CITY OF THREE FORKS

Standards for Design and Construction

City of Three Forks
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1.0 Introduction

1.1 Purpose

The City of Three Forks Standards for Design and Construction (STANDARDS) establish the requirements for design criteria, methods, processes, and practices relating to public infrastructure improvements in Three Forks. The primary goal of technical design standards is to establish uniformity in methods and materials and reduce uncertainty in planning, design, and constructing improvements. Standards can also aid in reducing maintenance costs and minimizing operational problems through provision of consistent and compatible materials and construction methods.

This document is intended to assist design engineers, architects, developers, contractors, or other interested individuals with the preparation of design reports, plans, and specifications for public infrastructure improvements to be owned and maintained by the City of Three Forks (City). These STANDARDS are not all-inclusive but aim to provide the basic design principles and standards to be used in developing and constructing public improvement projects that meet the requirements of the City.

Compliance with the STANDARDS does not relieve the designer, property owner, or contractor of the responsibility to apply conservative and sound professional judgment to protect the health, safety, and welfare of the public. These are minimum standards and are intended to assist, but not substitute for competent work by design professionals. Special considerations or environmental constraints may require more intense or rigorous design parameters than would be otherwise required. Under such circumstances, City staff will evaluate and use professional judgment in requiring more than these minimum standards.

1.2 Jurisdiction

The STANDARDS apply whenever any public or private work is performed within the public right-of-way or public easement of the City. The STANDARDS apply to the design of improvements, kind and use of materials, methods of construction, and the preparation of plans for construction, repair or alteration of streets, roadways, alleys, drainage, sewer, or water facilities which lie within City right-of-way or easements.

All development within City limits must be served by the City water and sewer systems. If a property is located outside the City limits, and the property owner wishes to utilize City services or anticipates initiation of City services in the future, the property owner is required to consent to annexation prior to development and new construction. Annexed land should be capable of being adequately served by extension of existing infrastructure.

1.3 Document Organization

The content within the STANDARDS generally falls into one of two main categories: Design Criteria or Administrative and Procedural Requirements. Table 1-1 summarizes the design and construction standards content and corresponding chapters and location within the document.

Table 1-1 – Document Organization

Content Category	Location in Document	General Content Description
Design Criteria	Chapter 2.0 Water System Improvements Chapter 3.0 Sanitary Sewer System Improvements Chapter 4.0 Storm Drainage Improvements Chapter 5.0 Transportation System Improvements	Technical criteria to be used for design of improvements such as sizing criteria, required analyses, design and calculation methods, assumptions, location requirements, material specifications, and installation requirements.
Administrative and Procedural Requirements	Chapter 6.0 Submittal Requirements	Requirements for design plans, specifications, and design report submittals to the City.
	Chapter 7.0 Review and Approval Process	Process for circulation of the design documents, obtaining comments, revisions, and submittal of final plans and specifications.
	Chapter 8.0 Construction Coordination	Procedures, permits, testing and inspection requirements, and documentation required before, during, and after construction of improvements.
Additional Details	Appendices	Checklists, forms, standard details, etc.

The design criteria chapters (Chapters 2, 3, 4, and 5) are generally organized by sections corresponding to a major improvement element (i.e., water main, valves, hydrants, etc.). Each element section begins by listing the required design standards for that element, followed by construction standards for that element. Design standards generally refer to criteria such as size, location, and design methodology and assumptions. Construction standards refer to element material selection and any modifications to the Montana Public Works Standard Specifications (MPWSS).

This document is intended to guide the design and construction process for public infrastructure improvements in Three Forks. It does not address the project initiation or planning phases of a project. Planning for infrastructure improvements is typically accomplished through preliminary engineering reports, infrastructure master plans, and capital improvements plans. Additionally, the process for development and subdivision of land is addressed within the subdivision regulations. All infrastructure improvement projects should be consistent with approved growth policies, master plans, and other City regulations and policies.

1.4 Other Referenced Documents and Standards

The following documents and applicable design standards are referred to within and should be considered in conjunction with the STANDARDS.

A. City Code of Three Forks Montana: The City Code contains ordinances that serve as local laws for the community. The City Code contains regulations relating to traffic signage, signals, crosswalks, traffic lanes, sidewalk construction, street excavations, water and sewer service line construction, and wastewater pretreatment requirements.

   The minimum STANDARDS required herein supplement the City Code of Three Forks, Montana, particularly Title 7 “Motor Vehicles and Traffic”, Title 8 “Public Ways and Property”, and Title 9 “Water and Sewer”. If any portion of this document is found to conflict with the City Code, the provisions of the City Code shall supersede this document.

B. City of Three Forks Growth Policy: The growth policy is the predominant policy statement and long-range planning mechanism for the City. It encompasses community goals and objectives regarding development and improvements as well as recommended implementation options.

C. City of Three Forks Subdivision Regulations: The subdivision regulations control and provide procedures for how parcels of land are divided into developable lots and how those lots are designed and laid out. The subdivision regulations apply to land within one mile of the municipal boundary. The subdivision regulations provide general design and improvement standards and should be consulted along with the STANDARDS when subdividing land in Three Forks.

D. MPWSS: The City has adopted the MPWSS as the standard specifications for new construction. All construction shall conform to the latest edition of the MPWSS and the STANDARDS. The STANDARDS shall in all cases either govern over the MPWSS where applicable or shall work in conjunction with the MPWSS where applicable.

E. Montana Department of Environmental Quality (MDEQ) Circulars: The MDEQ maintains standards for the design of plans and specifications for public water supply systems, public wastewater systems, and subdivision storm water drainage systems. All water, sanitary sewer, and storm drainage improvements must be designed to comply with MDEQ Circulars and receive MDEQ approval.

F. Industry Standards: The STANARDS reference several material industry construction standards. Where specified, assure products or workmanship meets the specified performance requirement.

Throughout the STANDARDS, an effort has been made to eliminate duplicative information with respect to the various design documents and standards listed above. In general, information is not repeated in the STANDARDS but reference to associated documents is made as applicable. With respect to the design and/or construction of public facilities, conflicts or differences between the documents and standards listed in this section shall be resolved in order of precedence as follows:

A. City Code of Three Forks, Montana
B. STANDARDS
C. City of Three Forks Subdivision Regulations
D. MPWSS

1.5 Standard Updates

The STANARDS may be amended as new technology is developed or experience is gained in the use of the STANDARDS. The City Council, following the recommendations of the City Engineer, shall consider revisions and/or amendments to the STANDARDS.

It is the intent of the City to revise the STANDARDS on an as-needed basis as regulations and policies are modified. Written comments on the STANDARDS are encouraged and may be submitted to the City.

New construction will be built under the STANDARDS in effect at the time of construction. If construction of the approved plans is not completed within 18 months from the date of design approval, and updates to the STANDARDS have occurred since the date of approval, the design plans, specifications, and reports shall be resubmitted for City review and approval. City review fees for additional reviews of previously approved plans shall be waived.

1.6 Deviations from Standards

It is the policy of the City to require adherence to the STANDARDS set forth herein; however, where unique circumstances or design considerations make it impractical to follow the STANDARDS, the City, with consent of the City Council, will consider alternate solutions and may approve departures from the STANDARDS when substantiated by engineered design analysis. Deviations from the STANDARDS may also be considered when innovative solutions are proposed that can result in a superior design.

1.7 Development

The STANDARDS apply to any public or private work performed within the public right-of-way or public easement of the City and may or may not be related to development. When improvements are required as the result of subdivisions or development, the following general criteria shall apply in association with the STANDARDS:

A. Subdivision Regulations: All subdivisions and developments shall comply with the City Subdivision Regulations, including all conditions of approval, and these STANDARDS.

B. Improvement Extent: Roadways and utilities shall be constructed from existing facilities to the far property line of the development or such other point within the development that may be specified by the City. Extension of water mains beyond the property line may be required as determined by the City for looping and redundancy. All utilities shall be within a public right-of-way or easement to permit free and unobstructed access.

C. Easements and Right-of-Way: Easements and right-of-way shall be obtained and provided to extend roadways and utilities to the far property line of the development. Written approval shall be obtained from the City, stating they have reviewed and approved the location of easements for the future extension of roadways and utilities.

D. Utilities: Underground City utilities and sanitary sewer collection and water distribution mains shall be located within the street or alley. Water transmission mains, sewer interceptor mains, and sewer force mains shall be located as approved by the City. Underground private utilities shall be located on private property. Underground utilities shall not be placed in the boulevard or sidewalk. No aboveground utility boxes, pedestals, vaults, or transformers shall be placed within any easement, proposed roadway, or access way to any City facility. Streetlights shall be at least two feet from the back of curb. All above ground utilities shall be at least one foot from the sidewalk.

E. Utility Easements: All public utility easements shall be a minimum of 15 feet wide for a single pipeline, with the pipe centerline at least five feet from both easement edges. For easements with two pipelines, the minimum width shall be 20 feet with each pipe centerline five feet from the easement edge.

1.8 Abbreviations

The following abbreviations are used throughout this document:

AASHTO	American Association of State Highway and Transportation Officials
ADA	Americans with Disabilities Act
APWA	American Public Works Association
AWWA	American Water Works Association
City	City of Three Forks

CN	Curve Number
DIP	Ductile Iron Pipe
gpcd	gallons per capita per day
HDPE	High Density Polyethylene
IDF	Intensity Duration Frequency
ITE	Institute of Transportation Engineer's
LOS	Level of Service
MDEQ	Montana Department of Environmental Quality
MDT	Montana Department of Transportation
MFE	Municipal Facilities Exclusion
MJ	Mechanical Joint
MPWSS	Montana Public Works Standard Specifications
MUTCD	Manual of Uniform Traffic Control Devices
psi	pounds per square inch
PVC	Polyvinyl Chloride
RCP	Reinforced Concrete Pipe
SCADA	Supervisory Control and Data Acquisition
SCS	Soil Conservation Service
SDWA	Safe Drinking Water Act
STANDARDS	City of Three Forks Standards for Design and Construction
TIS	Traffic Impact Study
TR-55	Technical Release 55
USDA	United States Department of Agriculture
VPD	Vehicles per Day

2.0 Water System Improvements

2.1 Water System Overview

The City water system consists of a network of groundwater wells located within and near the City, two water storage tanks and arsenic water treatment plant located southeast of the City proper, and distribution system made up of various types and sizes of pipes. Wells that do not require arsenic treatment pump directly into the distribution system, providing pressure to the system, and subsequently filling the water storage tanks. The arsenic treatment plant is located next to the water storage tanks and provides treatment for specific wells prior to discharge into the water storage tank. All active wells are controlled through the Supervisory Control and Data Acquisition (SCADA) system, reacting to the level in the water storage tanks. Liquid sodium hypochlorite is used for disinfection of all of the wells.

The distribution system consists of a piping network that serves the majority of the City limits southwest of Interstate 90 and northwest of the railroad. Pressures within this area of the City generally range from approximately 70 to 80 pounds per square inch (psi). The distribution system also includes a small piping system for service to the Ridge View Subdivision which is located on higher elevation ground southeast of the main portion of the City. The storage tanks and arsenic treatment plant are also located in this area. Due to the higher elevation of this area, pressures are less and generally range from 40 to 50 psi. A 10-inch transmission main generally follows the alignment of Kyd Road from the storage tanks into the main portion of the City. All customers within the system are metered.

Water system maps and additional system information can be obtained from the City.

2.2 General Requirements

MDEQ is the regulatory agency which ensures water systems comply with requirements of the federal Safe Drinking Water Act (SDWA). All additions or modifications to the City water system shall be designed and installed in accordance with the current edition of the MDEQ Circular DEQ 1 Standards for Water Works, MPWSS, and the STANDARDS. Additionally, the City has a number of ordinances pertaining to the water system, specifically with regard to water service line tapping, construction, and plumbing requirements. Related water system ordinances can be found within Title 9, Chapter 2.

A design report is required for all water system improvement projects. Specific water system design report requirements are detailed in Chapter 6 of the STANDARDS.

Any person desiring to make connection to the City's water mains must make application in writing and pay for the cost of tapping and any associated system development fees in accordance with City procedures.

2.3 Water Main

Design Standards

A. Hydraulic Analysis: All new water mains shall be sized using hydraulic analysis. Hydraulic calculation results must demonstrate the following assuming the addition of the new proposed water system demands:
    a. The water pressure is not less than 35 psi at any point in the water distribution system under a peak hour demand condition.

b. The working residual water pressure is not less than 20 psi at any point in the water distribution system under maximum day demand plus fire flow.
c. The velocity of the water in the system does not exceed 15 feet per second through a public main line.

B. Hydraulic Assumptions: The following assumptions shall be used in the hydraulic analysis:
   a. Average daily usage is based on 100 gallons per capita per day (gpcd)
   b. The maximum day to average day ratio is two to one (2:1)
   c. The peak hour to average day ratio is three to one (3:1)
   d. Required fire flow shall be determined by the City Fire Chief.

C. Diameter: The minimum diameter for any new main is eight-inch, unless specific approval in writing is obtained from the City for smaller diameters.

   The City reserves the right to direct a prospective customer requesting an extension to the municipal water system to install larger water system facilities than that required to serve the area included in said customer's water extension application and/or agreement. The customer may be eligible for compensation or partial compensation by the City and/or reimbursement from other customers connecting to said facilities for a portion of the costs of constructing the oversized facilities and/or the other water mains and appurtenances constructed to serve the customer's property. The compensation details and agreement shall be approved by the City Council.

D. Dead-end Mains: Water main extensions shall be looped, where possible. Where dead-end mains are necessary, all dead-end mains shall end with a fire hydrant. Temporary dead-end mains scheduled for future extension may end with a two-inch blow-off in lieu of a fire hydrant.

E. Fire Hydrant Leads: Fire hydrant leads shall be six-inch diameter and shall not exceed 50 feet in length.

F. Water Main Offsets: Water mains and appurtenances shall maintain horizontal and vertical offsets as required in MDEQ Circular 1. All underground electrical, gas, phone, fiber, and cable lines must be installed at least three feet horizontally and one foot vertically from water mains and services.

G. Pipe Cover: The minimum cover for all water mains from top of pipe to final finished grade shall be six and a half feet. Maximum bury depth shall be no more than eight feet. Mains with more than seven feet of bury require extensions at valves with centering donuts.

Construction Standards

A. Pipe Material: All water main piping material shall be Polyvinyl Chloride (PVC) meeting current MPWSS material and construction requirements unless specifically authorized by the City.

   Ductile Iron Pipe (DIP) may be used only as approved by the City Engineer. Furnish Class 52 wall thickness meeting American Water Works Association (AWWA) C151, American National Standard for DIP for water.

B. Fittings: DIP and DIP fittings shall be mechanical joint (MJ) meeting MPWSS material and construction requirements. Mechanical restrained joints may be used in lieu of concrete thrust blocking.

C. Couplings: Use pipe couplings as manufactured by Romac Macro series or equal as approved by the City. Restrained couplings shall not be used when connecting to asbestos cement or cast-iron pipe.

D. Encasement: All water main piping, fittings, valves, etc. (excluding PVC pipe) shall be encased in polyethylene wrap with a minimum thickness of 8 mils. All encasements shall be in accordance with AWWA C105 standards.

E. Tracer Wire: Ten-gauge copper coated tracer wire shall be installed along the top of new PVC water main and shall be attached to all valve box risers.

F. Detectable Warning Tape: Three-inch wide detectable tape shall be installed 12 to 24 inches below finished grade along the alignment of the new main. Tape shall be a minimum of five mils thick and shall conform to American Public Works Association (APWA) colors.

G. Marker Posts: Marker posts shall be used when a main is located outside a paved surface. Posts shall be APWA compliant Rhino TriView™1 or approved equal and shall be installed at a maximum spacing of 150 feet and at every valve or valve cluster and every change in direction

H. Sanitary Connections: Sanitary connection is defined as a section of new main connecting back to an existing main which cannot be pressure tested or bacteriologically tested. There shall be no fittings within 10 feet of the connection to existing. The length of sanitary connections shall be limited as much as possible in length and shall be submitted to the City for review and approval prior to construction.

2.4 Tapping Existing City Mains

Tapping City mains shall be in accordance with Title 9, Chapter 2 of the City Code.

Construction Standards

A. Tapping Sleeves: Furnish tapping sleeve manufactured by Mueller, Rockwell, Dresser, or an approved equivalent.

B. Inspection Requirements: The City water operator shall inspect and approve all water main connections (including service connections) under full pressure before backfilling is permitted.

2.5 Valves

Design Standards

A. Size and Type: 12-inch diameter and smaller valves shall be gate valves. Larger than 12-inch diameter shall be butterfly valves.

B. Location: Valves shall be located in accordance with the following unless otherwise approved or required by the City:
    a. All connections to an existing water main must begin with a new valve.
    b. At least one valve shall be provided for every block. Valve spacing shall not exceed 500 feet.
    c. Valves shall be installed at each leg of every tee and cross.
    d. Valves shall be placed so that main shutdowns can be accomplished with only one fire hydrant being out of service at a time.
    e. Valves shall not be located underneath curb and gutters, sidewalks, boulevards, travel route of a multiple use path, or within the wheel path of a vehicular travel lane.

Construction Standards

A. Gate Valves: Gate valves shall be Mueller Resilient Wedge Gate Valves, or an approved equal, conforming to AWWA C509 standards.

B. Valve Boxes: Valve boxes shall be cast iron, screw type adjustment. Extensions with a centering donut shall be provided and installed for valves on mains with more than seven foot of bury.

2.6 Hydrants

Design Standards

A. Location: Fire hydrants shall be provided at each street intersection and at intermediate points based on spacing requirements. Unless otherwise approved by the City Fire Chief, hydrant spacing shall not exceed 400 feet. The Fire Chief reserves the right to require additional fire hydrants if the demand of the structure(s) requires more flow than the minimum spacing provides. The placement of all hydrants shall be subject to approval by the City Fire Chief.

Hydrants shall be located with provision of a two-foot separation from the face of the barrel to the back of curb and from the edge of sidewalk. Bollards shall be provided for hydrants unprotected by curb.

Construction Standards

A. Fire Hydrant Type: Fire hydrants shall be 250 psig, 5¼", 3-way, "Mueller Super Centurion 250", "Kennedy K81A", or approved equal, conforming to AWWA C502 Standards. All hydrants shall be painted OSHA red above the ground line. All fire hydrants shall be equipped with a 5-inch Storz adaptor.

Pipe deflection on hydrant leads shall be minimal and shall not result in a finished hydrant more than one degree out of plumb. The hydrant valve shall be located in the street pavement or boulevard with a standard water valve. No valves shall be located within the curb and gutter.

Fire hydrants shall be covered until placed in service.

B. Flushing Hydrants: Furnish flushing hydrants as manufactured by The Kupferle Foundry Company (MainGuard No. 78, Underground Model) or an approved equal.

C. Yard Hydrants: Furnish sanitary yard hydrants as manufactured by Woodford (Model S3 with Repair Kits RK-Y1 and RK-SHL) or an approved equal.

2.7 Water Services

Design Standards

A. Designation: A water line is designated as either a service line or water main based on its use, not its size. A line serving a single building or facility is considered a service line and a line serving more than one building or intended to serve more than one building or facility is designated a water main.

B. General: Provision of water services shall be based on the following general requirements:
   a. All water service lines shall be arranged so that supply to each separate residence or building is controlled by a separate shutoff valve and curb box placed within the right of way near the property to be served. One singular, identifiable entity will be responsible for all the water used through each service.

b. Meters shall be placed on all services as directed by the Water/Wastewater Operator. Each metered consumer is subject to the minimum charge for such class of service as he receives.
c. New structures containing two or more residences or existing structures converted into two or more residences shall have separate service lines from the main, service valves, and meters for each residence. In the cases where individual service lines are not feasible, one service will be allowed with only one master meter that is the responsibility of the condominium associations or one individual for payment. In Residential Zoning Districts and mobile home parks, multifamily structures which have one meter shall be subject to a minimum charge for each residential unit. Multiple meters that are read and billed by the City will not be allowed on a single service.
d. New or existing offices or businesses that are rental units under common ownership shall have one service line, valve, and meter for all occupants within a single structure.
e. When a lot or parcel is developed to a permitted use, all duplicate, excess, and/or unused water services and fire services, including stub-outs, shall be abandoned at the main.
f. Aggregation of parcels will trigger abandonment of unused water and fire services at the main.
g. New or reconstructed services shall meet requirements of the STANDARDS, including location of curb stops and meter pits.
h. Domestic water services shall not be tapped on a fire service line or fire hydrant main.

C. Location: Services shall connect to and extend from the main perpendicularly and may enter the building at any point designated by the owner of the property or his agent. Service pipes shall be installed with a minimum of six and a half feet of cover and not in the same trench with sewer pipes. All risks due to freezing shall be assumed by the property owner.

All curb boxes for controlling service to consumers shall be located outside the property line, preferably centered within the boulevard. Curb box placement shall generally be avoided within the paved street surface, sidewalk, or bike/ped path.

D. Sizing Requirements: All service line stubs shall be sized to adequately serve the maximum anticipated demand for the property being served. Service line sizing shall be based on water requirements calculated by the fixture unit method, as specified in the Uniform Plumbing Code. Service line pipe velocity shall not exceed 10 feet per second. The water service tap, corporation stop, service line, curb stop, and meter shall all be the same nominal size from the main to the meter. Minimum service line size is ¾-inch diameter.

If a service line size is reduced prior to the meter pit or vault, the design engineer shall provide hydraulic data indicating maximum achievable flow rates at the meter are within the manufacturer's recommendations and obtain written authorization from the City Engineer.

The minimum size of a fire service line is one inch. The minimum size of a service line stub is one inch to allow for the potential use of the domestic supply for a fire sprinkler system.

Construction Standards

A. Service Pipe Material: All water service lines less than 4-inch diameter shall be polyethylene meeting material specifications listed in MPWSS from the main to the curb box. Type K copper pipe may be considered with approval from the City. All water service lines 4-inch diameter and greater shall be PVC. A tracer wire must be installed and tested for all poly pipe and PVC services.

B. Service Saddles: Service saddles shall be installed on service connections less than 4-inch and shall be full band, stainless steel, or approved equal. 4-inch and larger services shall be installed with a stainless-steel tapping sleeve.

C. Corporation Stops: Connections to mains shall be accomplished by corporation stops tapped to the existing main at a positive angle of thirty degrees to the horizontal. Corporation stops shall be Mueller or approved equal. The City water/wastewater operator shall inspect and approve the service connection under full pressure before backfill is permitted.

D. Curb Stop Valves: Curb stop valves shall be Mueller Series 300 ball style or approved equal.

E. Service Fittings: Shall be Mueller Insta-Tite or 110 Series compression fittings, or an equal approved by the City. Stainless steel inserts are required for all compression-type fittings.

F. Curb Boxes: All curb boxes shall be extension-type having a minimum length of six and a half feet. All curb boxes shall consist of an arch pattern base and shall be Mueller, Ford, or equal as approved by the City. All curb boxes shall have screw-on or other type lid, which can be attached to the top of the riser and equipped with a properly sized stationary road and a pentagon brass plug or approved equal. All curb boxes shall be within one degree of plumb and centered directly over the corporation stop nut. The curb box should be protected and maintained until final occupancy.

G. Service Line Meters: Water meters shall be purchased from the City by the water user and shall be installed inside the building by a certified plumber. Meter pits shall not be used unless specifically approved by the water operator.

H. Backflow Prevention: "Backflow" is defined as the undesirable reversal of water flow or the reversal of water flow containing other liquids, gases or other substances from a connected source that flows into the distribution pipes of the public water supply. The City may require, at its discretion, the installation of double check-valve assembly backflow protection devices on new or existing service lines when the water user is involved in water use practices that pose a threat to the City's water system. Backflow preventers shall be placed downstream of meters.

   The size and type of all backflow prevention devices will be determined by the City Engineer or based upon the size of service and the degree of hazard that exists or can be expected to exist on the premises served. Backflow preventers shall conform to the current adopted installation requirements of the International Association of Plumbing and Mechanical officials also known as "Uniform Plumbing Code."

3.0 Sanitary Sewer System Improvements

3.1 Sanitary Sewer System Overview

The City sanitary sewer system consists of gravity collection system piping that generally flows from south to north and southeast to northwest. The collection system discharges to a lift station located at the northeast corner of the City. The lift station pumps wastewater to the treatment system located southeast of the City. The Ridgeview Subdivision is located south of the lagoon system and consists of gravity collection mains, a solids collection tank system, and two effluent gravity mains that discharge into the treatment system.

The wastewater treatment system is a complete mix/partial mix lagoon system and receives all flow from the City lift station and Ridgeview effluent gravity main. The major components of the treatment system are a headworks facility, complete mix treatment lagoon, two partial mix lagoons, polishing reactor for ammonia treatment, and UV disinfection. The system also includes surge basins for storage and drying of sludge. The system discharges to the Madison River approximately one-mile northeast of the lagoons via a gravity effluent main. The discharge is located downstream of the Interstate 90 bridge between the railroad bridge and pedestrian trail bridge.

Sanitary sewer system maps and additional system information can be obtained from the City.

3.2 General Requirements

All additions or modifications to the City sanitary sewer system shall be designed and installed in accordance with the current edition of the MDEQ Circular DEQ 2 Design Standards for Wastewater Facilities, MPWSS, and the STANDARDS. Additionally, the City has a number of ordinances pertaining to the sanitary sewer system, specifically with regard to sanitary sewer service connections and wastewater pretreatment for industrial users. Related sewer system ordinances can be found within Title 9, Chapter 5.

A design report is required for all sanitary sewer system improvement projects. Specific sanitary sewer system design report requirements are detailed in Chapter 6 of the STANDARDS.

Any person desiring to make connection to the City's sanitary sewer mains must make application in writing and pay for the cost of tapping and any associated system development fees in accordance with City procedures.

3.3 Gravity Main

Design Standards

A. Hydraulic Analysis: All new gravity sewer mains shall be sized using hydraulic analysis. Hydraulic calculation results must demonstrate:
    a. New sewer lines are sized to flow at no more than 75 percent of full capacity at peak hour conditions upon the full build-out of the development.
    b. Downstream sewer lines have adequate capacity to accept the proposed development's sewer loading. Flow monitoring and surveying of existing pipe invert elevations may be required through coordination with the City.
    c. Maximum pipe velocity of 15 feet per second.

B. Hydraulic Assumptions: The following assumptions shall be used in the hydraulic analysis:
   a. New sanitary sewer lines to serve residential areas shall be designed to accommodate an average daily flow rate of 100 gpcd.
   b. Average daily flows for new sanitary sewer lines serving commercial or industrial areas shall be estimated using unit count methods, textbook values, or actual flow data from similar facilities. Flow assumptions and references shall be clearly stated in the design report.
   c. The average daily flow rate shall be multiplied by a peaking factor to determine peak hourly flow for each pipe segment. A peaking factor shall be calculated for each pipe segment based on the following equation:

$$PF = \frac{18 + \sqrt{\frac{P}{1000}}}{4 + \sqrt{\frac{P}{1000}}}$$

Where: PF = Peaking Factor
P = Contributing Population

   d. A Manning's friction factor of 0.013 shall be used in designing new sewers.

C. Diameter: The minimum diameter for any new main is 8-inch. Upsizing of mains will not be allowed for utilization of minimum slopes to meet elevation restraints.

The City reserves the right to direct a prospective customer requesting an extension to the municipal sanitary sewer system to install larger sanitary sewer system facilities than that required to serve the area included in said customer's sewer extension application and/or agreement. The customer may be eligible for compensation or partial compensation by the City and/or reimbursement from other customers connecting to said facilities for a portion of the costs of constructing the oversized facilities and/or the other sanitary sewer mains and appurtenances constructed to serve the customer's property. The compensation details and agreement shall be approved by the City Council.

D. Minimum Slope: Recommended minimum pipe slopes listed in Section 33.41 of Circular DEQ-2 will be considered adequate to maintain minimum flow velocities.

E. Location: Municipal wastewater system facilities shall be designed and constructed so that all such facilities are readily accessible for maintenance and repair. In addition, facilities shall be located to prevent the entrance of surface water. All sewer mains shall be centered in the right-of-way or easement to the greatest extent possible.

F. Alignment and Grade: Public sanitary sewers shall be installed with a straight alignment and grade between manholes as required by MDEQ Circular DEQ 2.

G. Offsets: Sewer mains and appurtenances shall maintain horizontal and vertical offsets as required in MDEQ Circular 2. All underground electrical, gas, phone, fiber, and cable lines must be installed at least three feet horizontally and one foot vertically from sewer mains and services.

H. Depth: Bury depth of sanitary sewer shall be in accordance with MDEQ Circular 2.

Construction Standards

A. Gravity Pipe Material: SDR 35 PVC pipe with gasketed joints and fittings shall be used for all gravity sanitary sewer main lines unless other materials are specifically approved by the City.

Connections to existing mains shall be made with PVC gasketed coupling or stainless steel sleeved flexible coupling. Gravity main shall not be directionally drilled.

All joints shall be watertight and inspected by the City engineer, water/wastewater operator, or an authorized agent prior to backfilling of trenches.

B. Detectable Warning Tape: Three-inch wide detectable tape shall be installed 12 to 24 inches below finished grade above all sanitary sewer gravity and force mains. Tape shall be a minimum of five mils thick and shall conform to APWA colors.

3.4 Manholes

Design Standards

A. General: Manholes shall be provided at pipe terminations, changes in pipe diameter, and changes in pipe direction.

B. Spacing: The maximum distance between manholes shall be as follows:

Table 3-1 – Manhole Spacing Requirements

Sanitary Sewer Pipe Size	Maximum Distance
8-inch to 15-inch	400 feet
18-inch to 30-inch	500 feet
Larger than 30-inch	600 feet

C. Barrel Size: The alignment and number of pipes into the manhole will determine the barrel size for the size of pipe used. Manholes shall have a minimum diameter of 48-inches and follow the National Precast Concrete Association Manhole Sizing Recommendations found in Appendix A.

D. Top Section: All 48-inch manholes shall have eccentric cone top sections if total manhole height is greater than six feet. All other manholes shall have flat tops.

E. Inverts: The invert of the outlet pipe shall be a minimum of 0.1 feet lower than the invert of the lowest inlet pipe.

F. Drop Manholes: All drop manholes shall be exterior drop as detailed in MPWSS Modified Standard Drawing No. 02720-3.

G. Diameter Changes: When a smaller main is being connected to a larger main at a manhole, the manhole inverts shall be set so the 8/10 depth of flow of each main is equal in elevation.

H. Flow Channels: Flow channels are required on all sanitary manholes and shall provide smooth transitions between inlet and outlet pipe inverts. Channel depth shall be one half the pipe diameter before the start of the sloped shelf within the manhole.

I. Buoyancy: Manholes shall be designed to counteract buoyant forces in areas with groundwater.

J. Access Roads: A 12-foot-wide all-weather gravel access road, with turnarounds if needed, shall be constructed to provide access to all sanitary sewer manholes not located within a paved public or private street or parking lot.

K. Location: Sewer valves and manhole covers shall not be located in curb and gutters, sidewalks, boulevards, or within the wheel path of a vehicular travel lane

Construction Standards

A. Manhole Material: All manholes shall be constructed using pre-cast reinforced concrete manhole sections. Structural strength shall withstand H-20 design load.

B. Manhole Covers: Watertight gasketed manhole covers shall be used in all locations where flooding may occur.

C. Adjustment Rings: Where adjustment rings are used to bring the manhole frame to grade, the maximum height of adjustment shall be 8-inches. If more than 8-inches is required, a precast riser section shall be used along with no more than 8-inches of rings to complete the adjustment.

3.5 Sanitary Sewer Services

Design Standards

A. General: All sanitary sewer service lines must be arranged so the discharge from each separately owned house, or buildings on separate lots, is a separate service line that connects to the main. The owner of each house or premises is liable for the charges for the wastewater service provided by the City to that owner's house or premises.

B. Minimum Diameter: The minimum diameter of a sewer service is 4-inches.

C. Slope: The minimum slope of a 4-inch service line stub is 1/4-inch per foot.

D. Location: Services are to be installed perpendicular to the main.

E. Cover: All sewer service lines shall be installed with a minimum of four feet of cover from the top of service pipe to final finished grade.

Construction Standards

A. Gravity Sewer Service Piping Material: Gravity sewer services shall be PVC Schedule 40.

B. Tapping City Sewer: Taps shall only be made at the main with an appropriately sized PVC wye for new construction; or with an appropriately sized and installed Inserta Tee® for connections to existing mains. The installation of the connection shall be according to the manufacturer's specifications. A watertight joint must be provided through provision of a mastic or bonding material (usually supplied by the manufacturer) and stainless-steel bands to connect the wye to the system. The wye entry shall be made in a downstream direction at an angle of approximately forty-five degrees (45°). The installation of the wye branch shall be inspected by City personnel.

C. Existing Services: Connections between new and existing services of differing materials shall be completed with stainless steel shielded flexible couplings, such as Fernco Shielded Couplings, or equal as approved by the City.

3.6 Lift Stations

Design Standards

A. Design Requirements: Lift stations and force mains shall meet the design requirements of MDEQ Circular-2.

Construction Standards

A. Pressure Piping Material: Force main material shall be either High Density Polyethylene (HDPE) or C900 PVC. Directionally drilled HDPE shall incorporate engineered expansion and contraction restraints, approved by the City. Service taps shall not be allowed on force mains. Private force mains shall be connected to the sewer collection system at a manhole. Tracer wire shall meet the same requirements as for water main.

B. Lift Station Manufacturer: The design engineer shall submit a list of three lift stations of the type proposed which have been in operation at least five years. The City reserves the right to accept or reject the proposed lift station. Lift station must be capable of connection to the City's existing SCADA system to convey lift station status including, but not limited to, alarms, pump status, valve status, liquid level, ATS position, and any other pertinent or required operational information deemed necessary by the City dependent on the lift station's location and category of critical infrastructure.

4.0 Storm Drainage Improvements

4.1 Storm Drainage System Overview

Land use within the City of Three Forks includes residential homes and commercial businesses with the area surrounding the City dominated by agricultural uses and a few residential homes. The area lies within a valley setting, located between the Madison River to the east and the Jefferson River to the west. Topography surrounding Three Forks is relatively flat and generally slopes to the north and northeast with average slopes of approximately two to three percent. The ground directly west of the Jefferson River and US Highway 287 rises more dramatically into rolling hills. A higher ridge also exists south of Three Forks in between the Jefferson and Madison Rivers.

Stormwater in Three Forks generally flows to the north/northeast as overland flow. There is no storm sewer/inlet system. The majority of roads east of Main Street/MT Highway 2 are paved while roads west of Main Street are primarily gravel.

4.2 General Requirements

Runoff control facilities and conveyance systems are required to prevent damage or unwanted excess water to adjacent properties and the public right-of-way due to proposed development. Stormwater improvements shall be designed to limit stormwater runoff from the development site to the pre-development runoff rates. Adequate on-site stormwater detention shall be provided for design storm runoff exceeding the pre-development rate.

A design report is required for all storm drainage improvement projects. Specific storm drainage design report requirements are detailed in Chapter 6 of the STANDARDS.

All construction within the City right-of-way shall be designed and installed in accordance with the current edition of the MPWSS and these STANDARDS.

4.3 Applicability

Compliance with the requirements of this chapter depend on the project type and specified regulatory thresholds. The following guidance applies to the applicability of the STANDARDS with regard to storm drainage improvements.

A. Development: Development is the conversion of previously undeveloped or permeable surfaces to impervious surfaces and managed landscape areas. Development occurs on vacant land or through expansion of partially developed sites. Development projects that increase the impervious area by 10,000 square feet or more shall comply with all requirements of this chapter.

B. Redevelopment: Redevelopment is the replacement of impervious surfaces on a fully developed site. Redevelopment occurs when existing facilities are demolished and rebuilt or substantially improved through reconstruction. Redevelopment projects that increase impervious area by 5,000 square feet or more must comply with all requirements of this chapter.

C. Exemptions: The following project types are exempt from the requirements of this chapter:

a. Actions by a public utility or any other governmental agency to remove or alleviate an emergency condition, restore utility service, or reopen a public thoroughfare to traffic.
b. Projects that, when completed, will not have physically disturbed the land.
c. City right-of-way and City owned property maintenance and reconstruction projects.
d. Chip seals and fog seals.
e. Single family residential improvements on existing lots.

4.4 Estimation of Peak Runoff

An estimation of the peak rate of runoff from a contributing area is needed in the design of drainage conveyance facilities such as storm drains, inlets, culverts, or open channels. Peak runoff values are acceptable for use in design applications where the time variation of storage is not a primary factor in the runoff process. If the design includes storage basins or complex conveyance networks, hydrograph procedures are required. This section discusses the hydrologic methods to be used for peak runoff estimation in Three Forks and the circumstances for their use.

A. Hydrologic Methods: Table 4-1 summarizes acceptable hydrologic methods for peak runoff calculations and corresponding limitations.

B. Rational Method: The basic assumptions that apply to the rational method are:
   a. Rainfall is uniformly distributed over the area for the duration of the storm.
   b. The peak runoff rate occurs when the duration of the storm equals the time of concentration.
   c. The runoff coefficient for a particular watershed is constant for a similar land use.

   The rainfall intensity is obtained form an intensity-duration-frequency (IDF) curve using both the return period and a duration equal to the time of concentration as input. The preferred values for the IDF curve are obtained from the Montana Department of Transportation (MDT) Hydraulic Manual, Chapter 7, Appendix B, for the Logan – 2W weather station. For times of concentration in between durations listed, linear interpolation should be used. Table 4-2 presents the preferred IDF curve values for various recurrence intervals.

   The value of the runoff coefficient (C) is a function of the land use, cover condition, soil group, and watershed slope. There are many available tables of C values located in a variety of textbooks and guidance materials. Where a drainage area is characterized by distinct subareas that have different runoff potential, the watershed should be subdivided, and the equation applied separately to each area. Where a watershed is not homogeneous but is characterized by highly dispersed areas that can be characterized by different runoff coefficients, a weighted runoff coefficient should be determined.

C. Soil Conservation Service (SCS) Curve Number (CN) Method: The basic assumption of the SCS curve number method is that rainfall is separated into three parts consisting of direct runoff, initial abstraction, and losses. The separation is based on the volume of rainfall, land cover and use, soil type, and antecedent moisture conditions.

   The design 24-hour precipitation depths for Three Forks are provided in Table 4-3 and are determined from the MDT Hydraulics Manual, Chapter 7, Appendix B, for the Logan – 2W weather station.

   CN values represent a hydrologic soil group, land use, and treatment class. A published soil survey can be used to determine the hydrologic soil group of the area in conjunction with available tables of CN values that can be found in a textbooks and guidance materials. When multiple land use/soil combinations are present, a weighted CN approach shall be used.

Table 4-1 – Approved Hydrologic Methods

Hydrologic Method	Conditions for Use and Limitations	Equation and Variables	Rainfall Data
Rational Peak Discharge Method	□ For use in predicting a conservative peak flow rate for small urban and rural watersheds. □ Best suited for sizing urban storm drain systems. □ Should be used with caution if time of concentration (T_c) exceeds 30 minutes. □ Drainage sub-basin area (A) shall not exceed 25 acres for a single calculation.	$Q_P = CiA$ Q_P = Peak Runoff Rate (cfs) C = Dimensionless Runoff Coefficient i = Rainfall Intensity (inches/hour) A = Drainage Area (acres)	Obtained from an IDF curve using the return period and duration equal to the time of concentration (T_c) (Refer to Table 4-2)
SCS Curve Number Graphical Peak Discharge Method (USDA Technical Release 55)	□ Basin should have fairly homogeneous CN values □ CN should be 50 or greater □ T_c should be between 0.1 and 10 hr. □ I_a/P should be between 0.1 and 0.5 □ Basin should have one main channel or branches with nearly equal times of concentration □ Neither channel nor reservoir routing can be incorporated □ F_P factor is applied only for ponds and swamps that are not in the T_c flow path □ For drainage areas less than three square miles.	$Q_D = \frac{(P-0.2S)^2}{P+0.8S}$ Q_D = Runoff Depth (inches) P = Rainfall Depth (inches) $S = \frac{1000}{CN} - 10$ S = Retention (inches) CN = SCS Runoff Curve Number $Q_P = q_u A Q_D F_P$ Q_P = Peak Runoff Rate (cfs) q_U = unit peak discharge ($ft^3/sec/mi^2/inches$)(1) A = Drainage Area (mi^2) F_P = Pond and Swamp Adjustment Factor	24-hour precipitation depths (Refer to Table 4-3)
SCS Curve Number Tabular Hydrograph Method (USDA Technical Release 55)	□ For designs where watershed or channel storage is significant, where flow routing is important, for large storm drainage systems, or where significant variation in land use, soil types, or topography exists within the watershed. □ Used to determine peak flows and hydrographs within a watershed. □ T_t should be 3 hours or less. □ T_c should be 2 hours or less. □ Drainage areas of individual subareas should not differ by a factor of 5 or more.	Refer to Chapter 5 of USDA Technical Release 55.	24-hour precipitation depths (Refer to Table 4-3)
Other Hydrograph Methods	Other hydrograph-based computer modeling methods may be appropriate depending on watershed/conveyance system complexity and may be used with approval from the City Engineer on a case-by-case basis.		

(1)Calculated using SCS Graphical Method using T_c (hours) and I_a/P as input. Initial Abstraction (I_a) = 0.2S.

Table 4-2 – Rainfall Intensity

Storm Duration	Intensity at Selected Recurrence Intervals (inches/hour)					
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
5 minute	2.53	3.31	3.83	4.48	4.96	5.45
10 minute	1.85	2.42	2.80	3.28	3.63	3.99
15 minute	1.50	1.96	2.27	2.66	2.95	3.23
20 minute	1.20	1.57	1.82	2.13	2.36	2.59
25 minute	1.02	1.34	1.55	1.81	2.01	2.21
30 minute	0.90	1.18	1.37	1.60	1.78	1.95
35 minute	0.80	1.04	1.20	1.41	1.56	1.71
40 minute	0.71	0.93	1.08	1.27	1.40	1.54
45 minute	0.65	0.85	0.98	1.15	1.28	1.40
50 minute	0.60	0.78	0.90	1.06	1.17	1.28
55 minute	0.55	0.72	0.83	0.98	1.08	1.19
1 hour	0.51	0.67	0.78	0.91	1.01	1.11
2 hour	0.29	0.36	0.41	0.47	0.52	0.56
3 hour	0.21	0.26	0.30	0.34	0.37	0.40
6 hour	0.13	0.15	0.17	0.19	0.20	0.22
12 hour	0.08	0.10	0.11	0.12	0.13	0.13
24 hour	0.051	0.060	0.066	0.074	0.080	0.086

Source: MDT Hydraulics Manual, Chapter 7, Appendix B, for the Logan – 2W weather station.

Table 4-3 – 24-Hour Precipitation Depths

Recurrence Interval	24-Hour Precipitation Depth (inches)
2 year,	1.22
5 year	1.45
10 year	1.60
25 year	1.78
50 year	1.92
100 year	2.06

Source: MDT Hydraulics Manual, Chapter 7, Appendix B, for the Logan – 2W weather station.

The unit peak discharge is calculated using graphical depictions as presented in the USDA Technical Release 55 (TR-55), using the time of concentration and initial abstraction/rainfall (I_a/P) ratio as inputs. A SCS Type I rainfall distribution shall be used to determine the unit peak discharge.

D. Basin Area: The basin area must reflect actual runoff characteristics as closely as possible and be consistent with the assumptions used. The impervious and pervious areas must be estimated form best available plans, topography, or aerial photography, and verified by field reconnaissance.

E. Time of Concentration: The time of concentration is the flow time from the most remote point in the drainage to the point in question. Time of concentration calculations should reflect

overland/sheet flow time and channel flow time. Channel flow time in gutters, ditches, or pipes may be determined by estimating velocities with the Manning equation.

F. Storm Event Calculations: Detention and retention facilities shall be designed to accommodate the 2-year design storm event. All other storm water facilities shall be designed to accommodate the 10-year design storm unless otherwise specified. All facilities should also be analyzed at the 100-year event to assess the potential flooding impacts to buildings and critical infrastructure both on- and off-site of the proposed development. A narrative description of off-site flooding potential is required from the proposed project discharge location or retention pond to the point downstream where the site runoff would join the existing drainage course. Proposed development cannot increase flooding potential to on- or off-site buildings.

G. Direct Runoff: If a portion of the development must directly runoff to offsite areas without being detained, the peak runoff rate of the direct runoff area(s) must be subtracted from the allowable pre-development runoff rate. The direct runoff cannot substantially increase the risk of flooding to adjacent properties or buildings.

H. Contributing Offsite Watersheds: Where practicable, contributing offsite watersheds shall be routed around proposed detention facilities and not run through them. If offsite runoff must be routed through the proposed detention facility, it must be included in hydraulic modeling to accurately predict the effects of flow through. Runoff from offsite contributing watersheds must be included in conveyance sizing calculations.

I. Additional References: The following references provide additional details and example calculations for the Rational and SCS Curve Number hydrologic methods:
    a. U.S. Department of Transportation Federal Highway Administration Hydraulic Engineering Circular No. 22 (HEC-22) Urban Drainage Design Manual
    b. MDT Hydraulics Manual, Chapter 7 – Hydrology
    c. USDA Urban Hydrology for Small Watersheds Technical Release 55.

4.5 Open Channels

Open channels are preferred, wherever possible, to improve infiltration, retention, flow velocity, maintenance, and sediment settling.

Design Standards

A. Design Storm: Sizing of channels shall be based on Manning's equation. Open channels shall be designed to convey the 10-year design storm peak flow rate assuming developed conditions of on-site tributary areas and existing conditions for off-stie tributary areas.

B. Minimum Slope: The minimum slope for concrete channels is 0.2%. The minimum slope for asphalt and graded earth channels is 0.5% and the minimum slope for close-cropped grass channels (i.e., lawn) is 1%.

C. Location: Channels shall be located within drainage parcels or easements and shall be located no closer than 10 feet to any structure foundation measured horizontally from the edge of the swale.

D. Minimum Depth: The minimum channel depth shall be 1.3 times the flow depth or one foot, whichever is greater.

E. Maximum Velocity: Open channel designs shall address maximum velocity to assure a stable channel design that will not erode. Table 4-4 provides general guidance regarding maximum

channel velocity with respect to channel cover. Additional guidance can be found in USDA NRCS Stream Restoration Design (National Engineering Handbook 654), Chapter 8, Threshold Channel Design.

Table 4-4 – Open Channel Maximum Velocities

Channel Cover	Maximum Velocity (ft/sec.)
Sparse Vegetative Cover	3.0
Vegetative Cover Established by Seeding	3.0 – 4.0
Well-established Sod of Good Quality	5.0 – 6.0

F. Channel Protection: If the velocity at a channel or culvert outlet exceeds the maximum permissible velocity for the soil or channel lining, channel protection such as riprap or manufactured products are required for erosion protection.

G. Maintenance Access: Provide maintenance access for inspection and debris removal by conventional equipment. Large channels will need access for dump trucks and loaders. For small channels, foot or pickup truck access is adequate.

H. Preservation of Natural Drainage Ways: New development shall be designed to protect existing natural drainage features that convey or store water or allow it to infiltrate into the ground in its natural location. Preserving the natural drainage way will help ensure that stormwater runoff can continue to be conveyed and disposed of at its natural location.

   Less prominent drainage ways in a non-residential development and in a residential development containing lots one acre or smaller may be realigned within the development provided the drainage way will enter and exit the site at the pre-developed location and that discharge will occur in the same manner as prior to development.

4.6 Culverts

Design Standards

A. Capacity: Culverts shall be sized to accommodate the peak runoff from a 10-year storm with no headwater. Capacity shall be determined by analyzing inlet, outlet, and barrel controls. The water surface elevation shall be at least one foot below the crown of the culvert for all culverts equal or greater to four feet in diameter to allow for the passage of floating debris.

B. High Velocities: When an abrasive bed load is anticipated or when velocities exceed 10 feet per second, protective measures shall be implemented to minimize pipe damage.

C. Driveway Culverts: The minimum diameter of any driveway culvert shall be 18-inches. Where minimum cover requirements cannot be met with 18-inch, a 12-inch diameter culvert is allowable.

D. Maintenance Access: Provide maintenance access to the upstream and downstream ends of the culvert for inspection and debris removal.

4.7 Inlets

Design Standards

A. Capacity: Flow, capacity, spread width, and bypass flow calculations shall be provided for each proposed inlet. A 35% clogging factor shall be used for grates. Bypass flow shall be less than 0.3 to 0.5 cfs at intersections and project boundaries. The maximum spread width may not encroach greater than one-half of the lane width of the adjacent travel lane.

B. Spacing: Maximum inlet spacing shall be 400 feet regardless of flooded width and flow depth. The first inlet shall be located within 600 feet of the point where gutter flow originates. Additional inlets shall be located as required to maintain spread width requirements.

C. Location: Roadway stormwater inlets shall be located in the curb line and shall be fitted with bike and pedestrian safe vaned grates. All grates within the traveled path must be ADA approved. Inlets shall be located at intersections to prevent flow from crossing the intersection. Inlets shall not be located at an ADA ramp and shall intercept flow upstream of the ramp, prohibiting flow and/or ponding at the ramp.

D. Grates: Inlet grates shall be depressed to ensure satisfactory operation. The maximum depression shall be one inch.

E. Sumps: Inlets shall have 24-inch sumps for sediment collection unless otherwise approved by the City.

4.8 Storm Sewers

Design Standards

A. Alignment: Storm sewer alignment shall be straight between manholes.

B. Slope: To prevent sediment deposits, storm sewers shall be uniformly sloped to maintain a minimum velocity of 3 feet per second at the design storm depth of flow, or when flowing full. Storm sewers shall maintain a constant slope between manholes.

C. Design Storm: Storm sewer systems shall have non-pressurized (non-surcharged) flow during the 10-year design storm; except at the last pipe run upstream of a detention facility or open outfall into a stream or lake. The upstream pipe may be inundated up to the first manhole that would overflow.

D. Minimum Diameter: The minimum pipe diameter for inlet laterals and storm sewer main is 12-inch.

E. Inlet Laterals: The minimum pipe slope for inlet laterals is 1%.

F. Offsets: Storm sewer mains and appurtenances shall maintain horizontal and vertical offsets as required in MDEQ Circular 1. All underground electrical, gas, phone, fiber, and cable lines must be installed at least three feet horizontally and one foot vertically from storm sewer mains and inlet laterals.

Construction Standards

A. Storm Sewer Pipe Material: Publicly maintained storm sewers shall be constructed of reinforced concrete pipe (RCP), solid-wall or corrugated PVC pipe, or HDPE complying and installed in

accordance with the current edition of MPWSS. PVC and HDPE pipe may only be used for pipe sizes of 36-inch diameter or less. Other pipe materials may be considered for private storm sewer facilities.

4.9 Detention Basins

Detention is the storage and gradual release of runoff to a storm sewer system, waterway, or a soil of high porosity. Detention facilities attenuate peak runoff rates and provide stormwater quality treatment of runoff flows. On-site detention is required for new development with the main design principle of limiting runoff release to the pre-development runoff rate. Release of water is controlled by specially designed outlet structures.

Design Standards

A. Basin Volume: The controlling basin volume shall be determined by limiting the peak discharge release rate to the pre-development flow rate at the 2-year storm event.

B. Basin Dimensions: Basins shall be designed with a two-foot minimum freeboard above the maximum water surface elevation during normal operation (not including emergency overflow). Basin length shall be at least three times the width or baffling used to prevent short circuiting and inlet velocities should be dissipated.

C. Basin Slope: Basin slopes shall be 3:1 or flatter.

D. Basin Location: Basins serving multiple lots shall be located in common open space owned by a Homeowners or Property Owners Association. Locating a basin within an easement on a lot will not be permitted unless approved by the governing body. Public park land shall not be used for storm water detention or retention ponds unless approved by the City.

E. Discharge Structure: Orifice or weir calculations shall be provided for controlling the discharge to the pre-development rate. Provide equations, references, coefficients, and assumptions used. Provide calculations or spreadsheet/table at applicable depths.

F. Discharge Piping: Discharge outlet piping (leaving the structure) shall be a minimum of 12 inches in diameter and sized to convey the design release rate from the pond. The discharge structure inlet piping (if so equipped) shall be a minimum of 12 inches. If a smaller size is needed to restrict flow, an orifice plate should be used. Orifices smaller than two inches are not allowed. Ponds shall be designed to avoid long-term standing water in the pond.

G. Emergency Overflow: An emergency overflow should be provided that is sized to pass the 100-year event without overtopping the embankments. The design shall assume the primary discharge structure is plugged.

H. Erosion Protection: Pond inlet and outlet piping shall be protected and designed to prevent erosion (i.e., splash pads, rip rap, etc.). Basins in floodplains shall have adequate erosion protection on the embankments.

I. Design Detail: A design detail shall be provided including adequate elevation information. Discharge structures shall be adequately protected from damage.

4.10 Retention Facilities

Complete retention facilities may be provided or required where discharge is not feasible or desirable.

Design Standards

A. Retention Volume: Retention facilities shall retain the entire volume of the design storm minus any direct runoff areas of the development. The Rational Method provides a peak runoff rate which occurs at the time of concentration. The Modified Rational Method approach shall be used to compute runoff volume for storm durations equal to or greater than the time of concentration. This method assumes the maximum runoff rate begins at the time of concentration and continues to the end of the storm. Maximum runoff rates for durations greater than the time of concentration are less than the peak runoff rate because average storm intensity decreases as duration increases. Total runoff volume is computed by multiplying the duration of the storm by the runoff rate.

$$V_R = CiAT_d$$

Where: V_R = Required Retention Volume (cubic feet)
C = Dimensionless Runoff Coefficient
i = Rainfall Intensity (inches/hour), corresponding to the design storm duration listed in Subsection B
A = Drainage Area (acres), not including direct runoff area
T_d = Storm Duration (seconds), as listed in Subsection B

B. Design Storm: Retention ponds shall be sized based on a 2-year, one-hour storm intensity and a 1-hour storm duration.

C. Direct Runoff: Direct runoff from a portion of the site may be allowed as long as it does not exceed the allowable pre-development release rate. The pre-development release rate and peak runoff rate of direct runoff are calculated using the Rational Method as explained in Section 4.4.B.

D. Emergency Overflow: An emergency overflow should be provided that is sized to pass the 100-year event without overtopping the embankments.

4.11 Floodplain Regulations

Floodplain regulations are detailed in Title 12 of the City Code and all proposed developments shall conform to the requirements. The regulations are intended to promote the public health and safety of citizens with respect to floodplain management. Title 12 details floodplain permit requirements, floodway development limitations, standards for subdivision proposals, and floodproofing requirements.

5.0 Transportation System Improvements

5.1 Transportation System Overview

Three Forks is located directly south of Interstate 90 which runs east and west across southern Montana. Interstate 90 connects Three Forks with Bozeman to the east and Butte to the west. State Highway 287 is west of Three Forks running south towards Harrison and north towards Townsend.

The transportation system within the City limits of Three Forks consists of Montana Highway 2, which bisects the City from northeast to southwest and connects Three Forks to Highway 287 to the west. The Montana Functional Classification Routes Web Map classifies this section of Highway 2 as a minor arterial. Near the center of the City, at the Highway 2/Date Street intersection, secondary Highway 287 originates and continues south through the City. The web map classifies this route as a major collector. All other roads within the City are defined as local. The majority of roads east of Main Street/MT Highway 2 are paved while roads west of Main Street are primarily gravel.

Sidewalks generally exist along Main Street, along streets one block east and west of Main Street, and at few other intermittent locations throughout the City. A multi-use paved trail network also runs throughout the City. Most streets do not currently have curb and gutter.

5.2 General Requirements

This chapter sets forth the minimum design and technical criteria and specifications to be used in the design of roadway systems, including private roadways. All roads within a proposed development shall be designed by a professional engineer and approved by the City Engineer. Except where these standards provide otherwise, design, workmanship and materials shall be in accordance with the current edition of the following specifications, regulations, and guidelines:

A. City Code of Three Forks, Montana
B. City of Three Forks Subdivision Regulations
C. MPWSS
D. Policy of Geometric Design of Highway and Streets, published by the American Association of State Highway and Transportation Officials (AASHTO)
E. Manual of Uniform Traffic Control Devices (MUTCD), published by the Federal Highway Administration
F. Americans with Disabilities Act (ADA)

5.3 Traffic

A traffic impact study (TIS) is required for developments contributing 200 or more vehicle trips per day to the City street system per utilization of the Institute of Transportation Engineer's (ITE) Trip Generation Manual. The proposed development shall maintain or improve the existing Level of Service (LOS) of the affected roadways. TIS study limits shall be determined by the City Engineer.

Additional TIS requirements are specified in Chapter 6 of these STANDARDS.

5.4 Roadways

City roads are defined by functional classification to define varying levels and types of transportation infrastructure and to provide for the safe and efficient movement of people and goods, while at the same time preserving residential areas and maintaining the economic vitality of commercial and industrial areas. The functional classification system classifies transportation facilities as either urban or rural roads. Within urban roads, they are further divided into arterials, collectors, or local roads. Table 5-1 provides general criteria for urban road functional classification designations. Listed speeds are typical maximums. Speed limits are further refined by roadway geometry, context, and engineering traffic and speed studies.

Table 5-1 – Urban Road Functional Classification

Street Type	Access	Purpose and Function	Maximum Speed	Traffic
Major Arterial	Provided at Intersections with other major arterials or to the interstate system. Direct access is minimal and controlled.	Services the major centers of activity, the highest traffic volume corridors, and the longest trip distances in an urbanized area. Provides for the expedient movement of traffic.	70 mph	Greater than 15,000 VPD
Minor Arterial	Interconnects with and augments the major arterial system. It also provides access to lower classifications of roads on the system and may allow for traffic to directly access destinations.	Provides for movement within sub-areas of the city, whose boundaries are largely defined by the major arterial road system. Serves through traffic, while at the same time provides direct access for commercial, industrial, office and multifamily development but generally not for single-family residential properties. The purpose of this classification of road is to increase traffic mobility by connecting to both the major arterial system and also providing access to adjacent land uses.	55 mph	5,000-15,000 VPD
Major Collector	Provides for land access and traffic circulation within and between residential neighborhoods, and commercial and industrial areas.	Provides for the equal priority of the movement of traffic, coupled with access to residential, business, and industrial areas. May at times traverse residential neighborhoods.	45 mph	3,500-5,000 VPD
Minor Collector		Provides for the equal priority of the movement of traffic, coupled with access to residential, business, and industrial areas. Future growth of the City outside the subdivision will have limited use of the roadway.		1,500-3,500 VPD
Local	Provides direct access to abutting lands and connections to higher systems.	Comprises all facilities not included in the higher systems. Through traffic movements are generally discouraged.	35 mph	Less than 1,500 VPD

Design Standards

A. Street Features: All newly and reconstructed roadways shall be designed to accommodate and coordinate all modes of transportation, both motorized and non-motorized, and people of all ages and abilities. Street features could include, but are not limited to, sidewalks, bicycle lanes, motor vehicle lanes, shared-use lanes and paths, paved shoulders, street trees, landscaping, vegetative planting strips, curb and gutter, ADA curb ramps, crosswalks, refuge islands, pedestrian and traffic signals, directional signs, street furniture, bicycle parking facilities, public transportation

stops and facilities, transit priority signalization, and traffic calming devices such as rotary circles and curb bulb-outs.

B. Right-of-Way Standards: The appropriate classification for new streets will be determined by the traffic study for the development along with all the relevant planning documents for the City. Table 5-2 contains a list of street features that must be considered and may or may not be required according to the discretion of the City Council.

Table 5-2 – Street Component Matrix

Street Feature	Local	Minor Collector	Major Collector	Minor Arterial	Major Arterial
Driving Lane	9' (2 lanes min.)	10' (2 lanes min.)	10' (2 lanes min.)	11' (2 lanes min.)	12' (4 lanes min.)
Bike Lane			5' each side	5' each side	5' each side
Parking Lane	6' each side	6' each side	6' each side	6' each side	6' each side
Curb and Gutter	2' each side	2' each side	2' each side	2' each side	2' each side
Boulevard	7' each side	7' each side	7' each side	7' each side	10' each side
Sidewalk	5' each side	5' each side	5' each side	5' each side	5' each side
Bike/Ped Path (can replace sidewalk on one side)	10' bike/ped path (5' sidewalk on opposite side)	10' bike/ped path (5' sidewalk on opposite side)	10' bike/ped path (5' sidewalk on opposite side)	10' bike/ped path (5' sidewalk on opposite side)	10' bike/ped path (5' sidewalk on opposite side)
Buffer Strip	1' each side behind sidewalk	1' each side behind sidewalk	1' each side behind sidewalk	1' each side behind sidewalk	1' each side behind sidewalk
Center Median				4' min.	4'min.
Center Turn Lane			10'	11'	12'
Total Right-of-Way at Full Build Out(1)	**65'**	**67'**	**87'**	**90'**	**123'**

(1)Assumes bike/ped path on one side and sidewalk on the other side.

C. Right-of-Way Hierarchy: It shall be the policy of the City to attain the desired right-of-way widths on all new roadway and development projects. If the right-of-way for existing streets is narrower than what is required and additional right-of-way cannot be obtained, the following list shall determine the hierarchy of which street features may be exempt from installation or the minimum set width:

a. The boulevard can be narrowed to not less than four feet for local streets and five feet for every other classification.
b. On-street parking on one or both sides of the street can be eliminated.
c. Collector and arterial lane widths and center turning lanes can be narrowed to 10'.
d. Collector and arterial bike lanes can be eliminated.
e. The boulevard can be completely eliminated.
f. Sidewalk on one side of the street can be eliminated.

D. Minimum Design Standards: Minimum roadway design standards for City streets are listed in Table 5-3 by street type.

Table 5-3 – Minimum Design Standards for City Streets

Minimum Design Standards	Arterial	Collector	Local
Minimum Alley Width			20 ft.
Minimum Curb Radius or Edge of Pavement at Intersections	30 ft.	25 ft.	15 ft.
Maximum Grade	Per AASHTO	8%	9%
Approaches onto Public Roads			
Minimum Sight Distance	Per AASHTO	200 ft.	150 ft.
Maximum Grade for 20 ft.	5%	5%	5%
Horizontal Curvature			
Minimum Design Speed	50 mph (Principal) 45 mph (Minor)	30 mph	20 mph
Centerline Radius on Curves	Per AASHTO	300 ft.	150 ft.
Cul-de-sac/Turnarounds			
Maximum Road Length			500 ft.
Cul-de-sac Minimum Outside Right-of-way Radius			45 ft.
Cul-de-sac Minimum Outside Roadway Radius			35 ft.
"T" Turnaround Backup Lengths (2 required)			30 ft. each
New Bridges			
Curb-to-Curb Widths[(1)]		26 ft.	24 ft.
Vertical Clearance		14.5 ft.	14.5 ft.

[(1)]Width of the bridge roadway surface should match the width of the roadway system it joins.

E. Intersections: All roadways shall intersect at right angles as nearly as possible. Where practicable, the angle of intersection shall not be less than 75° for a minimum distance of 60 feet as measured along the centerline, from the right-of-way line at the intersection street.

No more than two streets may intersect at one point. Two streets meeting a third street from opposite sides shall meet at the same point, or their centerlines shall be offset at least 125 feet for local roads and 300 feet for collectors.

Intersections of local streets with arterials shall be kept to a minimum.

Maximum straight tangent grade of approach to any intersection shall not exceed 3% for a distance of 60 feet as measured from edge of transverse pavement to provide for adequate starting, stopping, and stacking distances.

The grade of the "through" street shall take precedence at intersections. At intersections of roadways with the same classification, the City shall determine which roadway has precedence. Side streets shall be warped to match through streets. The elevation at the point of tangency (PT) of the curb return on the through street is always set by the grade of the through street in conjunction with normal pavement cross slope. Carrying the crown of the side street into the intersecting through street is not permitted.

At an arterial-arterial intersection, a more detailed review of the entire intersection's drivability shall be performed by the designer and submitted for review and approval.

F. Superelevation: Superelevation may be required for arterial roadways and selected collector roadways. Horizontal curve radius and superelevation shall be in accordance with the recommendations of AASHTO. Superelevation shall not be used on local roadways.

G. Spiral Curves: Spiral curves shall not be used on roadways within the City (State highways excluded) except by written approval of the City Engineer.

H. Minimum Grade: The minimum allowable grade for any roadway or alley is 0.5%.

I. Changing Grades: Continuous grade changes or "roller-coastering" shall not be permitted. The use of grade breaks in lieu of vertical curves is not encouraged. Where the algebraic difference in grade (A) exceeds 1.0%, a vertical curve is to be used.

J. Vertical Curves: All vertical curves shall be symmetrical. All vertical curves shall be labeled, in the profile, with length of curve (L) and K (=L/A).

K. Curb Returns: Minimum fall around curb returns, when turning water, shall be 0.3' for a 15' radius; 0.4' for a 20' radius; and 0.5' for a 25' radius. For all other curb return radii use a grade of 0.5% within the return to establish minimum fall when turning water. The maximum fall around a curb return is 4%. Show and label high point location, elevation, and intersection of flow line in plan view, if applicable.

L. Connection with Existing Roadways: Connections with existing roadways shall be smooth transitions conforming to normal vertical curve criteria if the algebraic difference in grade (A) between the existing and proposed grade exceeds 1%. When a vertical curve is used to make this transition, it shall be fully accomplished prior to the connection with the existing improvement. Field-verified slope and elevation of existing roadways shall be shown on the plans.

M. Offsite Design and Construction: The design grade, and existing ground at that design grade, of all roadways that dead end due to project phasing, subdivision boundaries, etc., shall be continued in the same plan and profile as the proposed design for at least 500' or to its intersection with an arterial roadway. This limit shall be extended to 1000' when arterial roadways are being designed. If the offsite roadway adjacent to the proposed development is not fully improved, the developer is responsible for the design and construction of a transition with a 4' road base shoulder for the safe conveyance of traffic from the improved section to the existing roadway. The following formula shall be applied to the taper or lane change necessary for this transition:

For Speed Limits of 40 mph or less:

$$L = \frac{WS^2}{60}$$

For Speed Limits 45 mph or greater:

$$L = WS$$

Where:
- L = Length of transition (feet)
- W = Width of offset (feet)
- S = Speed limit or 85th percentile speed (whichever is greater)

The City should be consulted for any unusual transition conditions. Grade breaks greater than 1% are not allowed when matching existing dirt or gravel streets. The cost of offsite pavement transitions shall be borne by the developer.

N. Sight Distance: Sight distance shall be determined by design speed as required by the AASHTO Green Book.

O. Curb and Gutter: Integral curb and gutter shall be used on all new roadways unless where the construction of curb and gutter will have an adverse impact on the natural flow of storm water runoff in the immediate area.

P. Crosspans: Crosspans (valley gutters) shall be constructed in accordance with MPWSS. Crosspans are not allowed across collector or arterial roadways. Crosspans may be used parallel with collector or arterial roadways to convey storm runoff across residential roadways. Crosspans are required for stormwater control at intersections where a stormwater system is not accessible.

Q. Inlets: Inlets shall be located to intercept curb flow as specified in Chapter 4 of the STANDARDS. Inlets shall also be installed to intercept cross-pavement flows at points of transition in superelevation.

R. Cross Slope: Except at intersections, or where superelevation is required, roadways shall be level from top of curb to top of curb and shall have a 2% crown for all streets with a grade less than or equal to 6%. A 2% crown will be allowed on streets where the grade exceeds 6%. The cross slope will be measured from centerline to edge of pavement. Parabolic or curve crowns are not allowed. Maximum pavement cross slope allowed is 5% at warped intersections, as measured above. In no case shall the pavement cross slope at warped intersections exceed the grade of the through street. When warping side streets at intersections, the crown transition should be completed within 75' horizontally for local streets, 100' horizontally for collector streets, and 150' horizontally for arterial streets. Quarter crowning may be accepted on a case-by-case basis needing prior approval from the City.

S. Driveways: All new driveway locations and modifications to existing driveways shall be reviewed and approved by the City prior to beginning construction. Drop-curbs for driveways may only be installed with the initial curb construction when the final building locations have been determined.

   The nearest edge of any driveway shall be not less than 35 feet from the edge of the pavement to the nearest intersecting street.

   Maximum driveway widths shall be 20-feet for single family residential, 24-feet for duplex and multi-family residential, and 40-feet for commercial properties.

   The City may allow deviation from driveway location standards on a case-by-case basis where existing conditions make adherence to the standards impractical.

T. Temporary Erosion Control: Temporary erosion control is required at the ends of all roadways that are not completed due to project phasing, subdivision boundaries, etc. Prevention of erosion at the roadway terminus shall be by methods approved by the City.

U. Barricades: Whenever roadways terminate due to project phasing, subdivision boundaries, etc., barricades are required in accordance with the MUTCD.

V. Median Treatment: Median curbs should be integral curb and gutter (with spill curb) unless otherwise approved. Medians less than 8' wide should be capped with M-4000 concrete a minimum of 3" thick. Wider medians should be topsoiled and seeded with an approved seed mix. The minimum median width is 4'. All medians or raised islands should be made clearly visible at night through the use of adequate reflectorization and/or illumination. Flexible delineators shall be placed at the beginning and end of all medians, and at the point of any horizontal alignment change. All median curbs shall be painted yellow.

W. Pavement Thickness: Pavement thickness design must be completed for all new or reconstructed roadways and shall be based on the current AASHTO Guide for Design of Pavement Structures, or the current Asphalt Institute Manual Series No. 1 (MS-1) for thickness design. The Pavement Design Report, based upon specific site soil data and design year traffic

loading conditions, shall be prepared by a Professional Engineer, or other qualified professional approved by the City, and submitted to the City along with the plans and specifications for the project. The design shall be based on at least a 20-year performance period traffic volume; however, the minimum design lane 18,000-lb Equivalent Single Axle Load (ESAL) used in the pavement design shall not be less than 50,000 ESAL. The minimum asphalt pavement thickness for any new roadway shall be 3". A minimum of 6" of high quality untreated aggregate base shall be provided for designs utilizing asphalt pavement over untreated aggregate base. Where full depth asphalt is designed, an adequate stabilizer lift shall be included, consistent with unpaved roadway design practices, to provide a suitable subbase capable of withstanding the traffic required for the initial construction of the roadway.

X. Monumentation: Monuments in monument boxes shall be provided in new or reconstructed streets at all section comers, quarter comers, and sixteenth comers.

Y. On-Street Parking: Where provided, parking spaces must adhere to location requirements specified in Title 7, Chapter 2 of the City Code.

5.5 Sidewalks

Design Standards

A. Sidewalk Location: Concrete sidewalks shall be constructed on both sides of all roadways unless otherwise approved by action of the City Council. Sidewalk design and construction shall be in accordance with Title 8, Chapter 2 of the City Code.

   Developments abutting existing or proposed roadways will be required to have sidewalks within the public right-of-way and parallel to the roadways.

B. Sidewalk Width: All sidewalks shall have a minimum width of five feet with the following exception:
   a. Per Title 8, Chapter 2 of the City Code, the minimum width shall be 14 feet for sidewalks on either side of Main Street and eight feet wide for all sidewalks on both sides of all streets crossing Main Street for the distance of one block from each side of Main Street.

C. Sidewalk Thickness: All sidewalks that are to be publicly maintained and all sidewalks along arterial streets shall be 6-inches thick reinforced concrete. Other sidewalks shall be 6- inches thick across driveways, and 4-inches thick elsewhere. Refer to Title 8, Chapter 2 of the City Code for specific construction requirements for sidewalks along Main Street.

D. Pedestrian Ramps: Pedestrian ramps shall be installed at all intersections and at certain mid-block locations for all new construction or reconstruction of curb and sidewalk. Pedestrian ramps shall be constructed in accordance with Americans with Disabilities Act (ADA) requirements.

E. Guardrails: Guardrails may be required in certain situations adjacent to sidewalk. Guardrails shall be designed and constructed in accordance with AASHTO standards or as directed by the City. Where guardrail is required, it must meet the Test Level (TL) that corresponds with the design speed of the roadway.

F. Curb Bulbs: Curb bulbs shall be considered on a case-by case basis for locations where enhanced pedestrian safety and visibility is desired at crossing locations. Curb transitions for curb bulbs shall be accomplished using 35' minimum radius curves to achieve the desired pavement narrowing. All curb bulbs shall be adequately marked with flexible roadway delineators and yellow curb paint, as necessary. The minimum curb bulb throat width is 24 feet (edge of pavement to edge of pavement).

G. Sidewalk Chases: Stormwater from concentrated points of discharge shall not be allowed to flow over sidewalks but shall drain to the roadway by the use of chase sections. The use of sidewalk chases is discouraged, and their use is limited to situations where it is not possible to use standard storm inlets and piping. Chase sections shall not be located within a curb cut of a driveway. Chase sections shall be identified by station and elevation.

5.6 Signs and Markings

Design Standards

A. Signs: Street identification signs shall be installed at all new intersections in accordance with the MPWSS. All regulatory traffic control signs shall be completed in accordance with the MUTCD. Stop signs shall be installed on local streets when they intersect with any collector or arterial streets.

   All proposed road names shall be submitted to the City for approval prior to preliminary plat submittal.

B. Crosswalks: Crosswalk markings should not be used indiscriminately. An engineering study should be performed before crosswalks are installed at locations away from traffic signals or stop signs. Mid-block crosswalks are discouraged.

Construction Standards

A. Signposts: Signposts shall be 2-inch by 2-inch Telespar brand square break away or approved equal.

B. Pavement Markings: All arterial intersection, crosswalk, stop bar, and word and symbol pavement markings shall be inlaid thermoplastic. Epoxy intersection markings are sufficient for collector-collector intersections. Arterial and collector roadway centerlines, bike lanes, and outside lane lines, away from major intersections, shall be epoxy paint.

5.7 Street Lighting

The City maintains an existing street lighting district. The design engineer shall consider the need for roadway lighting in the development of plans for any new or reconstructed roadways through coordination with the City.

The goal of roadway lighting systems is to enhance nighttime safety, utility, and security. Lighting practices and systems shall also attempt to conserve energy, minimize light pollution, glare, and overall degradation of the nighttime visual environment.

5.8 Bicycle Facilities and Multi-Use Paths

Design Standards

A. Bike Lanes: All bike lanes/paths shall be designed in accordance with the "Guide for the Development of Bicycle Facilities" (AASHTO, latest edition). Bike lanes shall be marked and signed in accordance with the MUTCD.

B. Multi-Use Paths: Multi-use paths or trails shall be at least 10 feet wide with an inside edge radius of at least 15 feet. The minimum asphalt pavement thickness shall be 2 inches with a minimum of 4 inches of high quality untreated aggregate base.

5.9 Bridges

Bridges shall be designed in accordance with current Gallatin County bridge requirements and the AASHTO Standard Specifications for Highway Bridges for “off-system” bridges.

5.10 Traffic Signals

The need for new traffic signals shall be based on design guidance provided in The Highway Capacity Manual or MDT’s Traffic Engineering Manual and on City policies. Safety and community traffic circulation and progression shall be the primary considerations in determining the location of a new signal. MUTCD provides guidance for the configuration of signalized intersections.

6.0 Submittal Requirements

This chapter provides general guidance and requirements for plans, design reports, and specification submittals to the City.

6.1 Plans

Civil plans shall be provided in PDF format. The following criteria shall apply to all construction plan submittals to the City.

A. Coordinate System: Project coordinate system shall be Montana State Plane – International Foot.

B. Datum: Project datum shall be North American Vertical Datum 1988 (NAVD 88).

C. Contours: Existing contours shall use a dashed line-style. Proposed contours shall use a continuous line-style. Major contour lines shall be thicker than minor contours.

   Urban area contour intervals shall be maximum 5-foot major contour interval and maximum 1-foot minor contour interval. Unimproved area contour intervals shall be maximum 10-foot major contour interval and maximum 2-foot minor contour interval. The City reserves the right to request smaller or larger contour intervals for clarity if necessary.

D. Alignment Data: Coordinate data shall be provided for the beginning of alignments, alignment changes in direction, and at the end of alignments. Curve data shall include length of curve, curve radius, chord length, and chord bearing. Bearings and distances shall be provided between points on alignments.

E. Title Sheet(s): Plan sets shall include a title sheet that provides the project title, vicinity map with project limits, firm or engineer information, MT professional engineer stamp, legend of symbols, public land survey system information, and table of contents.

F. Plan Sheets: All plan sheets shall clearly display the project title, sheet title, sheet number, MT professional engineer stamp, revision data, north arrow, and scale bar.

G. Detail Sheets: Provide detail sheets as necessary to highlight any additions, deletions, or modifications to standard details.

H. Plan and Profile Sheets: Plan and profile sheets shall be provided for all proposed water main, sanitary sewer main, storm main, and streets.

   Tables 6-1 and 6-2 summarize information and features to be included on construction plans.

Table 6-1 – General Plan Requirements

Plan View		Profile View
☐ North Arrow ☐ Legend of Symbols ☐ Property lines and ownership or subdivision information ☐ Street names and easements with width dimensions ☐ Project stationing ☐ Limits of existing paved or graveled surfaces ☐ Monument boxes ☐ Culverts	☐ Existing and proposed utilities and structures, including: ○ Line size and material where appropriate ○ Water lines (main lines and service lines), valves, and hydrants ○ Sanitary sewer lines (main lines and service lines) and manholes ○ Storm sewer lines, manholes, and inlets ○ Gas lines ○ Electric lines, poles, transformers ○ Telephone lines, manholes, junction boxes ○ Cable T.V. lines, junction boxes ○ Irrigation ditches and structures ○ Irrigation systems ○ Fiber optic lines, manholes, junction boxes ○ Streetlights ○ Proposed method of restoration of all areas disturbed during construction.	☐ Vertical and horizonal grids to scale ☐ Proposed ground (solid) ☐ Existing ground (dashed) ☐ Crossings of other utilities and separations from them ☐ Parallel utilities shown in greyed line style ☐ Project stationing ☐ Pipe with length, slope (if gravity), and material type ☐ Bury depth ☐ Groundwater depths (if identified) ☐ Structures and appurtenances with station and offset or coordinates

Table 6-2 – Utility and Roadway Plan Requirements

<table>
<tr><th colspan="3">Utility Plan Requirements</th><th>Roadway Plan Requirements</th></tr>
<tr><th colspan="3">General Notes</th><td rowspan="2">☐ Limit of cut or fill
☐ Existing and proposed utilities, including manholes and valves
☐ Proposed new construction, including paving width and limits, curb, and gutter, crosspans, sidewalks, and pedestrian ramps
☐ Existing and finished grades, with finished grade slopes
☐ Vertical and horizontal curves, with curve data:
○ Horizontal curves - R, △, L, PC and PT Stationing
○ Vertical curves - K, L, Station of PT' s
☐ Profile of centerline
☐ Profiles of left and right curb lines if they are not the same
☐ Any required utility adjustments
☐ Existing and proposed signs and pavement markings
☐ Existing and proposed storm drainage facilities, including culverts, pipes, inlets, sidewalk chases, ditches, and detention/retention ponds, with invert and/or spot elevations
☐ Top of curb elevations at P.C.s, P.T.s, and inlets
☐ Existing and proposed street monuments
☐ Typical roadway section(s), dimensioned and drawn to scale, showing:
○ Right-of-way
○ Backslopes
○ Sidewalks
○ Curb and gutter
○ Pavement thickness
○ Base and sub-base thickness
○ Compaction requirements
○ Cross-slopes</td></tr>
<tr><td colspan="3">☐ All construction will conform to MPWSS, (Latest Edition)
☐ Any existing or new valves which control the CITY's water supply shall be operated by CITY personnel only.
☐ The Contractor shall notify the CITY a minimum of 24-hours prior to beginning any work.
☐ Contractor shall field-verify line and grade of existing conditions.</td></tr>
<tr><th>Water</th><th>Sanitary Sewer</th><th>Storm Sewer/Drainage Facilities</th></tr>
<tr><td>☐ Size, type, and structural class of proposed new water line(s), including AWWA specifications
☐ Bedding class
☐ Type of excavation and backfill
☐ Existing water lines including size and material
☐ Proposed valves, fittings, fire hydrants, and service lines, with stationing
☐ Depth of cover from finish grade to proposed water line(s)
☐ Requirements for pipe deflection, if necessary
☐ Type of joint restraint, if required
☐ Size of gravity thrust blocks based on calculated design
☐ Existing or proposed pressure reducing valves.</td><td>☐ Size, type, and structural class of proposed new sewer line(s), including ASTM specifications
☐ Slope of each proposed pipeline segment
☐ Bedding class
☐ Type of excavation and backfill
☐ Existing sewer lines and manholes including size, material, field-verified invert elevations, and field-verified slopes
☐ Proposed manholes with stationing and rim and invert elevations
☐ Existing and proposed sewer service lines with size and stationing
☐ Existing and proposed cleanouts.</td><td>☐ Size, type, and structural class of proposed new storm sewer line(s), including ASTM specifications
☐ Slope of each proposed pipeline segment
☐ Bedding class
☐ Type of excavation and backfill
☐ Proposed manholes with stationing and rim and invert elevations
☐ Proposed inlets and inlet service lines with stationing and invert elevations
☐ Points of stormwater discharge.
☐ Cross-section of proposed ponds or swales including bottom elevation, structure elevations, maximum water surface elevation, inlet/outlet elevations, berm elevations and slopes
☐ Pond/swale landscaping and compaction requirements
☐ Riprap pad material gradation, thickness, and dimensions.</td></tr>
</table>

6.2 Design Reports

Design reports shall be provided in PDF format and submitted as separate documents for each report. A professional engineer licensed in the state of Montana, shall be responsible for each report and shall stamp the front cover of each separate document. All reports shall be inclusive, clear, legible, and reproducible. An uninvolved third party shall be able to review the report and determine whether all applicable standards have been met.

Calculations should be presented in a logical format with sufficient information to allow an uninvolved third party to reproduce the results. All assumptions, input and output data, and variables listed in computer printouts and hand calculations shall be clearly identified. All calculations used to determine the size of facilities shall be included within the design report.

The following additional criteria shall apply to design report submittals to the City.

A. Water Improvements Design Report: The design and design report shall meet the minimum requirements of MDEQ Circular 1.

   The report shall include flow test results or modeled flow results, as approved by the City. The City will perform the required hydrant flow testing or provide the modeled flow data to the design engineer at no cost, if so requested. The design engineer shall be limited to a single hydrant flow test per development per year, unless otherwise approved by the City.

   An overall plan of the development, including all areas outside of the study area which would naturally be served through the study area shall be provided.

B. Sanitary Sewer Improvements Design Report: The design and design report shall meet the minimum requirements of MDEQ Circular 2.

   An overall plan of the development, including all areas outside of the study area which would naturally be served through the study area shall be included.

C. Storm Drainage Improvements Design Report: The storm drainage improvements report shall meet the minimum requirements of MDEQ Circular 8 and include the following elements:
   a. Background information relevant to drainage design, including topography, soils, surface, and vegetative conditions, etc.
   b. Pre-development drainage patterns for all basins contributing flow to, on, though, and from the site. Include all assumptions and justifications used to determine curve numbers and/or runoff coefficients used in the analysis. Identify and discuss all existing natural or constructed on-site and/or off-site drainage facilities.
   c. All assumptions used to determine the characteristics of the post-developed basins, such as the size of roofs and driveways, and the curve numbers and/or runoff coefficients used in the analysis.
   d. Discussion of the probable impacts down-gradient of the project site such as properties receiving more standing or floodwater than the pre-developed condition, erosion, slope failures, or changed runoff patterns.
   e. Discussion of the hydraulic methods and storm events used in sizing the drainage facilities.
   f. Discussion of calculation results and a description of the proposed stormwater facilities. Include a table comparing the pre-developed and post-developed conditions including rates and volumes. Provide a table summarizing the maximum water elevation of the facilities for the design storms, outflow structure information, the size of facilities

"required" by the calculations, and the size of the facilities "provided" in the proposed design.

g. Information about the operation of the stormwater system so that an uninvolved third party can read the report and understand how the proposed system will function under various conditions.
h. Discussion of the provisions set forth to operate and maintain the drainage facilities in addition to the project owner's mechanism for funding the operation and maintenance activities.
i. Location of any proposed off-site easements required for proposed stormwater conveyance or disposal facilities outside the project boundaries.

D. Traffic Impact Study (TIS): A TIS is required for developments contributing 200 or more vehicle trips per day to the City street system per utilization of the ITE Trip Generation Manual. The TIS shall be prepared and stamped by a professional engineer and completed in accordance with MDT requirements and nationally accepted standards. Study limits of the TIS shall be determined by the City. The TIS shall include the following elements:
   a. Summary of the study's purpose and goals.
   b. Description of the site and study area.
   c. Summary of existing traffic conditions including roadway geometries, LOS of each intersection, traffic counts, crash analysis, and road capacity analysis.
   d. Anticipated nearby land developments and transportation improvements.
   e. Analysis and discussion of trip generation, distribution, and modal splits.
   f. Traffic assignment resulting from the proposed development.
   g. Projection and assignment of future traffic volumes.
   h. Identification of all negative impacts associated with the proposed development including LOS impacts.
   i. Details of a proposed mitigation plan for the negative impacts based on nationally accepted standards and resources.
   j. Recommendations for off-site improvements to the primary access and related transportation facilities and infrastructure which are directly attributable to the development.
   k. Discussion of other forms of transportation, including bicycle and pedestrian.

6.3 Specifications

The City has adopted the MPWSS as the standard specifications for new construction. All project manuals must incorporate, preferably by reference, MPWSS (latest adopted edition). Additions or changes to the above standard specifications must be done through Special Provisions or similar supplemental sections in the project manual.

6.4 DEQ Submittals

A. Water and Sewer System Designs: Water and sanitary sewer system designs shall be submitted for concurrent review to MDEQ.

B. Municipal Facilities Exclusion (MFE): An MFE may be required by MDEQ as part of their review process prior to construction. An MFE may be submitted to the City for certification of the availability of municipal services in cases where utilities are available to lots or subdivisions' utility plans have been approved by the City. The City's MFE approval and all capacity allocations shall expire with the expiration of DEQ's original design approval for construction.

C. The developer is responsible for any fees associated with DEQ review and approvals.

7.0 Review and Approval Process

7.1 Fees

Plan review fees shall be submitted to the City for items covered in this document. Additional review fees may be required for each successive plan review. Fees will be tabulated and paid for at the time of issuance of a zoning permit, or if a zoning permit is not required, after the submittal items have been reviewed and are ready for approval.

7.2 Responsibilities

The following responsibilities shall apply to parties involved with design and construction of infrastructure improvements in Three Forks:

A. Professional Engineer: The professional engineer must design improvements that meet the minimum STANDARDS as specified or referenced herein during design and construction.

B. Contractor: The contractor shall not start construction until final plans have been approved by the City. The contractor shall meet the minimum construction STANDARDS as specified or referenced herein, or as otherwise required by approved plans.

C. City Staff: City staff are responsible for review of the design and construction to verify compliance with the STANDARDS.

D. Developer: Developers must employ a professional engineer to design the project or development in accordance with the minimum STANDARDS as specified or referenced herein as well as verify compliance with minimum construction STANDARDS throughout construction of all proposed City infrastructure within the development. Developers shall employ a contractor to meet the minimum construction STANDARDS as specified or referenced herein.

E. All Parties: If at any point of design or construction, an unapproved deviation from the STANDARDS is realized by the engineer, contractor, the City, or the developer, immediate action shall be taken to correct the issue and bring the design or construction into compliance with the STANDARDS currently in effect at no cost to the City. Any changes from approved drawings shall be reviewed and approved in writing by the City engineering staff, prior to construction.

7.3 Initial Review

The City shall attempt to complete the initial review and provide written comments to the engineer/owner within 30 calendar days of receiving the initial submittal. A review meeting may be scheduled with the design engineer and City representatives to discuss review comments if the design engineer desires. The City will review all submittals for compliance with the STANDARDS. Acceptance by the City does not relieve the owner, design professional, or contractor from responsibility for ensuring the calculations, plans, specifications, construction, and record drawings follow the STANDARDS.

7.4 Revisions and Re-Submittals

Submittal of revised plans and specifications shall be accompanied by a written response from the design engineer which addresses each item in the initial City review comment letter. Individual civil plan sheets may be provided in re-submittals. All changes shall include revision bubbles. Revision notes shall be provided on the sheet including revision number, revision date, and any applicable notes.

The City shall attempt to complete each review of revised plans and specifications within 14 calendar days of receiving the revisions. All City review comments must be adequately addressed and resolved before the final plans and specifications are approved by the City for construction.

7.5 Design or Construction Deviation

Deviation requests shall be made in writing and shall identify the specific section of the STANDARDS requiring a deviation. The request shall state the standard as currently adopted, state the standard as proposed for the deviation, and provide adequate justification for the deviation. Requests shall be approved in writing by the City engineering staff. Deviations from the STANDARDS not individually approved as indicated above are not approved, even if shown in approved plans, specifications, or reports.

7.6 Final Plans and Specifications

Once all City review comments have been adequately addressed and resolved, the City must be supplied with three complete sets of the final plans and specifications, signed, and stamped by a Professional Engineer licensed in the State of Montana. Specification manuals are to be bound and contain the most current version of the revised documents and plan sheets are to be the most current version. The three final sets of plans and specifications submitted for City approval will be reviewed by the City to ensure that all requested modifications are included. An electronic version of the approved plans shall also be provided in PDF format.

A copy of the MDEQ project approval letter must be submitted to the City for projects subject to MDEQ review and approval.

Final stamped and approved plans and specifications will be distributed as follows: One set returned to the Engineer/Owner, one set to the City Public Works Department, and one set for City Hall.

No work is to begin on the project prior to obtaining the City's and MDEQ's written approval of the plans and specifications, and the completion of a preconstruction meeting conducted by the owner's engineer and attended by the contractor(s) and City representative(s). A "Pre-construction Meeting Checklist" will typically be included with the approval letter specifying additional documents which must be submitted prior to scheduling a pre-construction meeting.

8.0 Construction Procedures and Coordination

8.1 Pre-Construction Requirements

A. Contractor Registration: Any contractor working within an existing public right-of-way or easement shall be registered with the Montana Department of Labor and Industry, Employment Relations Division.

B. Liability Insurance: The contractor shall procure and maintain, at the contractor's expense, during the construction period, contractor's liability insurance in accordance with the supplementary conditions to the general conditions of the MPWSS for work within existing public right-of-way or easement.

C. Bonding: All construction work within the public right-of-way or easement (sidewalk, boulevard, pavement, curb construction, water, storm drainage, sanitary sewer service line installation, repair, etc.) will require the property owner/contractor to provide the City with a performance bond. The bond shall be equal to the value of the project and shall remain in force for one year. Contractors annually furnishing the City with a 2-year bond of $5,000 will not be required to furnish additional bonding if the $5,000 bond meets the requirements of these standards.

   Bonds may be in the form of a Surety Bond, a Certificate of Deposit (CD), a Certified Check or an irrevocable Letter of Credit issued by a bank licensed to do business in the state of Montana.

D. Public Right-of-Way Permit: All construction, excavation, or other work on public or private property which will necessitate the use of the public right-of-way or easement shall require a Public Right-of-Way Permit issued by the City. The work authorized by the permit includes but is not limited to street construction and repair; water, sewer, and storm system construction and repair; utility connections and repair; and landscaping, sidewalk, curbing and driveway construction and repair. Also included are any other uses of the public right-of-way where there is a possibility of creating a hazard. Examples of hazards are scaffolding, storage of materials or equipment, crane and equipment operations, demolition, sandblasting and painting operations, temporary construction or demolition dumpster placement and any other use deemed a hazard by the City.

   The permit will not be issued until all insurance and bonding requirements have been met. In an emergency which requires repairs to be made immediately, the contractor may excavate and complete the repairs without first having obtained a permit. Prior to beginning work at the site during normal working hours, the contractor shall notify the City. Prior to beginning work after hours, the contractor shall notify police dispatch. In either case, the contractor shall describe the circumstances and provide the location of the emergency repairs. The contractor shall obtain the permit no later than the next scheduled City workday.

E. City Fees: An impact fee shall be paid for the connection of each new water and sewer service to the system. This fee must be paid even if a service line has previously been stubbed to the property line or other accessible location. Impact fees for water and/or sewer must be paid before a zoning permit will be issued by the City and before service is approved.

F. Traffic and Pedestrian Control Plan: A Traffic and Pedestrian Control Plan shall be submitted to and approved by the City for all work within the public right-of-way. Plans shall conform to the latest edition of the MUTCD and shall illustrate the location and description of all traffic and pedestrian control devices. No work shall commence on the project until the plan is approved. All devices must be kept in place and maintained throughout the project. The City reserves the right to reject any device observed to be in substandard condition.

G. Pollution Control Permits: The contractor shall obtain all required Gallatin County pollution control permits prior to beginning construction. The contractor shall also obtain a storm water discharge permit for any land disturbance in the City. No sediment laden or polluted water shall be discharged off any construction or building site. A storm water discharge permit for construction sites is required for land-disturbing activities which include, but are not limited to, excavation, planting, tilling, and grading, which disturbs the natural or improved vegetative or developed ground cover so as to expose soil to the erosive forces of rain, stormwater runoff or wind. All installations and maintenance of franchise utilities such as telephone, gas, electric, etc., shall be considered land disturbing activities. The Contractor is responsible for preparing and signing a Storm Water Pollution and Prevention Plan (SWPPP) and submitting a complete Notice of Intent (NOI) package to the MDEQ. The Contractor will be responsible for all fees associated with the permit application.

H. Preconstruction Meeting: A preconstruction conference shall be held prior to the start of any construction. The City, project engineer, owner, contractor, and any other parties pertinent to the project shall be represented. The pre-construction conference shall include discussion of the construction schedule, shop drawing submittals, utility installation, materials testing, quality control, maintenance bond, and other items as may be necessary.

I. Shop Drawing Submittals: If the proposed items to be installed differ from the approved plans and specifications, shop drawings shall be submitted for review no later than 10 business days prior to the proposed installation.

8.2 Notices and Coordination

A. Applicable Laws and Indemnification of the City: The Contractor shall give all notices and comply with all federal, state, and local laws, ordinances and regulations affecting the conduct of the work, and shall indemnify and hold harmless the City against any claim or liability arising from, or based on, the violation of any such law, ordinance, regulation, etc., whether by himself or his employees.

B. Interruption of Service: Any construction that will interrupt the normal operation of city sewer, water, storm, or transportation facilities requires notification of affected City departments and property owners and/or residents. The contractor shall notify City Hall at least 48 hours prior to any street closures. All street closures or interruptions of utility services will require the contractor to provide a news release specifying the location of construction and the duration of the closure. The contractor shall present the news release to the news media at least two workdays prior to the beginning of any construction activity. The contractor shall also notify utility users affected by the interruption of the type and duration of the interruption at least 48 hours prior to beginning construction.

   In the event of an emergency interruption, the contractor shall notify City Hall immediately. The Contractor shall immediately dispatch members of his staff to notify affected individuals by telephone or personal contact.

C. Water Service Construction: When it is necessary to tap an existing water main for a service connection, the contractor will excavate around the main and prepare a safe trench from the main to the approved curb stop location. The City will provide the equipment, labor, and materials required to tap the main and install the service line from the main to the curb stop valve. The contractor will install backfill and restore the pavement surface. The City will charge the owner for equipment, labor, and materials required to complete the work. The owner will be responsible to construct the service line from the curb stop to the point of service.

D. Construction of Sewer or Storm Service: When it is necessary to tap an existing sewer or storm main for a service connection, the contractor will provide the equipment, labor, and materials required to tap the main, install the service line from the main to the point of use, and restore the public right of way to the pre-construction condition meeting minimum City Standards. City personnel shall inspect the tap prior to backfill.

E. Construction Inspection: Maintenance and repair work within public right-of-way or easement shall be inspected and approved by the City. It is the Contractor's responsibility to notify the City of the work requiring inspection at least 48 hours in advance so the City may schedule and perform such inspections.

A written Stop Work Order may be issued by the City if the maintenance and repair work in progress does not meet the STANDARDS, or for any other valid reason. Work may resume only after a written Resume Work Order has been issued by the City.

8.3 Traffic and Pedestrian Control

A. Emergency Access: Emergency access to the work area shall be maintained at all times.

B. Barricades: All barricades and obstructions shall be protected at night by suitable signal lights which shall be kept illuminated from sunset to sunrise. Barricades shall be of substantial construction and shall be constructed to increase their visibility at night. Suitable warning signs shall be placed to show in advance where construction, barricades or detours exist. All signs used at night shall be either retro-reflective with a material that has a smooth, sealed outer surface or illuminated to show the same shape and similar color both day and night.

C. Flagging: If flagging is required, it shall be accomplished by competent and properly equipped flag persons. Flagging shall be accomplished as described in the MDT Flagger's Handbook and the MUTCD.

D. Traffic Control: Traffic control devices shall be removed from visual contact with the traveling public when they are not being used for construction activities. The Contractor shall remove all traffic and pedestrian control devices within 24 hours of the conclusion of the project construction. If the contractor fails to maintain the Traffic and Pedestrian Control Devices in accordance with the approved plan, the City reserves the right to correct the deficiency and all labor, equipment, material, and administrative costs will be billed to the contractor.

8.4 General Construction Requirements

A. Disposal of Excavated Material: All material unsuitable for trench backfill, sub-base or base construction, excavated from the developed public right-of-way or easement shall be removed from the site and disposed of by the contractor. The disposal site shall meet regulatory provisions for disposal of the unsuitable excavated material. Unsuitable excavated material shall not be stockpiled on site without the written approval of the City. Excavated material shall be confined to the work zone as established during the preconstruction conference or as shown in the contract documents.

B. Equipment: All steel tracked equipment operating within a public street right-of-way shall be fitted with triple grouser street pads. The contractor shall be responsible for damages to City infrastructure within the public street right-of-way.

C. Intersection Monuments: When a street is to be reconstructed, prior to any excavation, a thorough search shall be made for existing intersection monuments. If found, such monuments

and any other survey monuments likely to be disturbed or destroyed, shall be preserved by or under direction of a Professional Land Surveyor in accordance with MCA 70-22-1151. All monuments set shall meet the requirements of ARM 24.183.11012. Monuments set in pavement or concrete driving surfaces shall be placed inside of a cast iron monument box.

D. Pavement Restoration: The contractor shall restore all surfaces within 14 calendar days after completing the backfill work.

Pavement restoration shall match the pavement structure thickness as shown on the roadway standard details. All excavations within four feet of the edge of the asphalt (including the outer edge, the crown, or adjacent seam) shall require removal and replacement from the edge of asphalt to the excavation edge. Asphalt patch areas that fall within the wheel path of the vehicular travel lane shall be increased in size to the center of the lane or adjacent lane. In no circumstance will the edge of a patch area be allowed to fall within the wheel path.

Any damage to the existing asphalt surface caused by the contractor's operations shall be repaired at the expense of the contractor, including but not limited to gouges, scrapes, outrigger marks, backhoe bucket marks, etc. A slurry seal shall be considered the minimum standard for a repair to existing surfacing.

The contractor shall be responsible for maintaining the area in a smooth and drivable condition until the permanent pavement is placed. If the ground is frozen, the road cut shall be temporarily repaired with a minimum thickness of 2-inches of cold patch material. The temporary repair shall be maintained by the contractor for safe winter usage. The permanent restoration shall be made as soon as the ground is thawed in the spring, or as directed by the City.

If the Contractor fails to restore the pavement within the 14-day period or fails to maintain the trench or area as required, the City reserves the right to complete the restoration or maintenance, and all labor, equipment, material, and administrative costs will be billed to the contractor. The City reserves the right to call on the contractor's performance bond if the bill is not paid within 30 days.

E. Relocation of Utilities: Requests to relocate an existing public utility shall be submitted in writing to the City. A sketch shall be included that illustrates the existing location of the utility and the preferred relocation site. The request shall describe in detail the circumstances for the request.

The City may require the utility relocation to be designed by a licensed professional engineer. If the relocation is approved by the City, the utility shall be relocated by a bonded and insured utility contractor. Under no circumstances will the City pay for any costs associated with the relocation of the utility. Relocation of water and sewer may also be subject to MDEQ review and approval.

F. Underground Utilities: All underground electrical, gas, phone, and TV cable lines must be installed at least three feet horizontally from water, sanitary sewer and storm sewer mains and services.

G. Boulevard Landscaping: The Contractor shall place a minimum of four inches of topsoil within the boulevard. The finished surface of the topsoil shall provide adequate drainage from the top of the sidewalk to the top of the curb. Topsoil shall be fertile, natural loam surface soil, free of clay, weeds, roots, or stones larger than one inch in any dimension.

8.5 Construction Inspection, Testing, and Quality Control

A. Construction Inspection: A professional engineer, or the professional engineer's designated representative, shall provide construction inspection and testing as required during construction.

Failure to submit required testing and other documentation shall be considered valid justification for non-acceptance of construction work and/or public infrastructure. Inspection and testing shall be in accordance with the current edition of the MPWSS and the STANDARDS.

B. Quality Control Procedures: The following quality control procedures shall apply to all utility and roadway construction projects. The City reserves the right to conduct independent quality assurance testing at the City's expense during any phase of the construction. The contractor shall bear the expense of failed tests and the expense of bringing the material into conformance with the required specifications.
    a. All water main valves and fittings, fire hydrants, sewer manholes, wet wells and sewer/water main crossings shall be inspected and approved by the professional engineer, or his designated representative, prior to backfilling.
    b. A professional engineer, or the professional engineer's designated representative, shall be present for all tests required in MPWSS. A written record of all test results shall be submitted to the City and certified by the professional engineer of record for the construction.
    c. A professional engineer, or the professional engineer's designated representative, shall provide the City with copies of daily inspection reports, including Proctors and compaction test results for all projects. These reports shall be submitted on a weekly basis and certified by the professional engineer of record for the construction.

C. Compaction Testing: Minimum compaction testing procedures and requirements are listed in Table 8-1 and shall apply to all utility and roadway construction projects. An independent accredited testing laboratory shall be retained to provide the following tests and frequency. Random longitudinal test locations are required. The professional engineer, or the professional engineer's designated representative, may require additional tests. For projects containing less than 300 linear feet of improvements, a minimum of one compaction test for each improvement shall be required for the improvements listed below.

D. Video Inspection of Sewer Mains: A video inspection of sewer mains shall be provided by the contractor. The contractor shall flush the main with dyed water immediately prior to inspection. Manholes and laterals shall be included in the video inspection. Inspection results shall be provided to the City in an electronic format capable of being viewed, copied, saved, and downloaded to standard Microsoft applications. Upon review of the video inspection by the authorized City representative, any deficiencies found shall be corrected by the contractor prior to final acceptance.

    The City reserves the right to inspect all underground utility systems by the use of a television camera prior to final acceptance. The cost of all video inspections by City staff will be billed to the contractor. The video shall include the distance traveled so that laterals and items of concern can be accurately located. The camera shall be equipped with a turret in order to inspect all services from a facing view of the camera. The crawler shall be equipped with means of measuring ponded water in bellies that may be in the pipe to meet the minimum requirements of MPWSS.

Table 8-1 – Compaction Testing Requirements

Surface Type	Sets of Tests	Minimum Density	Horizontal Frequency	Notes
Utility Trenches and Underground Structures	□ For trenches up to 8 feet in depth, density tests shall be taken at 12 inches above the pipe, at one-half the trench depth, and at the surface. □ For trenches greater than 8 feet in depth, density tests shall be taken at 12 inches above the pipe, at one-third and two-third the trench depth levels, and at the surface	95% Standard Proctor, ± 3% optimum moisture	□ Utility Mains: One set of tests per 150 feet. □ Service Lines: One set of tests per 3 services, per utility type. □ Open Pit: Minimum of one set of tests (Open Pit – at each manhole, water valve, storm inlet, curb inlet, vault, etc.)	Each test location shall be separated horizontally from a prior test location.
Street Subgrade	□ All sub-base □ All crushed gravel base	95% Standard Proctor, ± 3% optimum moisture	One random density test, every 100 linear feet of street per land with random offsets.	
Asphalt	Pavement and material testing requirements shall be in accordance with MPWSS Section 02510 Paragraph 3.28 and 3.29, except: □ Add subsection 3.28G to the standard as follows: "Asphalt compaction samples will be taken according to AASHTO T 230 and tested in accordance with AASHTO T 166. One location per lane per block as determined by the Engineer shall be required. □ Subsection 3.29E shall be replaced with: "The field density and thickness of the pavement is determined by measuring the cores tested. The actual thickness shall not be less than the design thickness and shall in no case be less than 4 inches." □ Subsection 3.29F shall be replaced with: "Asphalt thickness shall be measured using full depth core samples. Thickness shall be measured from the surface of the specimen to the bottom of the uniform plant mix which thickness shall not include foreign materials, seal coat, foundation material, soil, paper, or foil. Thickness less than specified thickness as measured on the acceptance sample shall be subject to rejection for the lane and block from which the specimen was taken as determined by the Engineer."			
Concrete	□ Air Content, Slump, Unit Weight, and Temperature are required on every truck of structural concrete delivered to the project. □ 4-inch or 6-inch concrete compressive strength cylinders shall be cast a minimum of once per day (when concrete is placed) or every 50 cubic yards placed. □ Cylinder sets shall include: One 7-day cylinder, Two 28-day cylinders, and One hold cylinder (for break error or low break)			All tests shall be performed by a technician with a minimum of an ACI Grade I certification.

8.6 Post-Construction Procedures

A. Final Acceptance: The City's final acceptance of the water, sewer, stormwater, and street improvements will occur upon completion and acceptance of all required infrastructure development. Final acceptance will be granted upon the completion of the following items:
   a. A comprehensive walk-through with City staff, the engineer of record, and the developer.

b. Completion of the final punch-list items.
c. Final certification from the professional engineer of record that the construction of the water, sewer and storm utilities and roadways meet the requirements of the approved construction documents.
d. Submission of final as-built drawings in an electronic format suitable for City archival.
e. Submission of the complete set of daily field inspection logs and photographs.
f. Copies of the test results required under Section 8.5.
g. Provision of a letter by the owner, requesting ownership transfer of the newly constructed public infrastructure to the City.
h. A two-year maintenance bond for public infrastructure as described in Section 8.6.B.

The City will not accept the project until all the required information has been received and approved by the City Engineer. City staff will respond in writing to a request for final acceptance.

B. Guarantee for Equipment, Materials, and Workmanship: The Contractor shall guarantee all materials and equipment furnished, and construction work performed for maintenance and repair work on existing City infrastructure for a period of two years from the date of written acceptance of the work by the City.

The guarantee for new City infrastructure shall be for a period of two years from the date of written acceptance of the work by the City. In the case of a subdivision, the date of acceptance will be final plat approval or acceptance by the City, whichever is later.

Guarantees shall be in the form of a maintenance bond which shall be required prior to final plat or certificate of occupancy. The maintenance bond shall be equal to 20% of the total value of public infrastructure constructed and shall remain in force throughout the guarantee period. The City reserves the right to draw on the maintenance bond for repairs not completed by the responsible party within 30 calendar days of being advised that repairs are required. Maintenance bonds may be in the form of a Surety Bond, a Certificate of Deposit (CD), a Certified Check or an irrevocable Letter of Credit issued by a bank licensed to do business in the state of Montana. The commencement date for the maintenance bond shall be the date set for the completion of the required improvements as stated in the subdivision improvements agreement, the date of substantial completion as certified by a professional engineer, or the date final plat is granted, whichever is later. If the expiration date of the maintenance bond falls after November 16, the expiration date of the maintenance bond shall be June 30 of the following year.

C. Two-Year Guarantee Inspection: The project engineer, or his designated representative, shall conduct a two-year guarantee inspection, to be attended by a representative from the City. The inspection shall take place not less than 90 days or more than 120 days prior to the expiration date of the maintenance bond. The maintenance bond will be released when all deficiencies have been corrected to the satisfaction of the City Engineer.

D. Warranty Work: The City Engineer, the project engineer, or the designated representative, shall notify the principal as listed in the maintenance bond of any work found to be not in accordance with the approved construction documents. The principal shall restore the work to meet the requirements of the approved construction documents prior to the release of the maintenance bond. The City expressly reserves the right to draft the maintenance bond for repairs not completed by the owner, developer, or contractor within thirty calendar days of being advised that repairs are required.

Appendix A

Manhole Sizing Requirements

MANHOLE SIZING RECOMMENDATIONS

Introduction

Round manholes are the most widely used maintenance utility structures that provide access to pipelines for inspection and cleanout. Manholes are used for connecting two or more converging storm or sanitary sewers, permitting pipe size changes, accommodating abrupt changes in alignment or grade and allowing for direct surface flow interception. The largest impact on the size of these structures is the diameter and angle of entrance of the intersecting pipe.

This document provides a guideline for sizing round manhole structures for various sizes and angles of incoming pipe.

Sizing Considerations

Two main design criteria in designing manholes, are that they must be large enough to accept the maximum pipe size, and the minimum structural leg width between pipe holes must be maintained.

The minimum pipe opening is assumed to be the pipe's inside diameter plus the wall thickness. The minimum structural leg is, as a practical minimum, 6 inches. Anything less than this width may allow cracking, which can lead to leakage, structural distress or durability concerns.

A typical additional over sizing of no more than 4 inches larger than the outside diameter of the pipe is used for the cutout. The final cutout or opening, therefore, includes all of these design provisions with respect to all other pipe openings, relative pipe elevations and vertical clearances.

The type of pipe entering the structure, and the connection method (boot, compression or mortar) must be known to accurately determine the required holes size and consequently, the manhole size.

When possible, avoid pipes entering into structure joints and corners, as this may compromise the structural integrity and watertightness of the structure. However, this practice may be necessary for certain installations and should be left to the discretion of an experienced precast concrete manufacturer.

Always consult your local precast concrete manufacturer and connector supplier for exact design requirements and product specifications.

Design Method

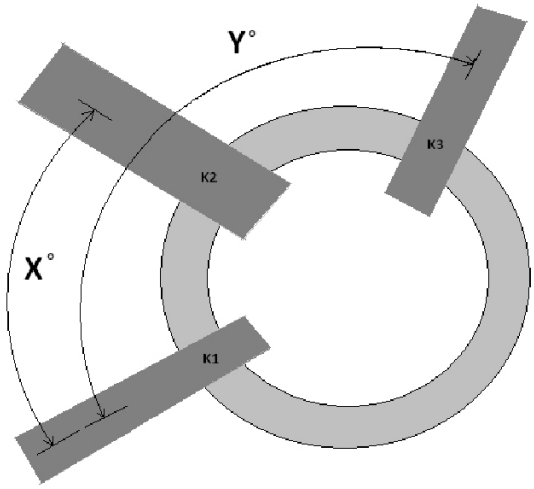
The following is a method that can be used to determine minimum manhole size for as many as three incoming pipes. (For installations where more than three pipes enter a manhole, the design equations in the Appendix must be used.)

The formulas are:

- **One Pipe:** $180° > K$
- **Two Pipes:** $180° > X° > (K_1+K_2)/ 2$
- **Three Pipes:** $180° > X° > (K_1+K_2)/ 2$ *and*
  $X° + (K_2+K_3)/ 2 < Y° < 360° - (K_1+K_2)/ 2$

Where **K** represents the **K Factor** that can be found in the tables that follow for different types of pipe.

X° and Y° are the angles between the pipes



Reference Pipe

NPCA
Precast ... The Concrete Solution

RCP AND HDPE PIPE 'K' FACTOR

Pipe Diameter (inches)	Manhole Diameter						
	48 in	60 in	72 in	84 in	96 in	108 in	120 in
72	-	-	-	-	154	120	102
66	-	-	-	-	129	106	92
60	-	-	-	142	112	95	83
54	-	-	-	119	98	84	74
48	-	-	131	102	86	75	66
42	-	154	109	88	75	66	58
36	-	118	91	76	65	57	51
33	180	106	84	70	60	53	47
30	136	96	76	64	55	49	44
27	117	86	69	58	51	45	40
24	103	77	63	53	46	41	36
21	90	69	56	48	41	37	33
18	79	61	50	43	37	33	29
15	68	53	44	37	33	29	26
12	59	46	38	32	28	25	23

PVC AND DUCTILE IRON PIPE "K" FACTOR

Pipe Diameter (inches)	Manhole Diameter						
	48 in	60 in	72 in	84 in	96 in	108 in	120 in
64	-	-	169	117	97	83	73
60	-	-	140	107	90	78	69
54	-	-	124	98	83	72	64
48	-	142	104	85	73	63	57
42	-	115	89	74	63	56	50
36	135	95	76	64	55	48	43
30	105	79	64	54	47	41	37
24	83	64	52	44	39	34	31
20	70	55	45	38	33	30	27
18	64	50	41	35	31	27	25
16	58	46	38	32	28	25	22
14	53	42	34	29	26	23	20
12	47	37	31	26	23	20	18
10	42	33	27	23	21	18	16
8	37	29	24	21	18	16	14
6	31	25	21	18	15	14	12

CORRUGATED METAL PIPE 'K' FACTOR

Pipe Diameter (Inches)	Manhole Diameter						
	48 in	60 in	72 in	84 in	96 in	108 in	120 in
72	-	-	-	141	111	94	83
66	-	-	-	121	99	85	75
60	-	-	138	106	89	77	68
54	-	-	116	93	79	69	61
48	-	134	100	82	70	61	55
42	-	110	86	72	62	54	48
36	128	92	74	62	53	47	42
33	113	84	68	57	49	44	39
30	101	76	62	52	46	40	36
27	91	69	57	48	42	37	33
24	81	63	51	44	38	34	30
21	72	56	46	39	34	30	27
18	63	50	41	35	30	27	24
15	55	43	36	31	27	24	21
12	47	37	31	26	23	20	18
10	42	33	28	24	21	18	16

Design Tables

Since the wall thickness for the design of reinforced concrete pipe and high-density polyethylene pipe are similar, a standard precast concrete C-wall pipe thickness was used for the development of the tables for these products. For inlet pipes, which have greater total outside diameters than standard ASTM C76 C-wall pipes, you must use the design equations in the appendix to determine the acceptable manhole diameter.

The design tables for PVC and ductile iron pipe were based on the outside pipe diameters specified in the AWWA C150 standards for ductile iron pipe. Profile wall PVC pipe that does not conform to the maximum ductile iron outside diameters may have to use either the RCP/HDPE or corrugated metal tables depending on which is closer to its cross-sectional thickness.

The corrugated metal pipe tables were developed using a 0.064 wall thickness and a 0.5-inch corrugation pattern for all sizes. Since there are a great number of corrugation depths available for this product, the designer should adjust the design values in the table accordingly.

The equations presented in the Appendix of this document are simplified in the tables as previously noted for each pipe type. These tables are used to determine the minimum size manhole required for one, two and three pipes entering a single manhole structure at various angles. The "K" factors are based on the pipe diameter including its wall thickness and an appropriate supporting wall between the entering pipe for each manhole diameter. Maximum vertical cutoffs are limited to an 8-foot high riser.

Example

Given: *Two pipes entering a manhole: 42-inch RCP and 36-inch PVC at 115°*

Find: *Smallest size manhole*

Solution: *For two pipes* $180° \geq 115° > (K_1 + K_2)/ 2$

Trial 1 (60-inch manhole) K_1 (42-inch RCP)=154 (from RCP Table)
K_2 (36-inch PVC)=95 (from PVC Table)
(154 + 95)/2 = 125 >115
Result: Not Acceptable

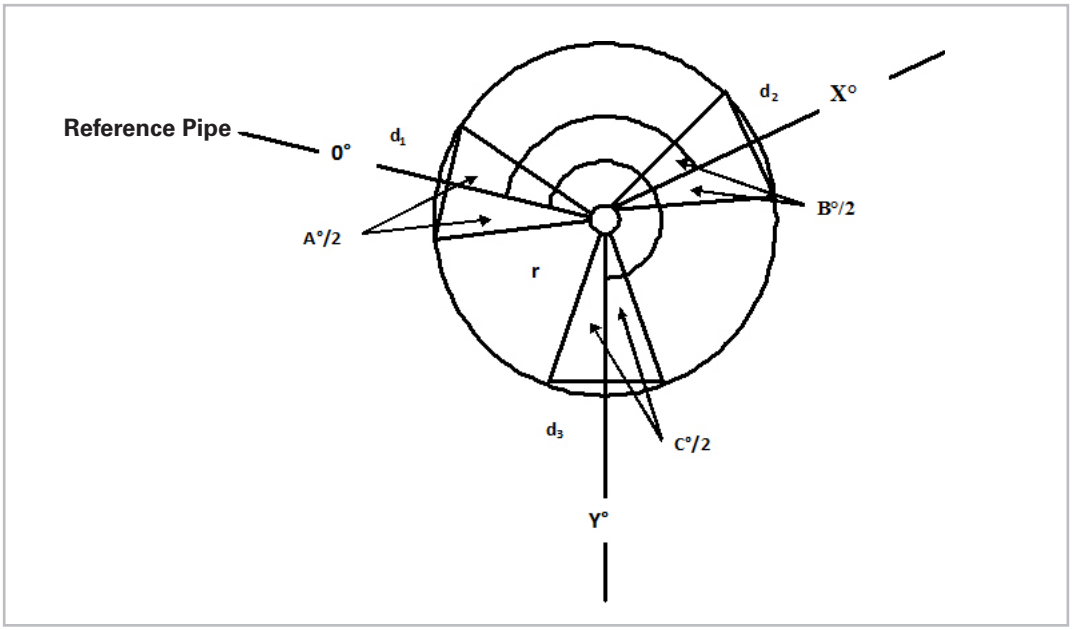
Trial 2 (72-inch manhole) K_1 (42-inch RCP)=109 (from RCP Table)
K_2 (36-inch PVC)=76 (from PVC Table)
(109 + 76)/2 = 93<115
Result: Acceptable

Summary

The procedures presented in this document provide a quick and easy solution for estimating the optimal size for manholes depending on the incoming pipe and type of connections being used. The ultimate design is the responsibility of the engineer, who must insure the angles are correct. The contractor must also obtain these angles in the field. If the pipe is installed at angles other than normal or 90 degrees to the manhole, new calculations must be made.

APPENDIX

The determination of acceptability of each entering pipe relative to all the other incoming pipe is based on the reference pipe, which is arbitrarily selected by the designer. For ease of design, it is best to use the largest pipe diameter as the reference pipe. The other incoming pipe are determined by their angle, x and y, to this reference pipe. The following illustration and corresponding equations are used for making these calculations:



DESIGN PARAMETERS

Pipe Opening	Pipe Angle	Pipe Equation	Angle Range
Reference Pipe (d_1)	0°	$A° = 2 [\sin^{-1} d_1/r]$	None
Pipe 2 (d_2)	X°	$B° = 2 [\sin^{-1} d_2/r]$	X° - B°/ 2 > A°/ 2
Pipe 3 (d_3)	Y°	$C° = 2 [\sin^{-1} d_3/r]$	Y°- C°/ 2 > X° + B°/ 2 and 360 -Y°- C°/ 2< A°/ 2

Where: d = [0.5 (pipe inside diameter) + pipe wall thickness + 5]

(all units in inches)