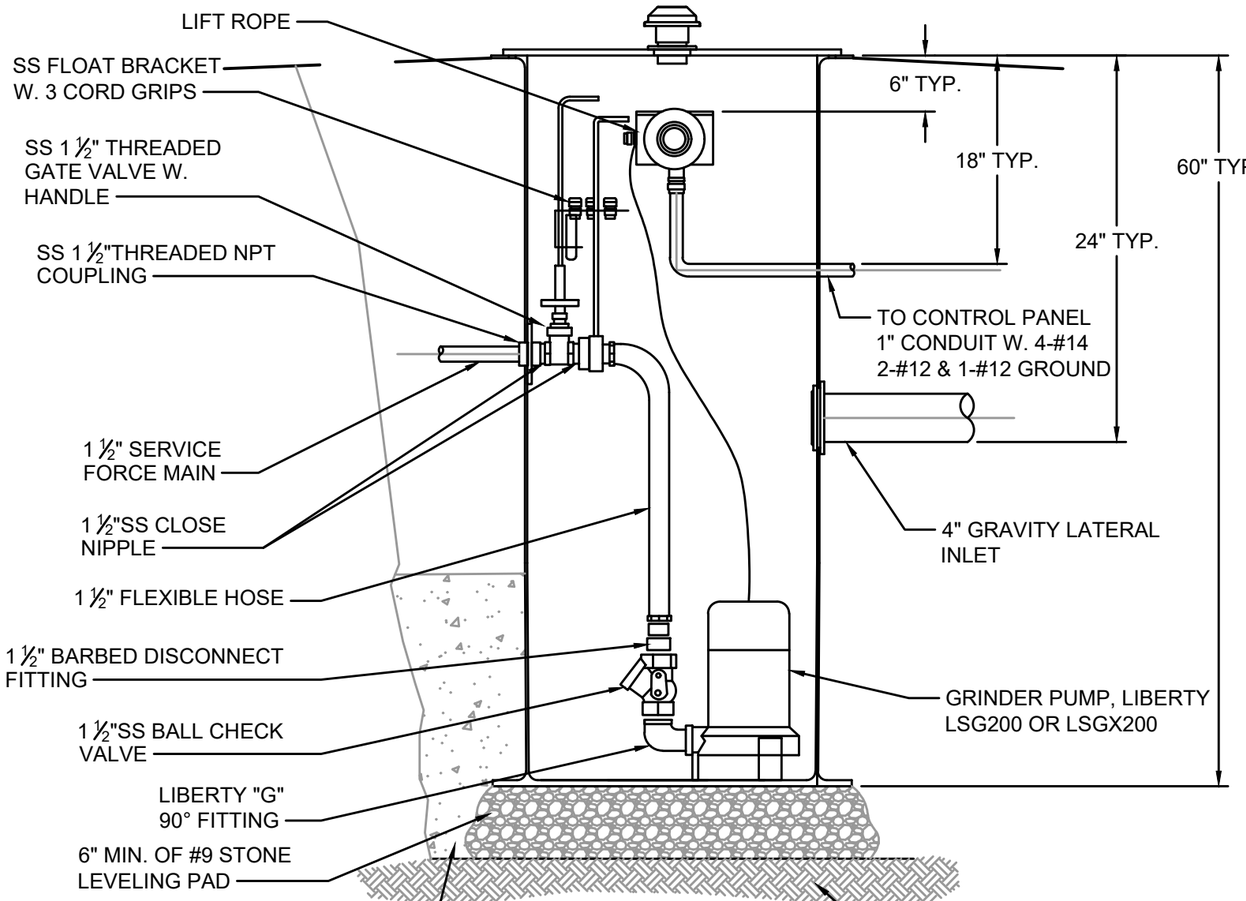




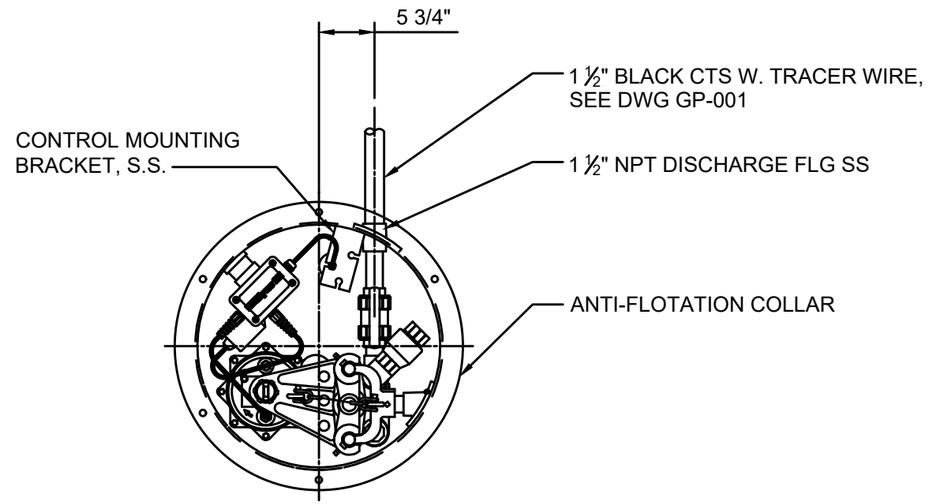




CONTROL PANEL



ELEVATION



PLAN

RESIDENTIAL GRINDER PUMP STATION - DETAIL

NOT TO SCALE

MOREHEAD UTILITY PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

SANITARY SEWER STANDARD DETAIL
RESIDENTIAL GRINDER PUMP STATION

Date	07/26/2021
Revision Date	01/14/2022
Dwg. No.	LPS-001

NOTES:

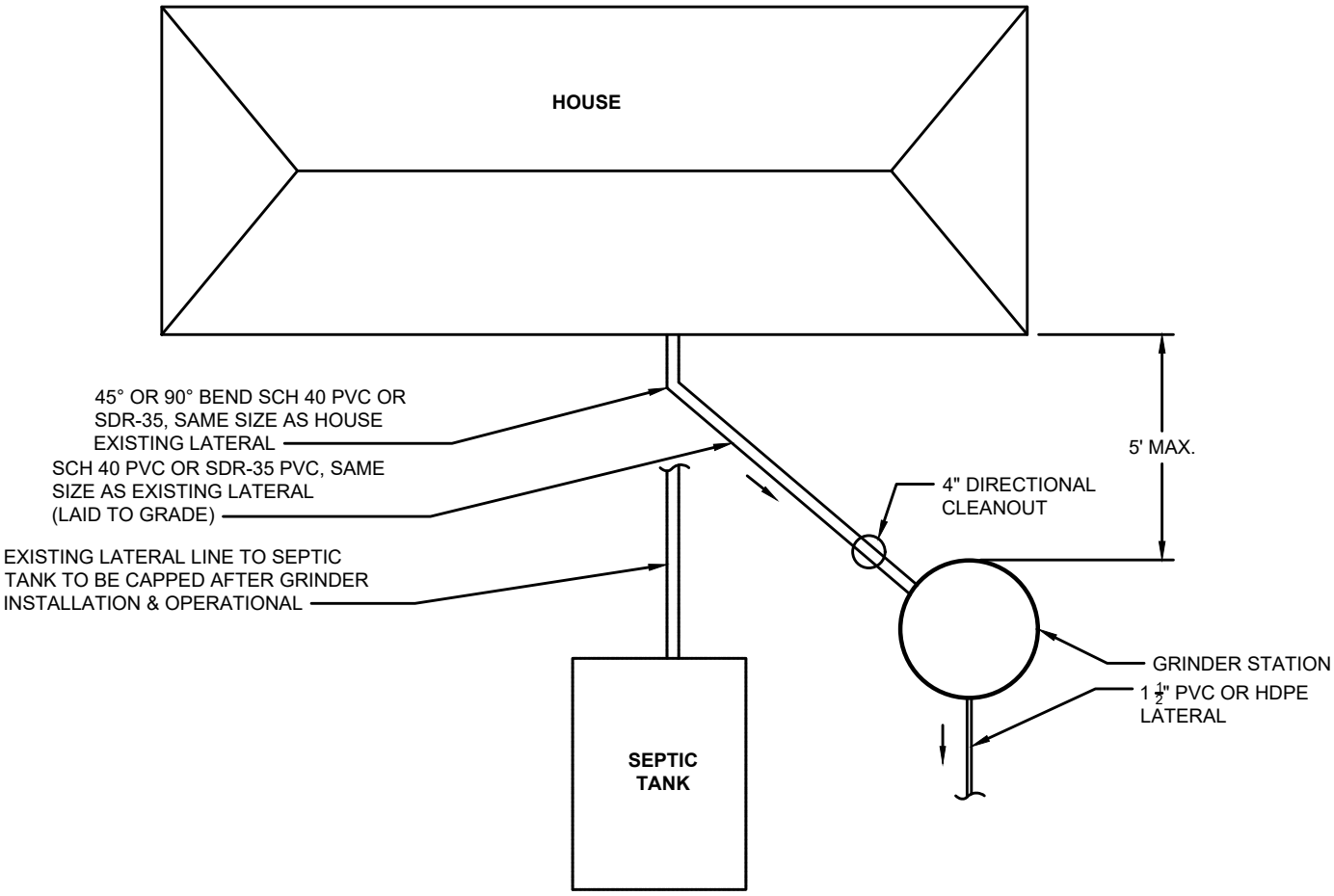
1. **CONTRACTOR SHALL FURNISH A LICENSED PLUMBER TO MAKE CONNECTION BETWEEN HOME'S EXISTING SEWER OUTFALL TO GRINDER UNIT. A PLUMBING PERMIT IS REQUIRED FOR ALL CONNECTIONS FOR HOMES/BUSINESSES AND MUST BE PULLED BY A LICENSED MASTER PLUMBER. WORK RELATING TO THE FINAL HOOK UP SHALL BE PERFORMED BY JOURNEYMAN PLUMBER. THIS SHALL BE INCLUDED IN THE PRICE OF GRINDER PUMP STATION.**

2. **A DIRECTIONAL FLOW CLEAN-OUT IS REQUIRED FOR EACH CONNECTION OF EXISTING HOME/BUSINESS. THIS SHALL BE INCLUDED IN THE PRICE OF GRINDER PUMP STATION.**

3. **CONTRACTOR SHALL INSTALL #12 GAUGE METAL DETECTABLE WIRE FROM GRINDER PUMP STATION TO FORCE MAIN. THIS SHALL BE INCLUDED IN THE PRICE OF GRINDER PUMP STATION.**

4. **IF THE PUMP STATION IS NOT INSTALLED AT THE SAME TIME AS THE CONNECTION INTO THE FORCE MAIN, THE CONTRACTOR SHALL TERMINATE THE SERVICE LINE AT THE PROPERTYLINE, SOLVENT WELD A SCH. 40 PVC CAP TO THE END OF THE PIPE AND PLACE A 2x4 MARKER EXTENDING ABOVE GROUND AT THIS LOCATION. NO GASKETED FITTINGS SHALL BE INSTALLED BETWEEN THE PROPERTY LINE AND THE FORCE MAIN.**

5. **AFTER HOOK UP HAS BEEN COMPLETED, EACH CONNECTION SHALL BE SMOKE TESTED BEFORE APPROVAL. IF SEWER IS NOT VENTED OUT OF THE ROOF, CONTRACTOR SHALL INSTALL A 2" VENT PIPE BEFORE SEWER ENTERS UNDERNEATH THE HOUSE.**



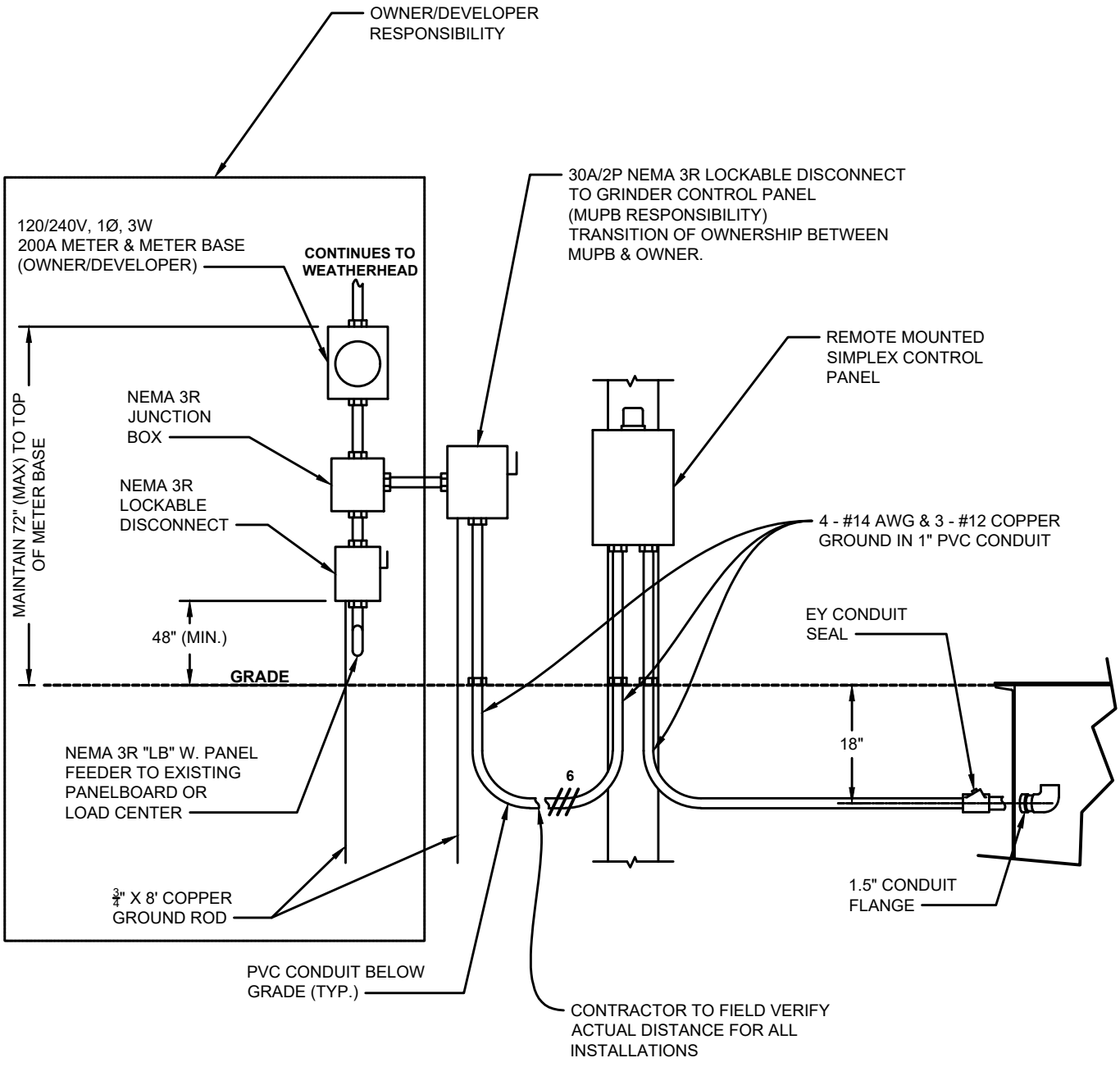
RESIDENTIAL GRINDER PLUMBING CONNECTION

NOT TO SCALE

MOREHEAD UTILITY PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

SANITARY SEWER STANDARD DETAIL
RESIDENTIAL GRINDER PLUMBING CONNECTION

Date	02/03/2021
Revision Date	01/14/2022
Dwg. No.	LPS-002



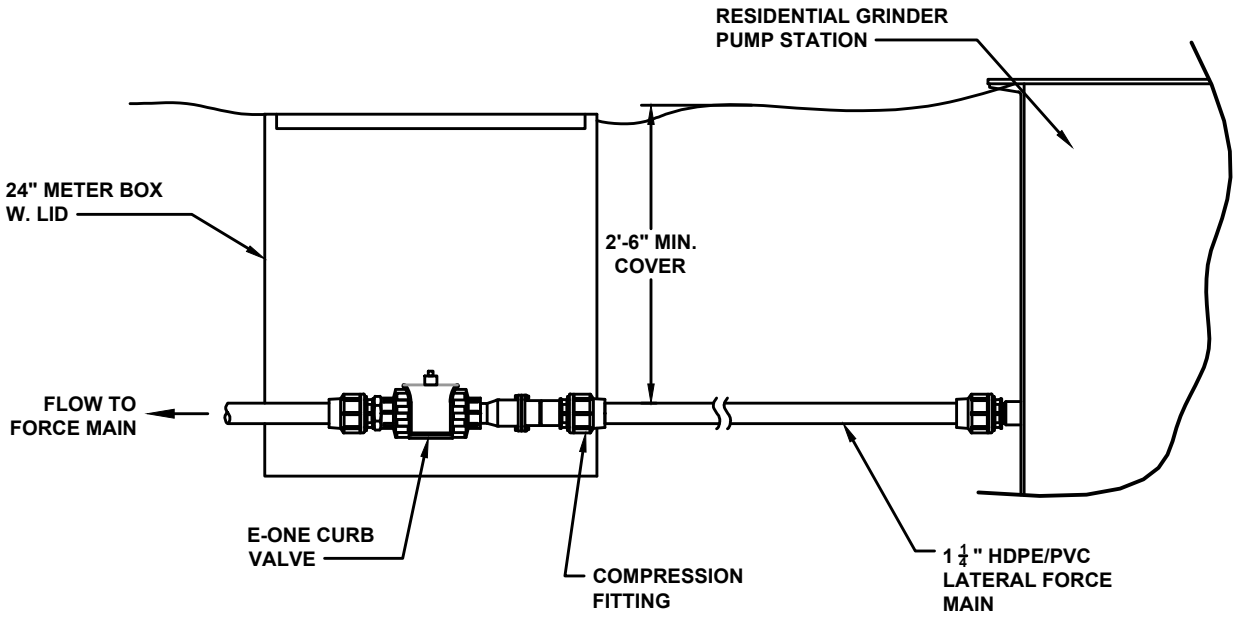
RESIDENTIAL GRINDER ELECTRICAL DETAIL - DETAIL

NOT TO SCALE

MOREHEAD UTILITY PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

SANITARY SEWER STANDARD DETAIL
RESIDENTIAL GRINDER ELECTRICAL DETAIL,

Date	07/26/2021
Revision Date	01/14/2022
Dwg. No.	LPS-003



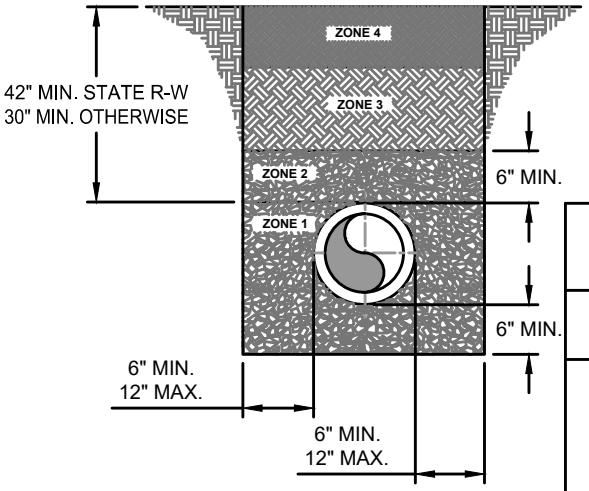
RESIDENTIAL GRINDER CURB VALVE ASSEMBLY

NOT TO SCALE

MOREHEAD UTILITY
PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

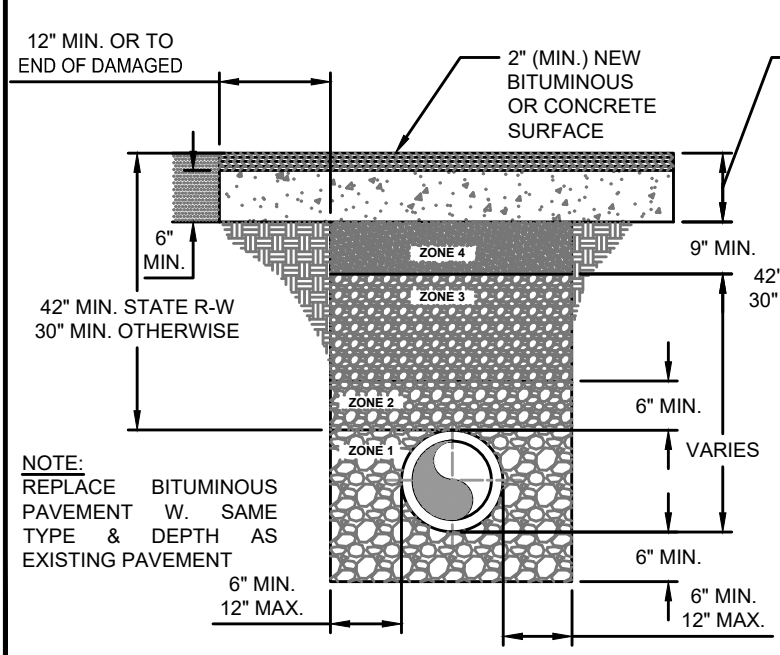
SANITARY SEWER STANDARD DETAIL
RESIDENTIAL GRINDER CURB VALVE ASSEMBLY

Date	07/26/2021
Revision Date	01/14/2022
Dwg. No.	LPS-004

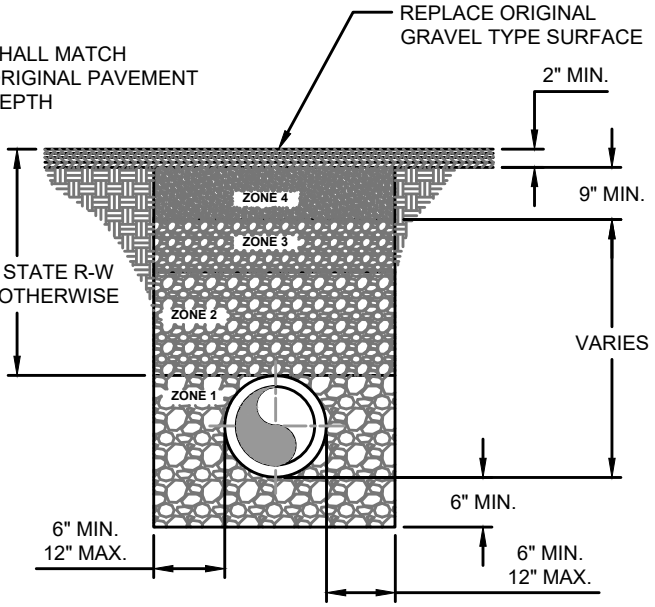


PIPE LAID IN ROCK OR EARTH TRENCH

BACKFILL NOTES				
SURFACE TYPE	ZONE 1	ZONE 2	ZONE 3	ZONE 4
EARTH TRENCH	No. 9 OR 68 CRUSHED STONE	NO. 9 OR 68 CRUSHED STONE	COMPACTED SOIL FREE OF ROCK	TOP SOIL
BITUMNOUS SERFACE > 2" THICK	NO. 9 OR 68 CRUSHED STONE	NO. 9 OR 68 CRUSHED STONE	NO. 9 OR 68 CRUSHED STONE	COMPACTED DGA
BITUMNOUS SURFACE < 2" THICK	NO. 9 OR 68 CRUSHED STONE	NO. 9 OR 68 CRUSHED STONE	NO. 9 OR 68 CRUSHED STONE	COMPACTED DGA



ORIGINAL BITUMINOUS OR CONCRETE SURFACE



ORIGINAL GRAVEL SURFACE

TRENCH BACKFILL - DETAIL

NOT TO SCALE

MOREHEAD UTILITY PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

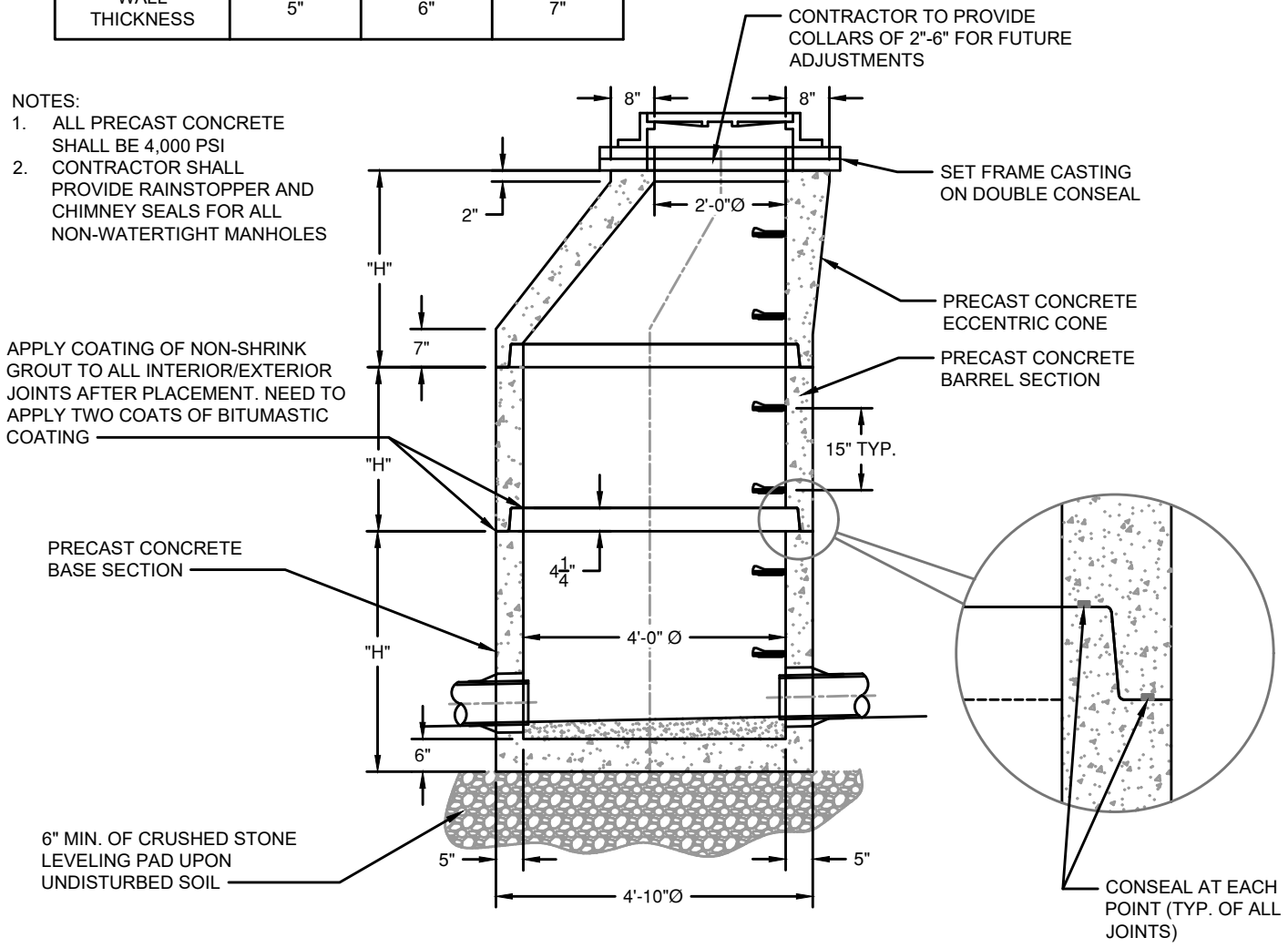
GRAVITY SANITARY SEWER STANDARD DETAIL
TRENCH BACKFILL

Date	07/23/2021
Revision Date	01/14/2022
Dwg. No.	SS-001

"H" VALUES			
MANHOLE SECTION	48" Ø	60" Ø	72" Ø
ECCENTRIC CONE	24",30",32", 36"	48"	NONE
BARREL SECTION	15", 30",45", 60"	UNLIMITED	UNLIMITED
BASE SECTION	23", 30", 32", 34" 44"	UNLIMITED	UNLIMITED
WALL THICKNESS	5"	6"	7"

MANHOLE DIAMETERS			
SEWER MAIN SIZE (INCHES)	48" Ø	60" Ø	72" Ø
<= 12	YES	MAYBE	MAYBE
12<=X<=18	NO	YES	MAYBE
<18	NO	NO	YES

NOTES:
1. ALL PRECAST CONCRETE SHALL BE 4,000 PSI
2. CONTRACTOR SHALL PROVIDE RAINSTOPPER AND CHIMNEY SEALS FOR ALL NON-WATERTIGHT MANHOLES



STANDARD PRECAST CONCRETE MANHOLE - DETAIL

NOT TO SCALE

MOREHEAD UTILITY PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

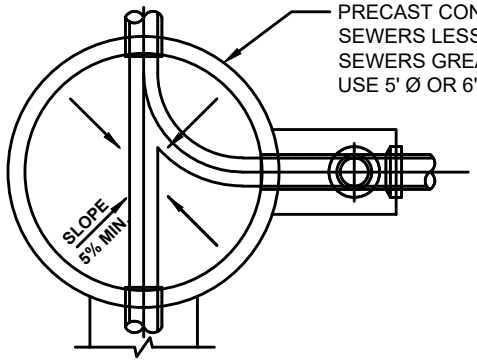
GRAVITY SANITARY SEWER STANDARD DETAIL
STANDARD PRECAST CONCRETE MANHOLE

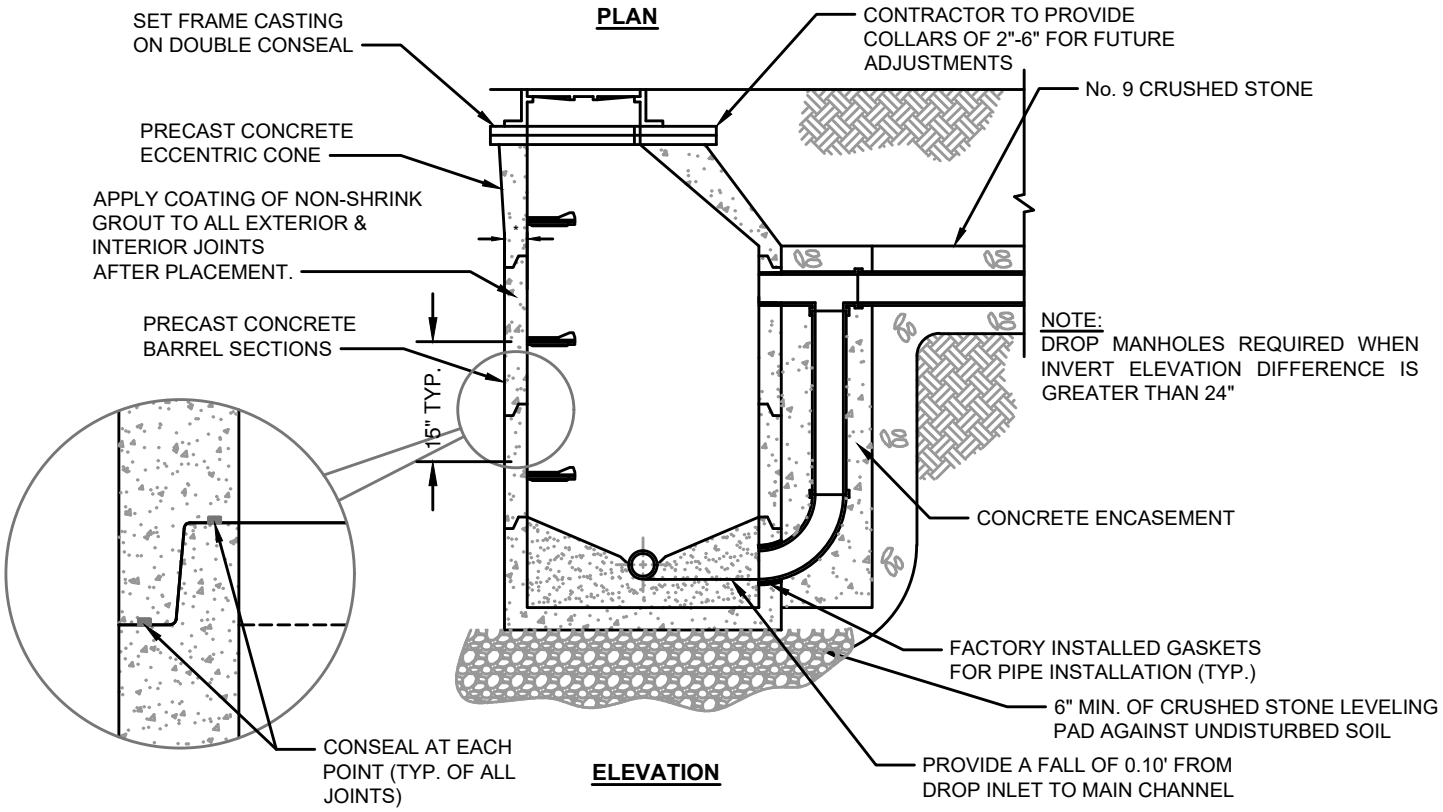
Date	07/23/2021
Revision Date	01/14/2022
Dwg. No.	SS-002

MANHOLE DIAMETERS			
SEWER MAIN SIZE (INCHES)	48" Ø	60" Ø	72" Ø
< 12	YES	MAYBE	MAYBE
12<X<18	NO	YES	MAYBE
X>18	NO	NO	YES

NOTE:
ALL PRECAST CONCRETE SHALL BE 4,000 PSI

* PRECAST CONCRETE MANHOLE WALL THICKNESS: 5" FOR 4' Ø MANHOLES, 6" FOR 5' Ø MANHOLES & 7" FOR 6' Ø MANHOLES





PRECAST CONCRETE DROP MANHOLE - DETAIL

NOT TO SCALE

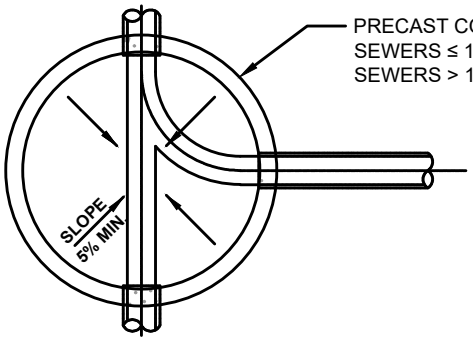
MOREHEAD UTILITY PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

GRAVITY SANITARY SEWER STANDARD DETAIL
PRECAST CONCRETE DROP MANHOLE

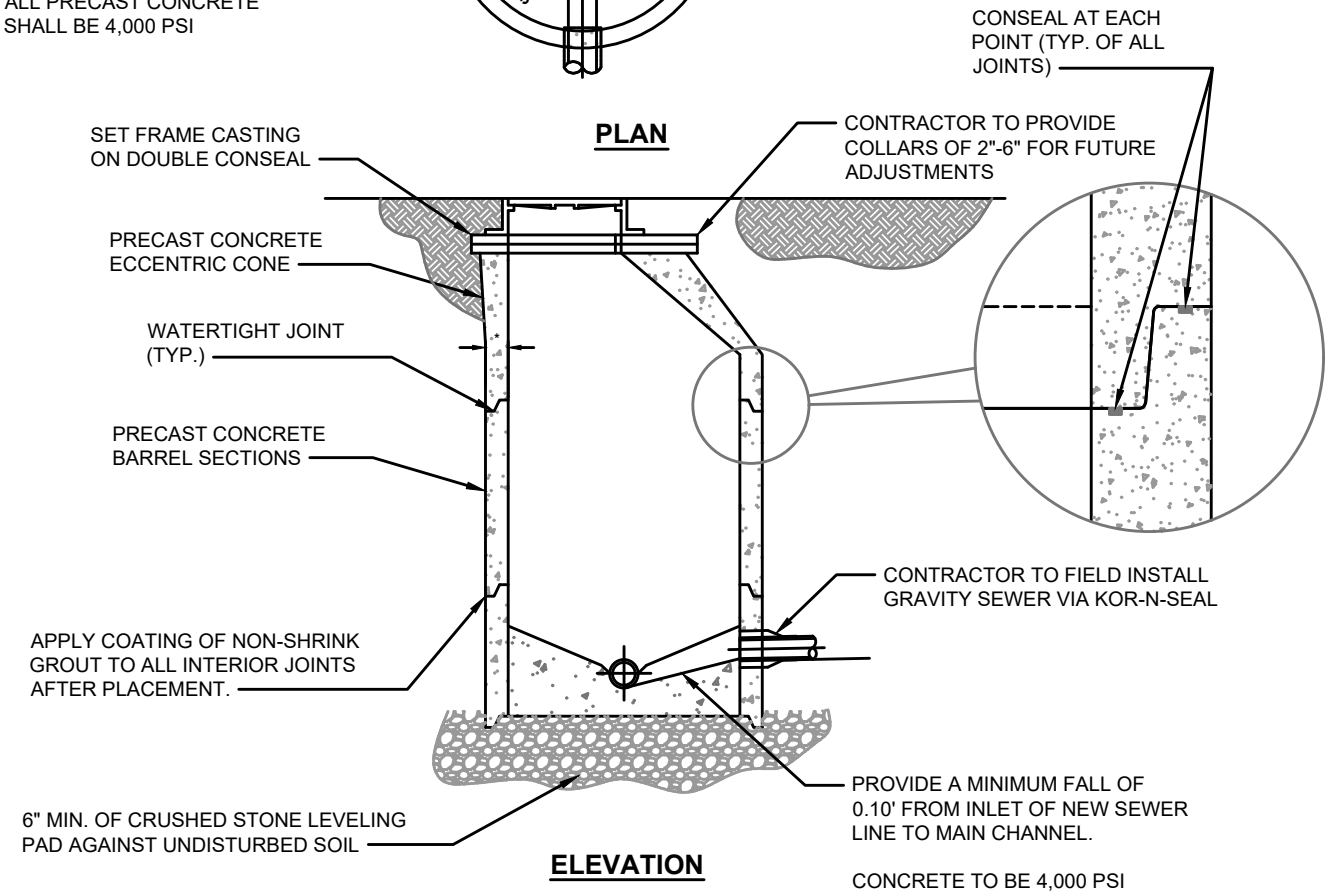
Date	07/23/2021
Revision Date	01/14/2022
Dwg. No.	SS-003

MANHOLE DIAMETERS			
SEWER MAIN SIZE (INCHES)	48" Ø	60" Ø	72" Ø
<= 12	YES	MAYBE	MAYBE
12>X<=18	NO	YES	MAYBE
X>18	NO	NO	YES

* PRECAST CONCRETE MANHOLE WALL THICKNESS: 5" FOR 4' Ø MANHOLES, 6" FOR 5' Ø MANHOLES & 7" FOR 6' Ø MANHOLES



NOTE:
ALL PRECAST CONCRETE SHALL BE 4,000 PSI



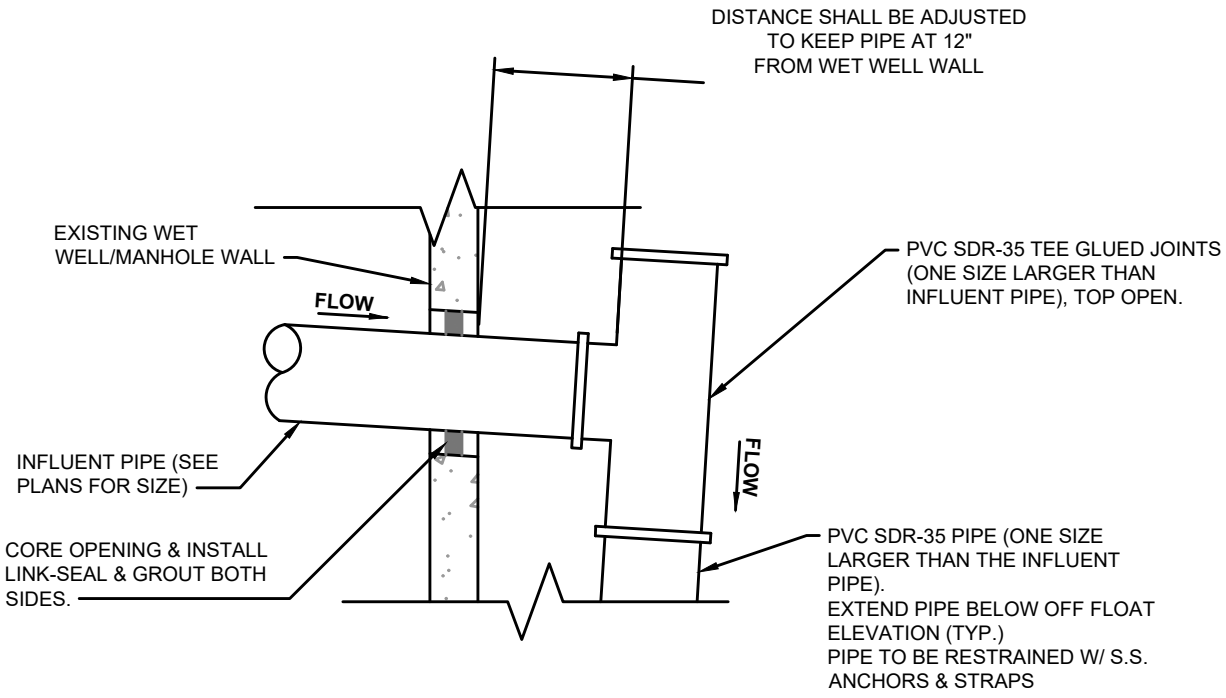
PRECAST CONCRETE "DOGHOUSE" MANHOLE - DETAIL

NOT TO SCALE

MOREHEAD UTILITY PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

GRAVITY SANITARY SEWER STANDARD DETAIL
PRECAST CONCRETE "DOGHOUSE" MANHOLE

Date	07/23/2021
Revision Date	01/14/2022
Dwg. No.	SS-004



INLET PIPE FOR EXISTING STRUCTURE - DETAIL

NOT TO SCALE

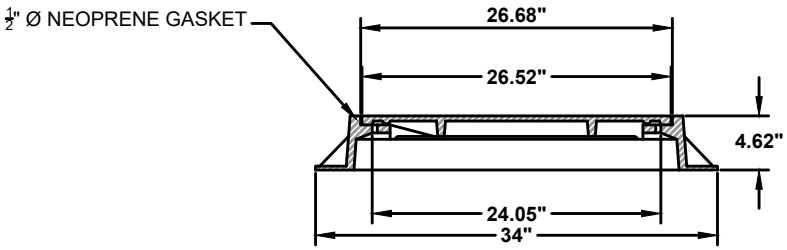
MOREHEAD UTILITY
PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

GRAVITY SANITARY SEWER STANDARD DETAIL
INLET PIPE FOR EXISTING STRUCTURE

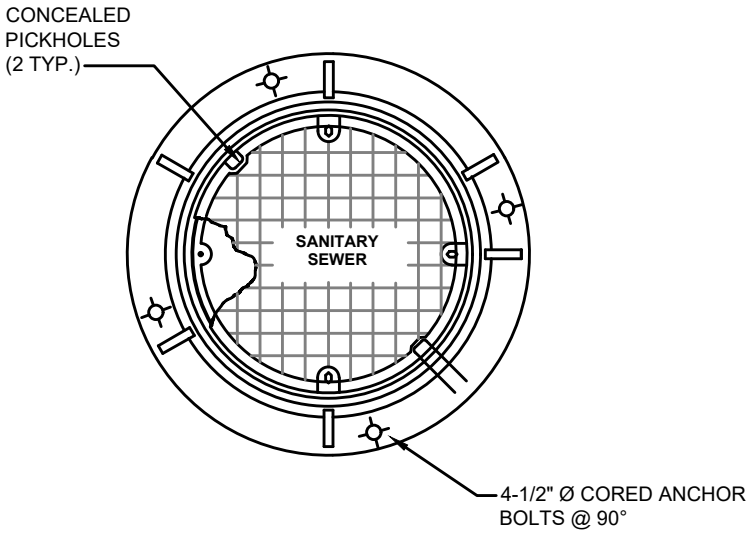
Date	07/23/2021
Revision Date	01/141/2021
Dwg. No.	SS-005

DETAIL NOTE:

1. MANHOLE LID & FRAME SHALL BE CAP ONE - 24 OR ENGINEERING APPROVED EQUAL
2. ALL MANHOLE LIDS SHALL BE WATERTIGHT, WITHIN FLOOD PLAIN
3. LIDS & FRAME SHALL BE COMPOSITE MATERIAL.
4. COMPOSITE MANHOLE LID & FRAME REQUIRED AT THE TWO CLOSEST MANHOLES TO A LIFT STATION.



ELEVATION



PLAN

COMPOSITE MANHOLE LID & FRAME - DETAIL

NOT TO SCALE

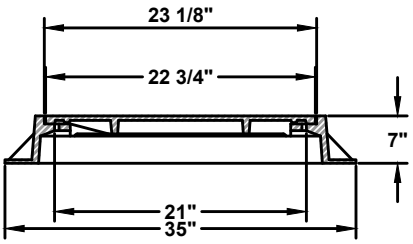
MOREHEAD UTILITY PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

GRAVITY SANITARY SEWER STANDARD DETAIL
COMPOSITE MANHOLE LID & FRAME

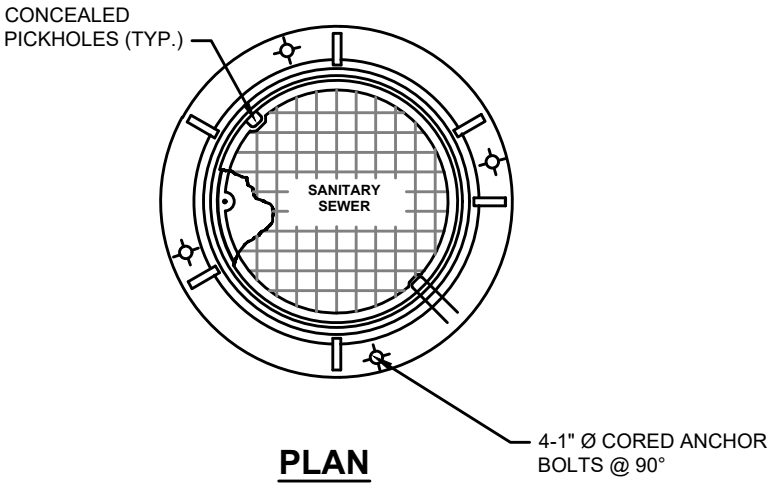
Date	07/23/2021
Revision Date	01/14/2022
Dwg. No.	SS-006

DETAIL NOTE:

1. MANHOLE LID & FRAME SHALL BE J.R. HOE MC 350 OR ENGINEERING APPROVED EQUAL



ELEVATION



PLAN

STANDARD MANHOLE LID & FRAME - DETAIL

NOT TO SCALE

MOREHEAD UTILITY
PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

GRAVITY SANITARY SEWER STANDARD DETAIL
STANDARD MANHOLE LID & FRAME

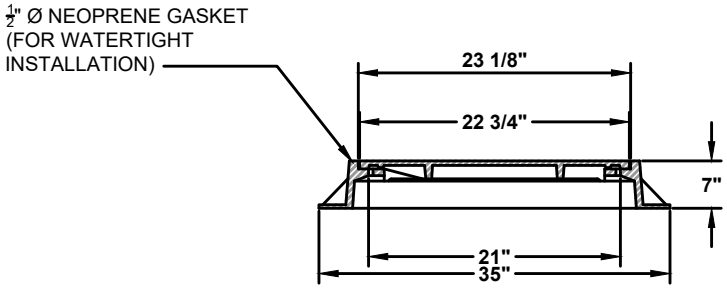
Date
07/23/2021

Revision Date
01/14/2022

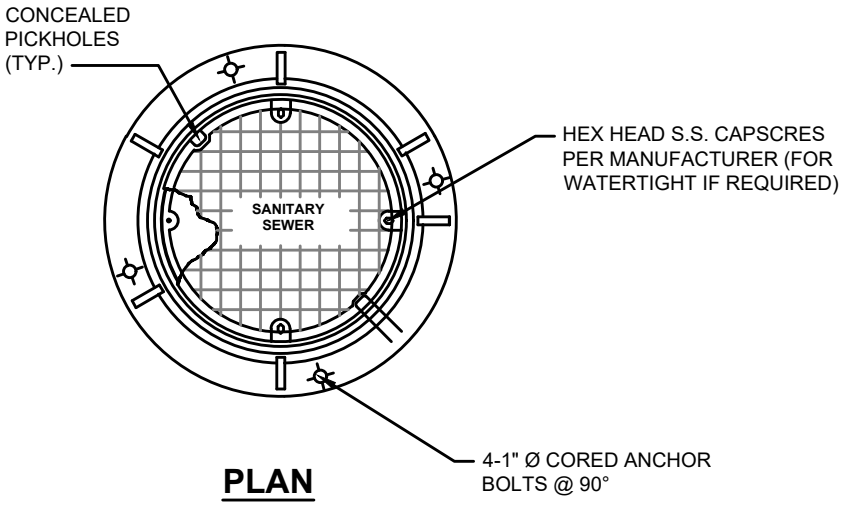
Dwg. No.
SS-007

DETAIL NOTE:

1. MANHOLE LID & FRAME SHALL BE J.R. HOE MC 350 OR ENGINEERING APPROVED EQUAL
2. ALL MANHOLE LIDS SHALL BE WATERTIGHT, WITHIN FLOOD PLAIN.



ELEVATION



PLAN

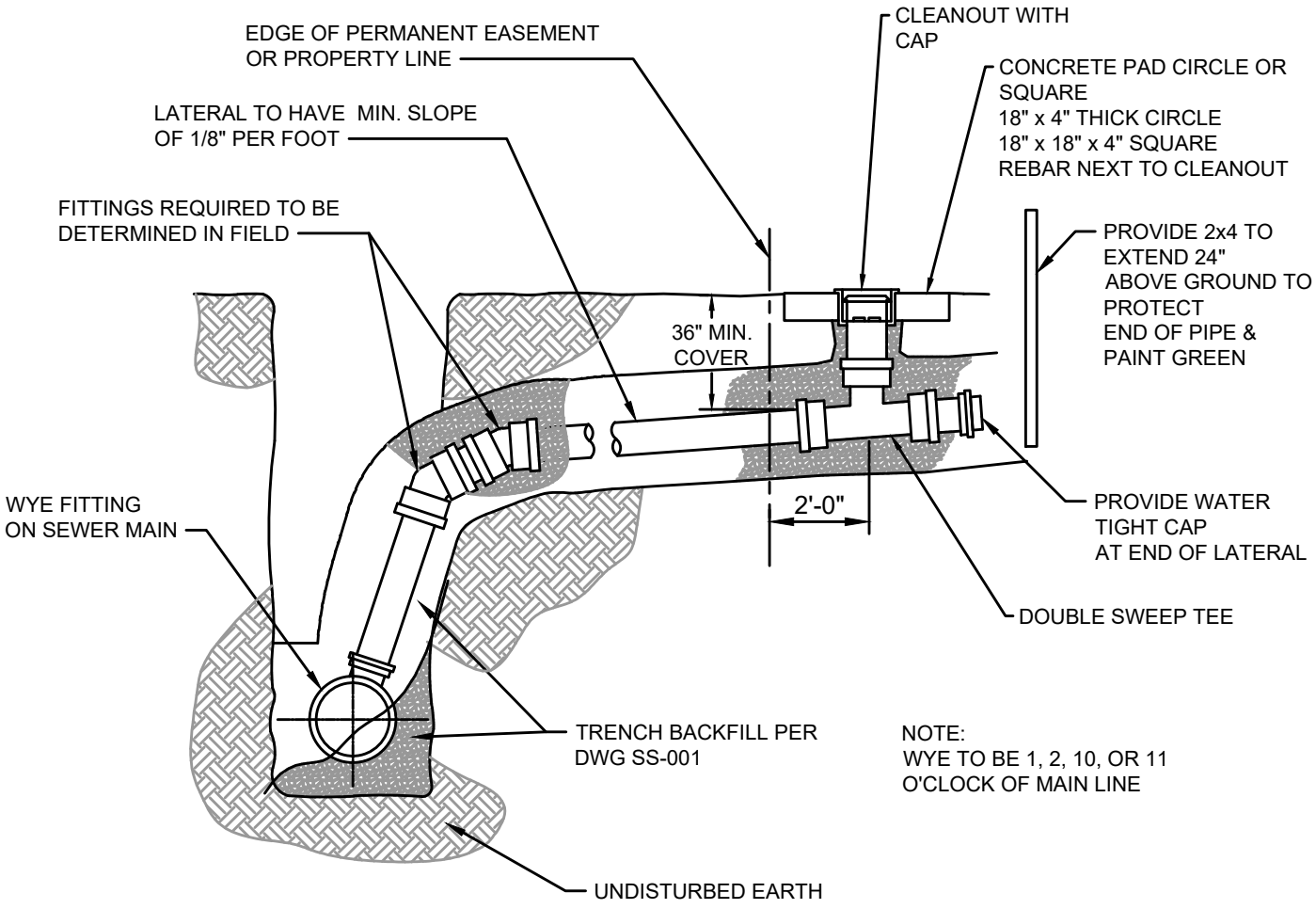
STANDARD WATERTIGHT MANHOLE LID & FRAME - DETAIL

NOT TO SCALE

MOREHEAD UTILITY PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

GRAVITY SANITARY SEWER STANDARD DETAIL
STANDARD WATERTIGHT MANHOLE LID & FRAME

Date	07/23/2021
Revision Date	01/14/2022
Dwg. No.	SS-008



LATERAL CONNECTION GRAVITY SEWER & LATERAL CLEANOUT - DETAIL

NOT TO SCALE

MOREHEAD UTILITY
PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

GRAVITY SANITARY SEWER STANDARD DETAIL
LATERAL CONNECTION GRAVITY SEWER &
LATERAL CLEANOUT

Date	02/03/2021
Revision Date	01/14/2022
Dwg. No.	SS-010

NOTES:

1. THE RUBBER SLEEVE IS AVAILABLE IN BOTH A 8.5" WIDE DOUBLE PLEATED AND A 10" WIDE TRIPLE PLEATED CROSS SECTION. THE SAME EXPANSION BANDS AND EXTENSIONS ARE USED FOR BOTH.

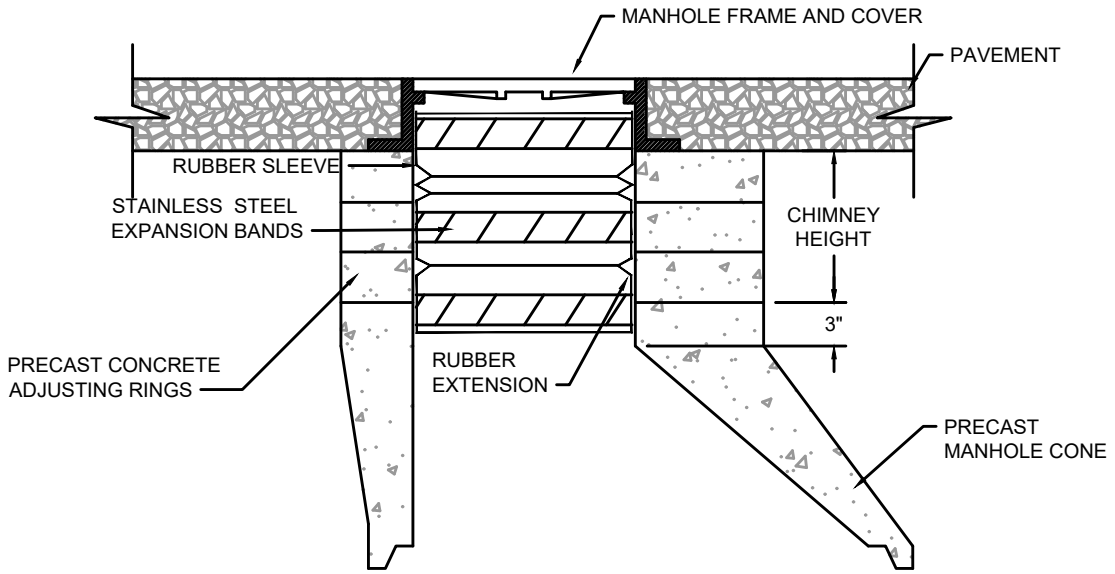
2. SEE CHIMNEY HEIGHT TABLE FOR SEAL AND EXTENSION COMBINATIONS NEEDED TO SPAN FROM THE FRAME TO THE TOP OF THE CONE ON MANHOLES WITH VARIOUS CHIMNEY HEIGHTS. FRAME OFFSETS OR DIAMETER DIFFERENTIALS WILL REDUCE THESE SPAN HEIGHTS.

3. THE TOP OF THE CONE MUST HAVE A MINIMUM 3" HIGH VERTICAL SURFACE THAT IS SMOOTH AND FREE OF ANY FORM OFFSETS OR EXCESSIVE HONEYCOMB. IF A 3" HIGH VERTICAL SURFACE IS NOT AVAILABLE DUE TO THE EXISTING CONFIGURATION OF THE EXISTING MANHOLE CONE, ONE MAY BE CREATED USING A CONE DISK FORM AND A NON SHRINK PATCHING MORTAR.

4. CHIMNEY SEAL SHALL BE AS MANUFACTURED BY CRETEX

CHIMNEY HEIGHT TABLE

CONBINATIONS OF SEALS & EXTENSIONS	TO SPAN HEIGHTS OF:	
	W/STANDARD SEAL	W/WIDE SEAL
SEAL ONLY	0 - 4.5"	2" - 7.5"
SEAL + 7" EXTENSION	OVER 4.5" - 10.5"	OVER 7.5" - 13.5"
SEAL + 10" EXTENSION	OVER 10.5" - 13"	OVER 13.5" - 16"
SEAL + MULT. EXTENSIONS	OVER 13"	OVER 16"
ADD 6" OF COVERAGE FOR EACH ADDITIONAL 7" EXTENSION ADD 8.5" OF COVERAGE FOR EACH ADDITIONAL 10" EXTENSION		



CHIMNEY SEAL - DETAIL

NOT TO SCALE

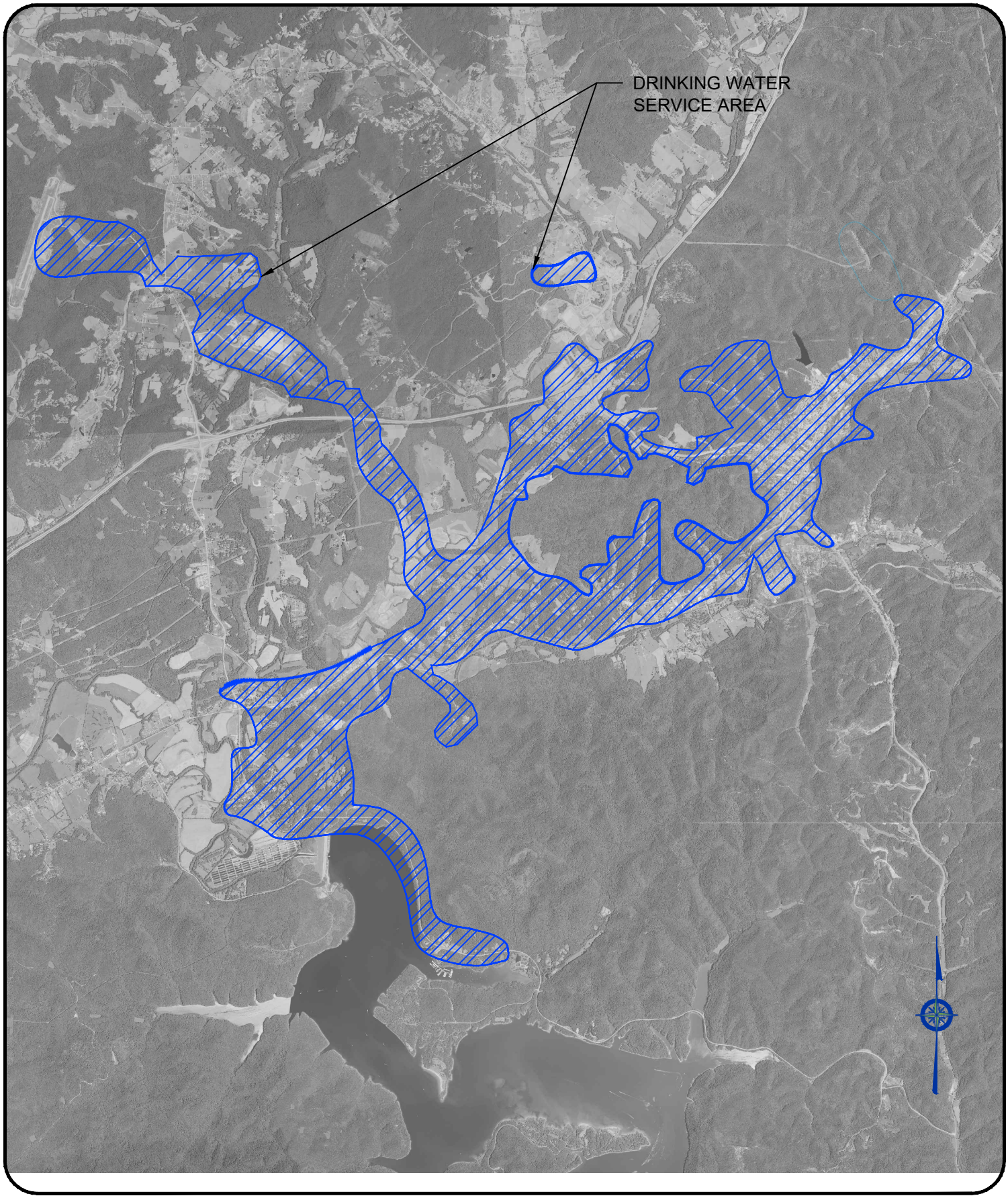
MOREHEAD UTILITY PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

GRAVITY SANITARY SEWER STANDARD DETAIL
CHIMNEY SEAL

Date 02/03/2021
Revision Date 01/14/2022
Dwg. No. SS-011

APPENDIX D

SERVICE AREAS



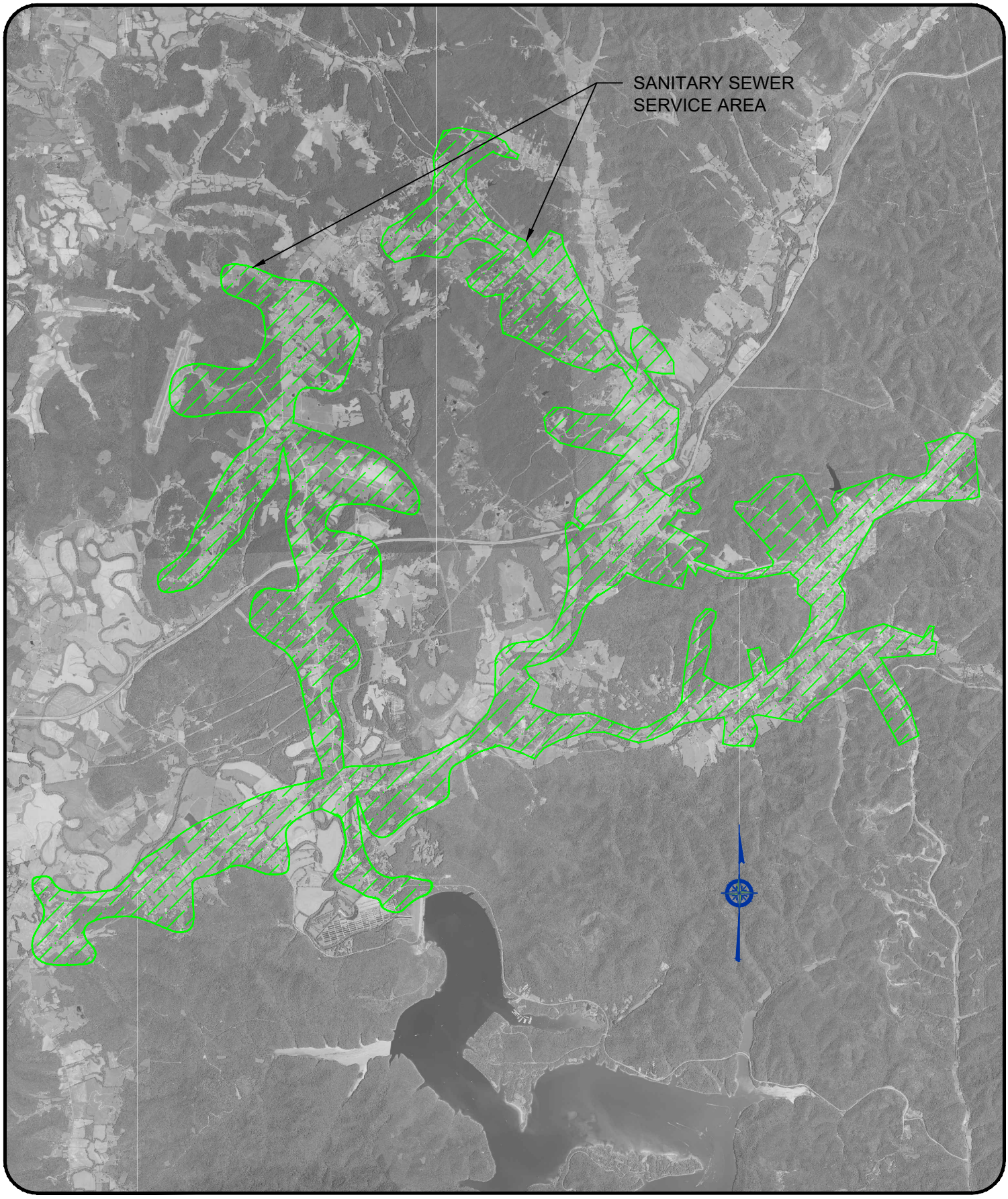
MOREHEAD UTILITY
PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

MUPB DRINKING WATER
SERVICE AREA

Date
07/21/2021

Revision Date
xx/xx/xxxx

Dwg. No.
D-001



MOREHEAD UTILITY
PLANT BOARD
135 SOUTH WILSON AVE.
MOREHEAD, KY 40351

MUPB SANITARY SEWER
SERVICE AREA

Date 07/21/2021
Revision Date xx/xx/xxxx
Dwg. No. D-002

APPENDIX E

RATE SCHEDULES

APPENDIX E: RATE SCHEDULES

DEVELOPMENT PLAN REVIEW

$150 for ALL Development Plans

DESIGN OF WATER FACILITIES – HYDRAULIC MODELING

EXTENSION LENGTH (Total Footage)	FEE
Small Extension (<1,000 Total LF)	$ 1,000
Medium Extension (1,001 to 5,000 Total LF)	$ 2,000
Large Extension (> 5,001 Total LF)	$ TBD

DESIGN OF BOOSTER PUMP STATION – HYDRAULIC MODELING

DEVELOPMENT SIZE (# of Lots)	FEE
Small Development (<5 lots)	$ 1,500
Medium Development (6 to 20 Lots)	$ 2,500
Large Development (> 20 lots)	$ TBD

DESIGN OF LOW-PRESSURE SEWER SYSTEM – HYDRAULIC MODELING

DEVELOPMENT SIZE (# of Lots)	FEE
Small Development (<5 lots)	$ 1,500
Medium Development (6 to 20 Lots)	$ 2,500
Large Development (> 20 lots)	$ TBD

DESIGN OF FORCE MAIN & LIFT STATION – HYDRAULIC MODELING

EXTENSION LENGTH (Total Footage)	FEE
Small Extension (<1,000 Total LF)	$ 1,000
Medium Extension (1,001 to 5,000 Total LF)	$ 2,000
Large Extension (> 5,001 Total LF)	$ TBD

APPENDIX F

CONSTRUCTION PLAN CHECKLIST

Checklist for Construction Plans

PROJECT NAME:_____ ID#_____

Note: This checklist is provided for the convenience of design firms, so that the most common errors and omissions may be avoided. Refer to MUPB's DESIGN and CONSTRUCTION MANUAL for MUPB UTILITIES for complete discussion of design requirements and parameters. ***PLEASE DO NOT INCLUDE THIS FORM WITH YOUR APPLICATION.***

DATES: 1st Sub._____ 2nd Sub. _____ 3rd Sub. _____

Cover Sheet and General	**1st sub.**	**2nd sub.**	**3rd sub.**
MUPB Project ID	Blank		
Engineer's Seal, Signiture and Date			
Accurate Sheet Index			
MUPB revision block, every applicable sheet			
MUPB Standard Notes & Details			
MUPB Standard Details included in plan set			
Standard Details provided are current			
Design follows applicable basis of design, preliminary plat, and/or master plans			
Facilities sized correctly			
Existing conditions and utilities shown			
Coordinate system and vertical datum identified			
CAD files for use in MUPB GIS	Required	Revisions Only	
Plan View - General	**1st sub.**	**2nd sub.**	**3rd sub.**
North arrow			
Adequate separation between water and sanitary sewer, and with other utilities			
Pipes a minimum 10' from all permanent structures			
Service connection for each building (water, sewer, storm water or gas)			
Easements shown for utilities outside of public right of way			
Easements unencumbered and accessable for traverse			
Landscaping outside of easements			
Access to utilities provided to adjoining properties			

Water - Plan View	**1st sub.**	**2nd sub.**	**3rd sub.**
Separation from sewer, curb, drains, and structures			
Dead-end line less than 500' for 8" and larger, 300' for 6"			
Adequate hydrant coverage to all structures			
All permanent terminations by means of a hydrant			
Air release valves specified at significant high points			
Hydrants at appropriate spacing and at substantial high and low points			
Tee, valve and blow-off assembly provided where future extension needed			
Valve between service connection and blow-off valve in temporary termination			
Valving at appropriate intervals and configurations			
Fire service independent with anchored branch valve (6" min.) at main			
Meter pits 5' from driveway apron and fire hydrants			
Load letter and meter sizing; coordinate plumbing concerns			

Sewer - Plan View	**1st sub.**	**2nd sub.**	**3rd sub.**
Manhole placement conforms with placement requirement			
Manholes provided where future extension are planned or anticipated			
Minimum of 90° between inlet and outlet pipes at manhole(s)			
Manholes placed according to maximum length per pipe diameter			
Adequate angle to provide separation between pipe penetrations at manhole			

Sewer - Profile View	1st sub.	2nd sub.	3rd sub.
All invert pipe information shown for each manhole			
Invert elevation of existing sewer based upon field survey			
Length, slope & diameter of sewer shown, matching plan view			
Minimum slopes provided based upon pipe diameter			
Cover on pipe per requirements			
Proper cover and type of creek crossing(s)			
Drop across manholes as required			
Maximum invert difference at manhole is less than 0.5 foot			
Rim elevation is at minimum of 1 foot above undeveloped land			
Water-tight manhole frame & lid in areas below 100 year flood elevation			
Vents provided were necessary			
Lining of manholes specified where necessary			
Specify type of pipe for existing & proposed sewers			
Diameter of manholes specified			

Sanitary Laterals	1st sub.	2nd sub.	3rd sub.
Laterals enter sewer at 90° & from 10 o'clock to 2 o'clock			
Laterals end 1 foot beyond easement or R-O-W			
Cleanout provided at termination of lateral			
Pretreatment devices specified per requirements			

APPENDIX G

WATER FACILITIES HYDRAULIC MODEL

Hydraulic Model Results and Data Summary

Project Name: _____ Date: _____

MUPB Project ID#: _____ Model Preparer Name: _____

or Preliminary Plan # _____ Preparer Email: _____

Software Package/Version used: _____ Model Iteration/Submission #: _____

Hydraulic modeling method used: _____ (e.g. steady state (default), extended, manual, etc.)

Description of Project:

Approx LF of proposed mains:

_____ <= 6"
_____ 8"
_____ 12"
_____ 16"
_____ >= 24"

Source of Demands: (Place "X" which applies)

_____ Using ERU unit rates and Ex. Zoning and Ex. uses
_____ Other: (explain in box below, e.g. rezoning, special demand, ...)

*Attach project Demands table with phasing as Attachment A with a map depicting node labels.

Model Start Point: (Place "X" which applies and explain in text box)

_____ Existing constructed main utilizing minimum Zone HGL as start condition. In box below, list the Zone, reservoir, and Low HGL assumed and the source of this data. [Default modeling basis]

_____ Existing Main with Two-Point Flow Test generated pump curve. In box below, list fire flow test number, date of test, static, residual and flow. Provide the model produced pump curve as Attachment B. [Alternate modeling basis, only as approved by MUPB]

_____ Extension from other existing modeled point. In box below, list the name and approval date of that existing model and other pertinent information. [Only as approved by MUPB]

Explanation / Detail of selection made above:

Hydraulic Model Results and Data Summary

Project Name: _____ Date: _____

MUPB Project ID#: _____ Model Preparer Name: _____

or Preliminary Plan # _____ Preparer Email: _____

Software Package/Version used: _____ Model Iteration/Submission #: _____

Hydraulic modeling method used: _____ (e.g. steady state (default), extended, manual, etc.)

Scenario Description:

Describe each "Parent" scenario below and the purpose of each scenario in the model. Single phase developments will generally have a basic model with one parent scenario and "child" scenarios for avg, max, peak and max+fire. Multi-phased developments will have multiple parent scenarios corresponding to each phase of project. Very complex or complicated models should have separate attachments with details as appropriate. Please note that only one water source (reservoir) is permitted, except where allowed by MUPB.

Scenario Name:	Description / Purpose / Phasing / Interim Condition
Scenario 1 ----------	
Scenario 2 ----------	
Scenario 3 ----------	
Scenario 4 ----------	
Scenario 5 ----------	
Scenario 6 ----------	

Scenario Results:

Each parent scenario generally will have critical node(s) (i.e. node with the lowest pressure in system/zone, node at the highest elevation, node at most distant location from the source, at important locations of demand). Max+Fire should indicate the node at which minimum available fire flow was determined and then which node was the resultant critical pressure node (which could be the same node). Repeat this page for models with more than six scenarios.

Hydraulic Model Results and Data Summary

Project Name: _____ Date: _____

MUPB Project ID#: _____ Model Preparer Name: _____

or Preliminary Plan # _____ Preparer Email: _____

Software Package/Version used: _____ Model Iteration/Submission #: _____

Hydraulic modeling method used: _____ (e.g. steady state (default), extended, manual, etc.)

		Scenario Name					
		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Max Day + Fire	Fire Flow Node Name:						
	Fire Flow Available gpm						
	Critical Node #1 Name:						
	Critical Node #1 Description:						
	Residual Pressure: psi						
	Demand at node: gpm						
	Node elevation: ft						
	Critical Node #2 Name:						
	Critical Node #2 Description:						
	Residual Pressure: psi						
	Demand at node: gpm						
	Node elevation: ft						
	Critical Node #3 Name:						
	Critical Node #3 Description:						
	Residual Pressure: psi						
	Demand at node: gpm						
	Node elevation: ft						
	Critical Node #4 Name:						
	Critical Node #4 Description:						
	Residual Pressure: psi						
	Demand at node: gpm						
	Node elevation: ft						

Closing Statement:

Submitter should provide any appropriate closing statement here, such as opinion of adequate pressure, flow, fire flow, meeting EDM criteria or other pertinent closing information.

APPENDIX H

LPS HYDRAULIC MODEL

Low Pressure Sewer
Hydraulic Model Results and Data Summary

Project Name: _____ Date: _____

MUPB Project ID#: _____ Model Preparer Name: _____

or Preliminary Plan # _____ Preparer Email: _____

Software used: _____ Model Iteration/Submission #: _____

Hydraulic modeling method used: _____ (e.g. Rational (default) or Probability, etc.)

Description of Project:

Approx LF of force mains:

_____ <= 2"
_____ 3"
_____ 4"
_____ 6"
_____ >= 8"

Pump Make & Model: _____

_____ Total number of individual grinder pumps
_____ Number of grinder pumps operating simultaneously

Low-Pressure Force Main Connection Point: (Place "X" which applies and explain in text box)

_____ Existing manhole & gravity sewer line.

_____ Existing Wet Well. Name lift station ( )

_____ Connection to existing force main. This option requires the hydraulic model to include all connected lift stations, grinder pumps and force main diameters.

Explanation / Detail of selection made above:

Low Pressure Sewer
Hydraulic Model Results and Data Summary

Project Name: _____ Date: _____

MUPB Project ID#: _____ Model Preparer Name: _____

or Preliminary Plan # _____ Preparer Email: _____

Software used: _____ Model Iteration/Submission #: _____

Hydraulic modeling method used: _____ (e.g. Rational (default) or Probability, etc.)

Scenario Description:

Describe each Scenario below and the purpose of each scenario in the model. Single phase developments will generally have a basic model with one Scenario and "Run(s)" to achieve flushing velocity for branch line(s). Multi-phased developments will have multiple parent scenarios corresponding to each phase of project. Multi-phased developments must include all phases for force main sizing. Very complex or complicated models should have separate attachments with details as appropriate.

Scenario Name:	Description / Purpose / Phasing / Interim Condition
Scenario 1 ----------	
Scenario 2 ----------	
Scenario 3 ----------	
Scenario 4 ----------	
Scenario 5 ----------	
Scenario 6 ----------	

Low Pressure Sewer
Hydraulic Model Results and Data Summary

Project Name: _____ Date: _____

MUPB Project ID#: _____ Model Preparer Name: _____

or Preliminary Plan # _____ Preparer Email: _____

Software used: _____ Model Iteration/Submission #: _____

Hydraulic modeling method used: _____ (e.g. Rational (default) or Probability, etc.)

Scenario Pipe Results:

Each Scenario generally will have critical pipe(s) (i.e. pipe(s) downstream of diameter changes, pipe(s) downstream of branch lines, etc.) Expand the table for model as required. Pipe name(s), pipe diameter(s) and force main velocity to be entered based upon hydraulic analysis results, provide pipe network with pipe & node labels.

Pipe Name	Pipe Size	Force Main Velocity				
		Scenario #1A	Scenario #1B	Scenario #1C	Scenario #1D	Maximum Velocity
	(inches)	(fps)	(fps)	(fps)	(fps)	
						0.00
						0.00
						0.00
						0.00
						0.00
						0.00
						0.00
						0.00
						0.00
						0.00
						0.00
						0.00
						0.00
						0.00
						0.00
						0.00
						0.00

Low Pressure Sewer
Hydraulic Model Results and Data Summary

Project Name: _____ Date: _____

MUPB Project ID#: _____ Model Preparer Name: _____

or Preliminary Plan # _____ Preparer Email: _____

Software used: _____ Model Iteration/Submission #: _____

Hydraulic modeling method used: _____ (e.g. Rational (default) or Probability, etc.)

Scenario Pump Results:

Each Scenario generally will have critical pipe(s) (i.e. pipe(s) downstream of diameter changes, pipe(s) downstream of branch lines, etc.) Expand the table for model as required. Pipe name(s), pipe diameter(s) and force main velocity to be entered based upon hydraulic analysis results, provide pipe network with pipe & node labels.

Lot Number	Pump Elevation	Grinder Pump Flow Rate (gpm)			
		Scenario #1A	Scenario #1B	Scenario #1C	Scenario #1D

Closing Statement:

Submitter should provide any appropriate closing statement here, such as opinion of adequate velocity, force main diameter(s) and grinder pump selections.

APPENDIX I

LIFT STATION REQUEST

APPENDIX J

SANITARY SEWER FACILITIES HYDRAULIC MODEL

Sanitary Sewer
Hydraulic Model Results and Data Summary

Project Name: _____ Date: _____

MUPB Project ID#: _____ Model Preparer Name: _____

or Preliminary Plan # _____ Preparer Email: _____

Software used: _____ Model Iteration/Submission #: _____

Hydraulic modeling method used: _____ (e.g. Rational (default) or Probability, etc.)

Description of Project:

Approx LF of force mains:

_____ <= 2"
_____ 3"
_____ 4"
_____ 6"
_____ >= 8"

Pump Make & Model: _____

_____ Total number of individual grinder pumps
_____ Number of grinder pumps operating simultaneously

Force Main Connection Point: (Place "X" which applies and explain in text box)

_____ Existing manhole & gravity sewer line.

_____ Existing Wet Well. Name lift station ( )

_____ Connection to existing force main. This option requires the hydraulic model to include all connected lift stations, grinder pumps and force main diameters.

Explanation / Detail of selection made above:

Sanitary Sewer
Hydraulic Model Results and Data Summary

Project Name: _____ Date: _____

MUPB Project ID#: _____ Model Preparer Name: _____

or Preliminary Plan # _____ Preparer Email: _____

Software used: _____ Model Iteration/Submission #: _____

Hydraulic modeling method used: _____ (e.g. Rational (default) or Probability, etc.)

Scenario Description:

Describe each Scenario below and the purpose of each scenario in the model. Lift Stations that discharge to existing manhole or wet well will generally have a basic model with one Scenario and "Run(s)" to provide velocities for pump #1, pump #2 and both pumps operating with water level of wet well at off elevation and at alarm elevation. Lift Stations that will discharge to existing force main will have multiple parent scenarios corresponding to the complexity of pressurized portion of the collection system. Very complex or complicated models should have separate attachments with details as appropriate.

Scenario Name:	Description / Purpose / Phasing / Interim Condition
Scenario 1 ----------	
Scenario 2 ----------	
Scenario 3 ----------	
Scenario 4 ----------	
Scenario 5 ----------	
Scenario 6 ----------	

Sanitary Sewer
Hydraulic Model Results and Data Summary

Project Name: _____ Date: _____

MUPB Project ID#: _____ Model Preparer Name: _____

or Preliminary Plan # _____ Preparer Email: _____

Software used: _____ Model Iteration/Submission #: _____

Hydraulic modeling method used: _____ (e.g. Rational (default) or Probability, etc.)

Scenario Pipe Results:

Each Scenario generally will have critical pipe(s) (i.e. pipe(s) downstream of diameter changes, pipe(s) downstream of branch lines, etc.) Expand the table for model as required. Pipe name(s), pipe diameter(s) and force main velocity to be entered based upon hydraulic analysis results, provide pipe network with pipe & node labels.

Pipe Name	Pipe Size	Force Main Velocity				
		Scenario #1A	Scenario #1B	Scenario #1C	Scenario #1D	Maximum Velocity
	(inches)	(fps)	(fps)	(fps)	(fps)	
						0.00
						0.00
						0.00
						0.00
						0.00
						0.00
						0.00
						0.00
						0.00
						0.00
						0.00
						0.00
						0.00
						0.00
						0.00
						0.00

Sanitary Sewer
Hydraulic Model Results and Data Summary

Project Name: _____ Date: _____

MUPB Project ID#: _____ Model Preparer Name: _____

or Preliminary Plan # _____ Preparer Email: _____

Software used: _____ Model Iteration/Submission #: _____

Hydraulic modeling method used: _____ (e.g. Rational (default) or Probability, etc.)

Scenario Pump Results:

Each Scenario generally will have critical pipe(s) (i.e. pipe(s) downstream of diameter changes, pipe(s) downstream of branch lines, etc.) Expand the table for model as required. Pipe name(s), pipe diameter(s) and force main velocity to be entered based upon hydraulic analysis results, provide pipe network with pipe & node labels.

Lift Station Name	Pump Elevation			Pump Flow Rate (gpm)			
	GR. Elev.	LWL EL.	Alarm EL.	Scenario #1A	Scenario #1B	Scenario #1C	Scenario #1D

Closing Statement:

Submitter should provide any appropriate closing statement here, such as opinion of adequate velocity, force main diameter(s) and grinder pump selections.

APPENDIX K

SPARE PART LIST

APPENDIX K: MUPB MATERIAL MANUFACTURERS

K.1. WATER FACILITIES

MATERIAL/ITEM	APPROVED MANUFACTURER
Air Release Valve	ARI or Engineer Approved Equal
Aluminum Hatch	Halliday, BILCO or Engineer Approved Equal
Precast Meter Vault	Old Cast, Sherman Dixie or Engineer Approved Equal
Solid Cooper Tracing Wire 12 AWG w. 30 MIL HDPE Insulation	State Origin or Engineer Approved Equal
Customer Individual Pressure Reducing Valve	Watts or Engineer Approved Equal
Customer Meter	Badger M25, M70, M170, M120 or Engineer Approved Equal
Customer Meter Box & Cover	
Customer Meter Resetter	Ford or Engineer Approved Equal
Customer Meter Tandem Setter	Ford, AY McDonald or Engineer Approved Equal
Double Strap Service Saddles for DI Pipe	Ford F202 or Engineer Approved Equal
Dual Disc Check Valve	N/A
Fire Hydrant Assembly w/Flexible Tee	American-Darling, Kennedy or Engineer Approved Equal
Yard Hydrant	Woodford X34 or Engineer Approved Equal
Full Circle Repair Clamps (all stainless steel)	Mueller, Smith & Blair, Ford, Powerseal, Cascade or Engineer Approved Equal
Grip Rings	Star or Engineer Approved Equal
Gate Valves	Mueller Resilient Seat or Engineer Approved Equal
Mainline Pressure Reducing Valve	Bermad or Engineer Aprroved Equal
Pipeline Marking Posts	
Master Meter	Badger or Engineer Approved Equal
MJ Fittings Compact/Full Body MJ Packs	McWayne (Tyler/Union, Clow), Griffin, US Pipe, American DI Pipe or Engineer Approved Equal
Pressure Gauges	

MATERIAL/ITEM	APPROVED MANUFACTURER
Restraint Joint Collar Fittings	Mueller, McWayne, Ford, EBBA or Engineer Approved Equal
Service Tubing – Polyethylene Tubing (CTS Service Tubing)	ENDOT Blue 250 psi or Engineer Approved Equal
Tapping Valves and SS Sleeves w/SS bolts	Mueller, Ford or Engineer Approved Equal
Telemetry	MicroComm
Underground Detectable Tape	State Origin or Engineer Approved Equal

K.2 GRAVITY SANITARY SEWER

MATERIAL/ITEM	APPROVED MANUFACTURER
Precast Manholes	Old Cast, Sherman Dixie or Engineer Approved Equal
Cast Iron Manhole Lids & Frames	J.R. Hoe & Son or Engineer Approved Equal
Composite Manhole Lids & Frames	CAPone or Engineer Approved Equal
Cast Iron Water Tight Manhole Lids & Frames	Tigre, Charlotte Pipe or Engineer Approved Equal
PVC Cleanout Cap	Mueller, Ford or Engineer Approved Equal
Pipe Manhole Connects	Kor-n-seal or Engineer Approved Equal
Manhole Lid Inflow Inserts	Marlex HXM or Engineer Approved Equal
Casing Spacers	Advance Product or Engineer Approved Equal
Manhole Chimney Seals	Cretex or Engineer Approved Equal

K.3. PRESSURE SANITARY SEWER

MATERIAL/ITEM	APPROVED MANUFACTURER
Combination Air Release Valve	ARI or Engineer Approved Equal
Aluminum Hatch	Halliday, BILCO or Engineer Approved Equal
Precast Valve Vaults	Old Cast, Sherman Dixie or Engineer Approved Equal
Precast Concrete Wet Wells	Old Cast, Sherman Dixie or Engineer Approved Equal
Fiberglass Wet Well	
Cast Iron Manhole Lids & Frames	J.R. Hoe & Son or Engineer Approved Equal

MATERIAL/ITEM	APPROVED MANUFACTURER
Composite Manhole Lids & Frames	CAPone or Engineer Approved Equal
Cast Iron Water Tight Manhole Lids & Frames	Tigre, Charlotte Pipe or Engineer Approved Equal
DI Check Valve Flanged	Mueller, Ford or Engineer Approved Equal
DI Plug Valve Flanged or MJ	
Pressure Gauges	
Pressure Transducer	
Residential Grinder Pumps	Liberty or Engineer Approved Equal