AGENDA
CITY OF LAUREL
PUBLIC WORKS COMMITTEE
MONDAY, FEBRUARY 26, 2024
6:30 PM
COUNCIL CHAMBERS

Public Input: *Citizens may address the committee regarding any item of business that is not on the agenda. The duration for an individual speaking under Public Input is limited to three minutes. While all comments are welcome, the committee will not take action on any item not on the agenda.*

General Items

1. Approval of the Minutes from January 22, 2024

New Business

2. Emergency Callouts Report
3. KLJ Report
4. Review Public Works Standards Update

Old Business

Other Items

Announcements

5. Next meeting will be Monday, March 18 at 6:00pm in Council Chambers

The City makes reasonable accommodations for any known disability that may interfere with a person's ability to participate in this meeting. Persons needing accommodation must notify the City Clerk's Office to make needed arrangements. To make your request known, please call 406-628-7431, Ext. 5100, or write to City Clerk, PO Box 10, Laurel, MT 59044, or present your request at City Hall, 115 West First Street, Laurel, Montana.

File Attachments for Item:

4. Review Public Works Standards Update

Part 1 - General Provisions

1.1 ESTABLISHMENT OF MINIMUM STANDARDS

~~This Public Work Standards Manual, based upon sound, practical, and well-established principals of civil engineering, is~~These Standards for Public Works Improvements are prepared for the purpose of adopting minimum standards for the design of improvements, kind and use of materials, methods of construction, and the preparation of plans for construction, repair, or ~~alternation~~alteration of streets, roadways, alleys, drainage, sewer, or water facilities which lie within ~~municipal right-~~the City of~~-way or easements~~ Laurel.

1.2 UNIFORMITY OF ENGINEERING AND CONSTRUCTION PRACTICES

~~This Public Work~~These Standards ~~Manual is~~for Public Works Improvements are established to promote the maximum uniformity of engineering and construction practices within the community and thereby reduce design, supply, construction, and maintenance costs.

~~1 ADHERENCE TO STANDARDS~~

1.3 General Specifications

Use Latest Edition of Montana Public Works Standard Specifications Including Addendums Thereto and as Supplemented Herein.

1.4 General Design Standards

Use Latest Edition of State of Montana Department of Environmental Quality Water Quality Division Circulars and as Supplemented Herein.

1.5 Adherence to Standards

It will be the policy of the Department of Public Works to require adherence to the Standards set forth herein; however, where unique circumstances of design consideration make it impractical to follow the Standards and where such adherence would actually create problems detrimental to the public interest, the Department of Public Works will consider alternate solutions and may approve departures from Standards when substantiated by design analysis.

~~2 LICENSES~~

2. ~~Contract construction~~ Definitions

2.1 For the purposes of these specifications, the words and phrases set out in the following articles shall have the meanings as follows:

- "Alley" means a narrow public thoroughfare, providing access to the rear of the

abutting properties. It also serves primarily as a service access to individual lots.

- "Appurtenances" refers to machinery, appliances, or auxiliary structures attached to the sewer or water system to enable it to function, but not considered an integral part of it.

- “Bicycle Path” and/or “Walkway” is an access way for non-motored use, primarily for recreation use.

- “Boulevard” within the City is that area within any street, avenue, or highway right-of-way not occupied by street paving, curb and gutter, and sidewalks. An “inside boulevard” is the boulevard area on the property line side of the sidewalk. An “outside boulevard” is the boulevard areas on the street side of the sidewalk.

- "Building Sewer" means the privately-owned extension of the building drain to the public sanitary sewer or other place of disposal.

- "City" or "City of Laurel" means the City of Laurel in the County of Yellowstone and State of Montana.

- “Collector Street” is a street used for major traffic flow. Access to residential lots should be discouraged, and access to business lots should require turning lanes.

- "Combined Sewer" shall mean a sewer receiving both surface runoff and sewage.

- “Cross-slope” is the gradient determined by dividing the difference in elevation from crown to pavement edge by the horizontal distance from crown to pavement edge, expressed as a percentage.

- “Crown” is the highest part of the street shape between paving edges.

- "Curb Cut" means the total street curbing that is removed to place a driveway and slopes.

- "Curb Return" means the curved portion of a street curb at drive approaches.

- "Customer" means any person receiving municipal utility service either directly or indirectly from the municipal water supply system/municipal wastewater system.

- "Discharge" is the direct or indirect introduction of treated or untreated wastewater into the waters of the State of Montana, either through the municipal wastewater system and municipal wastewater treatment plant or through a point source into State waters.

- "Domestic Wastes" means liquid wastes

  - from the non-commercial preparation, cooking, and handling of food,

    or

  - containing human excrement and similar matter from the sanitary conveniences of dwellings, commercial buildings, industrial facilities, and institutions.

- "Driveway" means that area on private property where vehicles are operated, parked, or allowed to stand.

- "Driveway Apron" means the area, construction or improvement between the curb cut or proposed curb line and the back edge of walk or proposed walk line, to provide ingress and egress for vehicles from the alley, street or roadway to a definite area of the private property.

- "Driveway Width" means that portion of the street curbing that is removed excluding curb returns or transitions to provide ingress to and egress from abutting property.

- "Environmental Protection Agency" or "EPA", means the U.S. Environmental Protection Agency, or, where appropriate, the terms may also be used as a designation for the administrator or other duly authorized official of EPA.

- "Excavation" shall mean and include any ditch, trench, cut, hole or change of grade, including changes made by road grading by means of a blade or other device that removes, alters or adds dirt, gravel, or alters the crown of a street or alley or affects drainage.

- "Extension" means the act or process of extending, adding to, or enlarging the municipal water supply system/municipal wastewater system on the City's side of the point of delivery/point of connection to provide municipal utility services to a prospective customer or group of prospective customers.

- "Fire Hydrant Meter" means the meter which is owned by the municipal utility and which is used to measure the amount of water delivered to a customer through a fire hydrant.

- "Fireline" means all service pipes, curb stops and/or valves, curb boxes and/or valve boxes, backflow prevention devices, check valves, inside piping, fittings, fixtures, and any other apparatus on customer's side of the point of delivery that is used for, and limited to, the providing of water to customers for fire suppression activities.

- “Grade” is the slope of the longitudinal road profile generally measured along the centerline, expressed as a percentage.

- "Holding Tank Waste" means any waste from holding tanks such as vessels, chemical toilets, campers, trailers, recreational vehicles, or septage haulers.

- "Individual Extension" means an extension of the utility system to provide utility service to an individual customer.

- "Industrial" means of or pertaining to industry, manufacturing, agriculture, commerce, trade, or business.

- "Industrial User" means (a) any person or source that introduces or discharges wastewater from industrial processes into the municipal wastewater system or (b) any non-domestic user or source regulated under Sections 307(b), (c), or (d) of the Clean Water Act.

- "Industrial Wastes" or "Industrial Wastewater'' means all liquid or water-carried wastes other than domestic wastes. The terms includes, by way of example and not by limitation, the trade wastes produced by food processing and bottling plants, food manufacturing plants, slaughtering plants, tallow **works,** plating works, disposal services, industrial cleaning plants, fertilizer plants, car and truck washing operations, vehicle repair facilities, commercial laundries and cleaning establishments, cooling plants, industrial plants, factories, feedlots, and chemical treatment installations.

- "Interceptor Sewer" means a public sanitary sewer having a size greater than 24 inches that was installed by the City for the principal purpose of collecting and conveying wastewater from several district trunk sewers to the municipal wastewater treatment plant for treatment and disposal.

- "Intersection" means that area embraced within the prolongation or connection of the lateral curb lines, or if none, then the lateral boundary lines of the roadways which join each other at, or approximately at, right angles, or the area within which vehicles traveling upon different roadways joining at any other angle may come in conflict.

- “Local Street” is a street which provides access to individual lots or areas. Cul-de-sacs are within this category. Traffic flow of 400 vehicles per day or less.

- "Main" means a pipe or conduit carrying water for domestic, industrial, fire suppression, and other similar uses.

- "Meter" means the instrument, including any auxiliary equipment, which is used to measure the amount of water delivered to a customer from the

municipal water supply system or the amount of wastewater contributed to the municipal wastewater system by a user.

- "Municipal Wastewater Treatment Plant" means the wastewater treatment plant owned and controlled by the City of Laurel.

- "Municipal Water Meter" means the meter, including the meter horn and remote read equipment, which is owned by the utility and which is used to measure the amount of water delivered to a customer through the customer's water service line.

- "Municipal Utility" or "Utility" means the Public Works Department of the City of Laurel.

- "Natural Outlet" means any outlet into a water course, pond, ditch, lake, or other body of surface or ground water.

- "Person" means any firm, company, partnership, public or private corporation, association, group or society, governmental agency, or other entity as well as a natural person.

- "pH" refers to the negative logarithm of the hydrogen ion concentration in moles per liter of solution. pH is an indicator of the acid or base content of the solution.

- "Point of Connection" means the point at which the municipal wastewater system connects physically to a user's building sewer. The point of connection shall be located at and include the user's service tee or wye fitting, which, in turn, is normally attached to the public sanitary sewer located in the public right-of-way that abuts and fronts the property to be served.

- "Point of Delivery" means the point at which the municipal water supply system connects physically to a customer's corporation stop, which, in turn, is normally attached to the public water main located in the public right-of way that abuts and fronts the property to be served.

- "Pollutant" means any dredged soil, solid waste, incinerator residue, sewage, garbage, septic waste, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discharged equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharges into water.

- "Pollution" means the alteration of the chemical, physical, biological, or radiological integrity of water by human activity.

- "Polluted Waters" means water that contains objectionable wastes or suspended solids as a result of human activity.

- "Pretreatment" or "Treatment" means the reduction of the amount of pollutants, the elimination of pollutants, the alteration of the rate of their introduction into the municipal wastewater system, or the alteration of the nature of pollutant properties in wastewater to a less harmful state, prior to or in lieu of discharging or otherwise introducing such pollutants into a municipal wastewater system. The reduction or alternation can be achieved by physical, chemical, or biological processes, process changes, or by other means, except as prohibited by 40 CFR Section 403.6(d).

- "Pretreatment Requirement" means any substantive or procedural requirement related to pretreatment, including National Categorical Pretreatment Standards, imposed on an industrial user.

- “Private Water Service” means the water line owned by the property owner to include curb stop, curb box, service line, meter loop and all internal building piping excluding the water meter.

- "Public Building" means any building held, used, or controlled exclusively for public purposes by any department or branch of government, federal, state, county, or municipal, without reference to the ownership of the building or of the realty upon which it is situated.

- "Public Sanitary Sewer'' means the sewer directly controlled by the City and laid in the street or other right-of-way for the collection of wastewaters from users' building sewers.

- "Public Service Commission" refers to the elected body of Public Service Commissioners and their staff of the State of Montana.

- "Public Water Main" means the main directly controlled by the City and laid in the street or other right-of-way for the distribution of water to customers’ water service lines.

- "Rate Schedule" means a resolution approved by the City Council which sets forth the charges and conditions for a particular class or type of utility service.

- "Readily Accessible" means safely and easily reached and not being under "lock and key", "fenced in", "covered up", or otherwise obstructed.

- “Residential street” is a street which provides main ingress and egress to a subdivision or neighborhood. Traffic flows of 400 vehicles per day to 4500 vehicles per day.

- ” Right-of-Way” means public property dedicated for streets, alleys, or other public uses.

- “Roadway” means that portion of the street improved, designed, and customarily used for vehicular travel, exclusive of the berm or shoulder.

- "Sanitary Sewer'' means a sewer that carries wastewater or sewage.

- "Sanitary Sewer Service Line" or 'Wastewater Service Line" means that portion of the privately-owned building sewer extending from the property served to the public sanitary sewer.

- "Secondary Wastewater Meter'' or "Secondary Meter" means a meter which is furnished, installed, and maintained by a user, and which is used to determine the amount of wastewater contributed by such user to the municipal wastewater system.

- "Septage" means the mixed liquid and solid contents pumped from septic tanks used for receiving primarily segregated domestic wastes or wastes from sanitary conveniences.

- "Septage Disposal Permit" means a written receiving ticket issued by the City of Laurel permitting the discharge of septage into the City of Laurel's approved location in accordance with the provisions of these rules and regulations.

- "Septage Hauler" means a person having a valid City of Laurel business license, when appropriate, and, in addition, licensed by state and local government agencies to operate a business for the purpose of cleaning septic tanks and transporting septage to an approved septage disposal facility.

- "Sewer'' means a pipe or conduit for carrying wastewater or drainage.

- "Shall" is mandatory; "May" is permissive.

- “Sidewalk” means that portion of a street between curb lines or the outer lateral lines of a roadway, and the adjacent property lines, intended for use of pedestrians.

- "Source" means any building, structure, facility, or installation from which there may be a discharge of pollutants.

- "Sprinkling Meter" means a municipal water meter that is installed on a water service line for the purpose of measuring the water delivered by the utility to a customer exclusively for lawn and garden irrigation.

- "State" means the State of Montana.

- "Storm Sewer'' or "Storm Drain" means a sewer which carries storm and surface waters and drainage but excludes wastewater and polluted industrial wastes.

- “Street” means the entire width between the boundary lines of the right-of-way publicly maintained when any part thereof is open to the use of the public for purposes of vehicular travel.

- "Subdivision Extension" means an extension of the wastewater system or provide water or wastewater service to serve a subdivision, Certificate of Survey, commercial or industrial development, or any other similar type annexed parcel of land wherein the extended water or wastewater system facilities within the development are to be owned by the City, not including any privately-owned facilities.

- "Sub Meter" means a meter or meters which are furnished, installed, and maintained by a customer, and which are installed downstream of the municipal water meter by the customer for the purpose of proportioning municipal utility charges between various tenants.

- "Suspended Solids" means solids that either float on the surface or are in suspension in water, wastewater, or other liquids, and which are removable by laboratory filtering.

- "System Development Fees" means one-time charge paid by new development as a proportionate share of the "general benefit" to finance the construction of public facilities needed to serve the development.

- ''Tampering" means damaging, altering, adjusting, or in any manner interfering with or obstructing the operation or function of any metering device that is used for measuring or registering municipal utility service.

- "User'' or "Customer" means any person receiving municipal water wastewater service either directly or indirectly from the municipal water supply system or municipal wastewater system.

- 'Waste Disposal Site" means the City of Laurel's designated waste disposal station for the purposes of disposing of septage.

- 'Wastewater" or "Sewage" means the liquid and water carrying industrial or domestic wastes from dwellings, commercial buildings, industrial facilities, and institutions, together with any ground water, surface water, and storm water that may be present, whether treated or untreated, which is discharged into

or permitted to enter the municipal wastewater system.

- 'Wastewater Meter" means a meter which is furnished, installed, and maintained by a user, and which is used to measure the amount of wastewater contributed by such user to the municipal wastewater system.

- 'Wastewater Service" or "Municipal Wastewater Service" means the act of either directly or indirectly discharging wastewater into the municipal wastewater system from users' building sewers for the purpose of collecting, transporting, treating, and disposing of users' wastewater.

- 'Wastewater Service Area" means that particular territory which has been officially adopted by the City Council as the area it intends to provide with municipal wastewater service.

- 'Wastewater System" or "Municipal Wastewater System" means any wastewater facilities, including interceptor sewers, outfall sewers, wastewater collection systems, and wastewater treatment facilities, controlled by the City of Laurel.

- 'Water Service" or "Municipal Water Service" means the supply of water directly or indirectly from the municipal water supply system, or the availability of water supplied either directly or indirectly from the municipal water supply system, at the point of delivery and also the water so delivered or used.

- 'Water Service Area" means that particular territory which has been officially adopted by the City Council as the area it intends to serve with municipal water service.

- 'Water Service Line" means all privately owned facilities, including service saddle, service pipe, corporation stop, curb stop, curb box, municipal water meter box or vault, backflow prevention device, expansion tanks, pressure reducing valve, inside piping, appliances, and other apparatus on the customer's side of the point of delivery, except the municipal water meter and any other equipment owned by the City of Laurel.

- 'Water Supply System" or "Municipal Water Supply System" means any devices, facilities, structures, equipment, land or works controlled by the City for the purpose of the processing, treatment, transmission, storage, distribution, pumping, and measurement of water supplied to customers.

~~3 MEETING REGIONAL NEEDS~~

~~3.1 All public improvements shall be designed as a logical part of the development of the surrounding area. Storm sewer and sanitary sewer shall be sized to accommodate the~~

~~entire drainage basin which they will ultimately serve. Water mains shall be designed to provide distribution and looping to adjoining systems. Arterial streets will be developed to the extra width for "Streets". Utilities and street improvements will be extended to the boundaries of the development for future extensions to adjoining areas. The Public Utilities Director (PUD) may require oversizing of utility lines to accommodate future growth of the City.~~

~~3.2 Where existing City utility lines do not adjoin the proposed development, the developer will be required to extend the lines to the development as necessary. Where the existing roadway improvements do not extend to the proposed developments, the developer may be required to improve the roadway to the development. Except as provided below, these extension will be at no cost to the City.~~

~~4 RECOVERING COSTS~~

~~When the improvements serve adjoining properties (e.g., extensions of existing utilities or improvements along the boundary of the development), a portion of the cost can be recovered from owners of the adjoining property by one of the following methods:~~

~~4.1 A private agreement between the various property owners.~~

~~4.2 A Sewer/Water Extension Agreement, requiring the owner of adjoining property to pay an equitable share of the costs in the future at the time they connect to the improvements (requires City Council approval for formation of reimbursement), as negotiated by the Department of Public Utuilities.~~

~~4.3 A Special Improvement District, which authorizes the City to make the improvements and to distribute the costs to the benefitted property owners, usually allowing ten years for repayment (requires City Council approval and usually agreement of more than 50% of the property owners). Property owners will be required to pay, in advance, a portion of any new development infrastructure costs.~~

~~5 CITY PARTICIPATION IN COST~~

~~The City may share the cost of oversizing of improvements for public use in excess of the following. Typically this is offered when oversizing is for the purpose of meeting regional requirements, and that it exceeds requirements of the specific project being built.~~

~~5.1 Water lines, valves, and associated materials in excess of 12 inches in diameter.~~

~~5.2 Sanitary sewers in excess of 1O inches in diameter.~~

~~5.3 Storm sewers in excess of 24 inches in diameter.~~

~~5.4 Street widths in excess of 40 feet (curb to curb back).~~

2.2 The following abbreviations shall have the designated meanings:

- “APWA” means the American Public Works Association.
- “ASTM” means the American Society for Testing and Materials.
- “AWWA” means the American Water Works Association.
- “DEQ” means Montana Department of Environmental Quality.
- “EPA” means the Environmental Protection Agency.
- “MCA” means Montana Code Annotated.

- "MPWSS" means Montana Public Works Standard Specifications
- "PUD" is the Laurel Public Utilities Department.
- "PWD" is the Laurel Public Works Director

~~The City's share of the cost of oversizing will be based on the extra material costs caused by oversizing. The City's share of materials cost will be determined by the PUD using recent bids received by the City and/or price quotations from reputable suppliers on similar impartial information. Any agreement by the City to share the costs of oversizing is subject to the availability of City funds, must be in writing, and must have the prior approval of the City Council by resolution. Any work completed prior to City Council approval of an agreement will not be eligible for City payment for oversizing.~~

~~6 DEFERRED CONSTRUCTION~~

~~When projects are located remote to existing roadway improvements, portions of street work may be deferred to a later date to allow more orderly construction of a complete project. The developer will be required to provide security for the estimated cost of deferred work in an amount and form approved by the City Council.~~

Part 2 - General Engineering Submittal Requirements

The following items, if they apply, will be required before the checking of plans can be completed. As many items as possible should be submitted with the initial submittal. Items not included in the initial submittal may add additional rechecks to the checking procedure. A complete list of requirements will be returned with the first check.

1. COMPLETE ~~SET OF PLANS~~SUBMITTAL PACKAGE

1.1 Plans

A complete set of plans shall be drawn to include the following:

1.1.1 Title Sheets

The title sheet shall be sheet 1 of each set of plans and will include the following items:

A. Suitable title that is descriptive of the project.

B. Legal description or address of the area to be worked.

C. Name and Contact information (address & phone #) of the persons responsible for the work.

D. Name and Contact information (address & phone #) of the persons designing the work.

E. Location and/or Vicinity Map w/north arrow at a scale that encompasses the entire project area and shows physical location.

F. Involved Entities and their contact information

G. Engineer's signature, seal, & date

H. Index of Included Sheets with sheet number and title

1.1.2 Notes & Detail Sheets

A. General notes and details that provide enough information for the complete construction of improvements

B. Basis of bearing and Elevation Datum

C. Legend

D. Abbreviations (if used)

1.1.3 Utility Improvement Sheets

A. Adjacent streets, property lines, utility easements, and references thereto.

B. Location, material, and size of Water, Sanitary Sewer, Storm Sewer and associated appurtenances.

C. Location of water courses, wells, streams and railroad crossings, water mains, gas mains, culverts and underground power, CATV or other utility wherever possible.

D. Limits of hard surface improvements ~~will include~~ with dimension references.

E. Location and size of property to be used for the ~~following items:~~development with respect to known references such as roads, streams, sections lines, or streets.

F. Topography of existing and proposed contours at intervals not greater than two (2) feet.

G. Profile views to show highest and lowest elevations of existing and proposed grades and installed below ground utilities.

H. Size, length, and materials of proposed construction.

I. Suitable title plate with scale, north arrow, date, drawings number, and name, address and telephone of engineer.

1.1.4 Site Improvements Sheets

A. Street Section Typical

B. Show type of pavement, curb, and sidewalk for each street (by name) in the project. Partial street improvements (using asphalt concrete paving) that do not terminate with a curb shall have an extra 1 foot of asphalt concrete paving width at the edge of right-of-way.

C. Dimensions Shown. Right-of-way, centerline to curb, curb to property line sidewalk, and sidewalk to property line.

D. Stationing

E. Scale. One (1) inch equals 50 feet (1"=50') horizontal and 1 inch equals 5 feet vertical (1"=5') is the recommended scale to be used for the plan and profile.

F. Original Drawings. All sheets must be drawn in black India ink on ~~24~~11-inch by ~~36~~17-inch (~~24"x36") size mylars.~~11"x17").

G. Existing and New Improvements and Easements. Existing and new improvements and easements shall show width. Existing easements

should also show the document number and the receipt date.

1.1.5 Landscape and Irrigation Sheets (optional)

~~1 ADDITIONAL ITEMS TO BE INCLUDED ON ALL PUBLIC IMPROVEMENT DRAWINGS:~~

1.1.6 Additional Items

A. Street Names

B. Subdivision Boundary

C. Lot Lines and Numbers

D. Pavement Shaded

E. Concrete Symbol on Sidewalk, etc.

F. Size, Material and Length of Each Run of Pipe

G. Centerline, Curb, Storm Drain, Sewer, and Water Data

H. All roads and improvements that are not public are to be labeled "Private"

~~2 GENERAL ENCROACHMENT PERMITS. General encroachment permits are required for all private facilities within any public right-of-way or easement.~~
~~General encroachment permits are required for all private facilities within any public right-of-way or easement .~~

~~2.1 When an encroachment is approved, a note will be put on each sheet where it applies.~~

~~2.2 Some typical examples of encroachments are private drains tying into public drains, sidewalk underdrains, fences, and walls in easements or right-of-way.~~

~~3 PROFILE ITEMS SHOWN WHEN APPLICABLE~~
~~Show all of the street, driveways; structures, pipelines, etc., which *affect* the profile.~~

~~ALLEYS~~

~~3.1 Alleys are to be improved as specified in the conditions of improvement for each particular project.~~

~~3.2 Alley aprons, curbs, and pedestrian ramps are required at all street or alley intersections.~~

2. RIGHT-OF-WAY AND EASEMENT PLATS AND LEGAL DESCRIPTIONS, IF NEEDED

3. SOILS AND GEOTECHNICAL REPORT

See Part 8, Appendix C for Geotechnical Report requirements.

4. STORMWATER ANALYSIS AND DESIGN REPORT

See Part 8 for stormwater report guidelines and requirements.

Part 3 – Construction Changes Revisions *(Reserved)*

~~Any change made to a set of plans after they have been signed will require a construction change. Some minor changes may be approved by the Field Inspector, which will then be included in the "As-Built Drawings".~~

~~1 REVISIONS OF EXISTING SHEETS~~

~~Only items being covered by the proposed revision will be shown on the plans. Future changes not to be approved at this time will not be shown on the plans.~~

Part 4 – As-Built Plans *(Reserved)*

~~The original plans shall be certified by BOTH the Design Engineer and the City as being "As- Built", prior to the finalizing of any public works improvement projects. Plans needing "As-Builts" are:~~

~~a. Grading / Drainage~~
~~b. Street Improvements~~
~~c. Storm Drain~~
~~d. Sanitary Sewer~~
~~e. Water System~~
~~f. Site Improvement~~

~~A developer shall give to the City on AutoCAD, or other Computer-Aided Drafting system, acceptable to the City, a diskette will all of the projects "As Built" documents in addition to hard copies. All documentation shall be given to the City 30 days before acceptance is expected. All test documentation and certifications shall have an Engineer's certification.~~

Part 5 - Street Design Technical Standards

1. GENERAL CONDITIONS

1.1 All maintenance and repairs of public streets, alleys, sidewalks and other public ways shall be under the supervision of the PWD.

1.2 It is unlawful to construct or lay any pavement on any public street, sidewalk, alley or other public way, or to repair the same, without having first secured a permit therefor. Applications for such permits shall be made to the City Clerk-Treasurer, and approved by the PWD, and shall state the location of the intended pavement or repairs, the extent thereof, and the person or firm who is to complete the construction.

1.3 The arrangement, type, extent, width, grade, and location of all new streets must be considered in their relation to existing and planned streets, to topographical conditions and to public convenience and safety, and in their relation to the proposed uses of the land to be served by them.

1.4 All roads must meet the appropriate regulations within Title 12.04.030 "Streets" of the City of Laurel Municipal Code. ~~meet the design specifications in Table 1. Urban-suburban roads must meet the design specification in Figure 1.~~

1.5 Proposed roads which will intersect State and/or County roads shall be permitted by entities having jurisdiction of said roads. ~~shall be kept to a minimum. State and county permits and/or authorization must be obtained. Turn lanes may be required and must be built to the Approach Standards for Montana Highways.~~

~~1.6 Residential driveways must not have direct access to primary highways. Where no reasonable option is available, the Montana Department of Transportation may issue a road approach permit.~~ **Moved to Section 9**

~~1.7 Local streets must be designed so as to discourage through traffic.~~

~~1.8 Whenever a subdivision abuts or contains an existing or proposed arterial highway or major thoroughfare, the governing body may require frontage roads, with a reservation prohibiting access along the rear property line, deep lots, or other treatment as may be necessary for adequate protection of residential properties and to separate arterial and local traffic.~~

~~1.9~~ 1.6 All roadway improvements including pavement, curbs, gutters, sidewalks, and drainage must be constructed in accordance with the specifications and standards prescribed in the latest edition of the Standards for Public Works Improvements for the City of Laurel.

~~1.10~~ 1.7 Plans, specifications, and special provisions for street ~~design~~ construction projects must be ~~completed~~ sealed by a Registered Professional Engineer licensed in the State of Montana and submitted with the permit application.

1.8 All street improvements shall be inspected during the course of construction by an inspector appointed by the PWD.

~~1.11 Roadway subgrades must be free of topsoil, sod, vegetation, or organic matter, soft clay, or other substandard materials, properly rolled, shaped, and compacted, and subject to approval by the governing body.~~

~~1.12 Streets and roads must be designed to ensure proper drainage, including but not limited to surface crown, culverts, curbs and gutters, drainage swales, and storm drains.~~

~~1.13 Where access from a public road to the subdivision will cross properties not owned by the subdivider, the subdivider must obtain proper easements, at least 60 feet wide, from each property owner or the appropriate administration of public lands. Each easement must allow construction and perpetual maintenance of a road across the property and allow vehicular travel on the road.~~

Repeat of Table 16.16.C.1 of the Subdivision Code

Table 1
Road Design Standards Subdivisions

~~m1mum es,gn tandar s~~	~~Minor Collector~~ e,*ft7Np	Local Street
~~1. Minimum Right-of-Way Width~~		
~~2. Minimum Roadway Width~~	~~26 ft~~	~~24 ft~~
~~3. Minimum Curb Radius or Edge of Pavement atIntersections~~	~~25 ft~~	~~15 ft~~
~~4. Maximum Grades~~	~~8%~~	~~9%~~
~~5. Approaches onto Public Roads~~		
~~a. minimum sight distance~~	~~200 ft~~	~~150 ft~~
~~b. minimum width~~	~~35 ft~~	~~30 ft~~
~~c. maximum grade for 20 feet~~	~~5%~~	~~5%~~
~~d. minimum grade for 20 feet~~	~~1%~~	~~1%~~
~~6. Curvaturec~~		
~~a. design speed~~	~~25mph~~	~~25mph~~
~~b. maximum curve~~	~~23~~	~~53.5~~
~~c. minimum radius~~	~~249 ft~~	~~107 ft~~
~~7. Cul-de-Sacs and Turnarounds~~		
~~a. Long Cul-de-Sac~~		
~~l. maximum road length~~		~~600 ft~~
~~ii. cul-de-sac: minimum outside right-of-way radius~~		~~52 ft~~
~~iii. cul-de-sac: minimum outside roadway radius~~		~~44 ft~~

b. Short Cul-de-Sac	100 ft
I. maximum road length	40 ft
ii. cul-de-sac: minimum outside right-of-way radius	35 ft
iii. cul-de-sac: minimum outside roadway radius	
C. "T" or"Y" Turnaround	30 ft ea.
I. backup lengths (2required)	26 ft
ii. inside turning radius	38 ft
iii. outside turning radius	

Adequate and appropriate easements must be granted by each property owner through a signed and notarized document that grants the easement.

The location of any road easement must be shown on the plat or on a supplemental map. The existence of easements must be noted on the face of the final plat and any deeds or other instruments conveying lots within the subdivision.

- Where parking will be permitted, add eight feet on each side. If guardrail installation is required or a shoulder is desired, add two feet to each side of roadway.

ь Grades over 10% must not exceed 100 feet in length.

° Curvature is based on a superelevation of 0.08/ft.

2. DESIGN CRITERIA FOR STREETS

2.1 Minimum centerline radius of horizontal curvature shall be based on the latest edition of the AASHTO Geometric Design of Highways and Street for the following design speeds. The road classification will be as determined by the City Public Works Director.

Table 5.1 – *Roadway design speeds (mph)

Arterial	Collector	Local	Alley
50	40	30	20

*or as approved by the PWD

2.1 Minimum centerline radius of horizontal curvature based on design speeds shall be as follows (assuming a normal crown):

2.1.1 Major streets - 1,000 feet (25 mph)

2.1.2 Collector streets and industrial and commercial streets - 800 feet (25 mph)

2.1.3 Residential collector streets - 500 feet (25 mph)

2.1.4 Residential streets - 300 feet (25 mph)

2.1.5 Alleys - 50 feet (15 mph)

2.2 Intersections

2.1.1 Intersection design should follow the latest edition of "A Policy on Geometric Design of Highways and Streets" as modified by the following.

2.1.2 ~~2.2.5~~ Maximum grade of approach to an intersection must not exceed 5% for 50' from the edge of traveled way.

~~2.2.1 Streets must intersect at 90 degree angles, except where topography precludes, and in no case may the angle of the intersection be less than 60 degrees to the centerline of the roadway being intersected.~~

~~2.2.2 Two streets meeting a third street from opposite sides must be offset at least 125 feet for local roads and 300 feet for arterials or collectors.~~

~~2.2.2 No more than two streets may intersect at one point.~~

~~2.2.3 Intersection design must provide acceptable visibility for traffic safety as dictated by the designed operating speeds on the individual roadways.~~

~~2.2.4 Hilltop intersections are prohibited, except where no alternatives exist. Intersections on local roads within 100 feet of a hilltop are prohibited. Intersections on arterial and collector roads within 200 feet of a hilltop are prohibited.~~

2.3 Where a sight-distance problem may be anticipated, additional easements or Right of Way may be required by the PWD.

~~2.3 Where the angle of intersection is acute, or where a sight-distance problem may be anticipated, an increased property line radius may be required by the PWD.~~

~~2.4 The angle between centerlines of intersecting streets shall be as nearly right angles as possible, but in no case less than 80 degrees or greater than 100 degrees, except as approved by the PWD.~~

~~2.5 All streets entering upon any given street shall have their center lines directly opposite each other or separated by preferably 300 feet, 200 feet minimum.~~

~~3. GRADIENT~~

~~Streets and roads must be designed to ensure proper drainage, including but not limited to surface crown, culverts, curbs and gutters, drainage swales, and storm drains.~~

3 Grading

3.1 All grading or excavating in public right-of-way and encroachments shall be first authorized by a valid encroachment permit.

3.2 Additional grading beyond the right-of-way may be required to provide for safe sight-distance and to control drainage.

3.3 Easements shall be provided for all property where grading will be required outside of the right-of-way.

4. PAVEMENT, STRUCTURAL SECTIONS

All streets shall be surfaced in accordance with the following specifications:

4.1 All design shall conform to the latest edition and revisions of the MPWSS.

4.2 Road surfacing shall be Type B asphaltic concrete with a PG 64-28 binder.

4.3 Structural section shall be determined using a Geotechnical analysis and design report prepared by a Professional Engineer licensed in the State of Montana.

4.4 Existing street patches or restoration shall include asphalt and a crushed base course per table 5.2

Table 5.2 – Asphalt Thickness for Road Restoration

Road Classification	Asphalt Thickness	Crushed Base Course
Arterials	Min 4" or Match Existing	Min 14" or Match Existing
Collectors	Min 4" or Match Existing	Min 10" or Match Existing
Local Commercial	4"	10"
Local Residential	3"	10"

4.5 Street cross slopes to be designed with a minimum of 2%, maximum of 5% and a preferred cross slope of 3%.

4.6 Alley surfacing shall be of 4 inches of ¾-inch minus crushed base course, and 4 inches of 3-inch minus crushed sub-base course.

5. UTILITY PLACEMENT WITHIN STREETS

Water and sewer utilities to be constructed in streets shall be installed according to Part 6 and Part 7.

6. SITE TRIANGLE

6.1 At Alley intersections a clear vision triangle shall measure ten (10) feet parallel to the alley and twenty (20) feet parallel to the street as measured from the property line corner.

6.2 At uncontrolled intersections, a clear vision triangle shall measure seventy-six (76) feet in both directions as measured from the intersection of the centerlines in the adjoining street intersection.

6.3 At controlled intersections (stop sign or traffic signal) a clear vision triangle shall measure twenty (20) feet in both directions as measured from the property line corner. Exceptions include the existing downtown business district. See zoning code for Central Business District (CBD).

6.4 Any fence, wall, signs, plant material or other material shall provide an unobstructed cross-visibility at a level between 3 feet and 8 feet above the street surface elevation. Trees having over eight (8) feet of clear trunk as measured from the surface elevation with limbs and foliage trimmed in such a manner as not to extend into the cross-visibility area and complying with section 7.2.3 of Division 2 of the Rules and Regulations Governing Utility Services and Streets of the City of Laurel, Montana, are permitted in the clear vision triangle.

6.5 Vehicles shall not be parked in the public right-of-way to obstruct the line of site created by the clear vision triangle. In the Central Business District where line of site is restricted by zero building setback, vehicles shall not be parked in the public right-of-way that obstruct site distance or as per Montana Department of Transportation standards where applicable.

7. ALLEYS

7.1 Alleys

Alleys shall be designed and improved by the developer.

7.1.1 Right of way shall be a minimum of 20 feet in width.

7.1.2 There shall be no intersecting alleys.

7.1.3 Road surface shall be 15 feet wide, except at intersections with streets where standard returns shall be constructed.

8. CURB AND GUTTER, SIDEWALKS

8.1 Sidewalks shall be constructed of 4" Portland Cement Concrete over 3" of ¾" crushed base course.

8.2 Sidewalks shall typically be constructed parallel to the curb line. Other sidewalks shall be constructed only if authorized by the PWD.

8.3 Curb, gutter and sidewalks shall be constructed at the total cost of developers or property owners.

8.4 Sidewalks shall be ADA compliant.

8.5 Warning Plates are to be Cast Iron Truncated Domes.

9. DRIVEWAYS

9.1 Residential Driveway

9.1.1 Driveways serving property used solely as a single family, two-family, or three-family residence shall be residential type driveways with approaches conforming to the latest edition of the MPWSS Standard Drawings.

9.1.2 Driveways widths shall be 12-foot minimum/~~24-foot maximum~~ 30-foot maximum, measured at the base of the driveway.

9.2 Commercial Driveway

9.2.1 All driveways other than residential driveways shall be commercial driveways with approaches conforming to the latest edition of the MPWSS Standard Drawings.

9.2.2 Commercial driveway widths shall be 12-foot minimum/~~25-foot maximum~~ 50-foot maximum, measured at the base of the driveway.

9.3 Driveway Separation/Distance from the Property Line

9.3.1 For residential driveways, except for approved joint-use driveways and driveways of lots having 25-feet of frontage or less, shall be located at least 5 feet from the side property line. Exceptions are allowed for cul-de-sacs. Multiple driveways for a single lot may be approved on a case-by-case basis.

9.3.2 All commercial driveways shall be approved by the PWD.

~~Driveways, other than approved joint-use driveways, shall be separated by a distance of at least 10 feet. Exceptions are allowed for cul-de-sacs. Multiple driveways for a single lot shall only be approved on a case-by-case basis.~~

9.4 Location

9.4.1 Driveways shall be so located to minimize interference with the free movement of normal traffic or the proper functioning of highway signs, signals, lighting, fire hydrants or other devices that affect traffic operation.

9.4.2 All commercial driveways shall be designed such that vehicles entering, or egressing shall not be required to back from or into a street right-of-way.

9.4.3 Any necessary adjustments to utility facilities, light standards, fire hydrants, catch basins, street signs, signals, underground conduits for street lighting or fire alarm systems, or other public improvements or installations shall be

accomplished without cost to the City.

9.5 Frontages

Frontages of ~~50~~ sixty (60) feet or less shall be limited to one (1) driveway. Not more than two (2) driveways shall be provided to any single property tract or business establishment, except where the property frontage exceeds six hundred (600) feet, there may be one (1) additional driveway for each additional three hundred (300) feet of frontage. In cases where lots have more than one street frontage, each frontage shall be treated separately when determining the allowed number of driveways.

9.6 Right-of-Way Distances

Gasoline pump islands or other installations with parking parallel to the right-of-way line shall be at least 10 feet outside of the right-of-way line. Buildings or other installations with an angle of ninety degrees parking between it and the right-of-way line shall be at least 30 feet outside the right-of-way line.

9.7 Culverts

Driveway culverts shall only be allowed by approval of the PWD. If permitted, culverts shall be maintained by the property owner.

Culverts used for the crossing of irrigation ditches shall be approved by the associated ditch company.

10. STREET NAME SIGNS

10.1 Street name signs shall be installed in accordance with the Manual of Uniform Traffic Control Devices and at all new intersections.

11. SURVEY MONUMENTS

Boundary, lot corner and street survey monuments shall be installed or preserved as with all street improvements as follows:

- During construction or development of any street other than in a new subdivision, Contractor shall reset or preserve all existing monuments affected by the street improvements.

12. REPAIRING UTILITY CUTS

12.1 When requested by the PWD, construction equipment and procedures to be used shall be described in the permit application.

12.2 Pipe installation shall be done according to the requirements of the appropriate

agency specifications in use. Any required granular backfill material shall meet the material requirements for Select Granular Fill in the MPWSS, latest edition.

12.3 Pavement shall be saw cut in a neat line at termination points of pavement replacement.

12.4 Pavement and shoulder removal shall be done in a manner that provides for proper restoration of the replacement section.

12.5 Straight vertical cuts of the pavement are required. Pavement surfaces that become undermined shall be cut back and removed.

12.6 Excavations shall be filled at the end of each workday unless approved otherwise by the PWD. Any excavations that are allowed to remain open must be properly signed and barricaded. The longest length of trench to remain open overnight shall not exceed 50 lineal feet.

12.7 Construction which adversely affects the subsurface drainage of the pavement structure shall be corrected by the addition of surface or subsurface drain.

12.8 Pavement replacement limits shall extend a minimum of 24-inches, in all directions, beyond the limits of disturbed soil and far enough such that all existing pavement to remain, is supported firmly by the existing underlying base material. The new pavement patch shall be restored to the proper grade, cross-slope, and smoothness. All joints shall be tacked.

12.9 The City PWD requires inspection and testing of utility repairs and surface restoration.

12.10 All street cuts shall be parallel and perpendicular to the street centerline. No diagonal cuts shall be accepted.

12.11 If remaining asphalt width between asphalt cut and asphalt edge is less than or equal two (2) feet, it shall be removed and replaced.

12.12 Asphalt removed shall be replaced at the thicknesses designated in Table 5.2 or match existing, whichever is the greater.

12.13 Non-shrink backfill may be required by the PWD.

13. STREET LIGHTING

Streetlights shall be installed and shall comply with Montana Department of Transportation standards.

PART 6 - SEWER DESIGN TECHNICAL STANDARDS

1. PURPOSE

The purpose of this design criteria is to provide engineers, designers, engineering technicians, and others, in ~~handy~~ reference form, the City's minimum standards for sanitary sewer design.

These criteria are intended to cover the design of main line sanitary sewers and apply to any sewer systems, public or private, 6 inches in diameter or greater. Private on-site sewer systems serving mobile home parks, condominiums or apartments may be designed in accordance with the uniform plumbing code and approved by the appropriate building inspector.

The design criteria set forth below are intended to result in sewers which will:

1.1 Be consistent with the Sewer Master Plan, Preliminary Engineering Report or other latest governing body accepted planning document.

1.2 Be consistent with Montana Department of Environmental Quality (DEQ) Circular DEQ 2, latest edition.

1.3 Be consistent with the latest edition of the Montana Public Works Standard Specifications (MPWSS~~.~~).

1.4 Be of adequate size to carry the expected flow, within their design life, and at sufficient depth to serve adjacent properties.

1.5 Have sufficient grade to maintain a minimum velocity of 2 feet per second when flowing half full.

1.6 Be strong enough to resist all external loads which may be imposed.

1.7 Be of materials resistant to both corrosion and erosion.

1.8 Be economical and safe to build and to maintain.

1.9 Prevent infiltration or inflow of ground and surface waters.

1.10 Be designed for municipal wastewater only, not storm water roofs, streets, or ground waters.

Alternate materials and methods will be considered for approval on the basis of these objectives.

2. REFERENCES

2.1 ~~"Waterworks Standards,"~~ Circular ~~WQB-2 MT~~ DEQ-2, Design Standards for Public Sewage Systems, Montana Department of Environmental Quality, ~~Design Standards for Wastewater Facilities,~~ latest edition.

2.2 Montana Public Works Standards Specifications, latest edition and revisions.

3. APPROVAL OF ALTERNATE MATERIALS OR METHODS

Approval of any major deviation from these standards will be in written form.

4. MONTANA ~~WATER~~ DEPARTMENT OF ENVIRONMENTAL QUALITY ~~BUREAU~~ STANDARDS

~~WQB-2, published by the State of~~ Montana~~,~~ Department of Environmental Quality ~~(DEQ),~~ ~~is~~Circulars are hereby incorporated into this document. ~~WQB's criteria will be used as a guideline to determine~~ The document with the more stringent standards ~~needed for items not specifically covered in this document~~ shall govern.

5. SPECIAL PROBLEMS

The design of the following are considered special problems and are not covered in detail in these standards: ~~WQB-2 provides general guidelines for most of these items.~~These items will be reviewed and approved on an individual basis. The following is a brief list of items but shall not be considered all encompassing.

5.1 Pump ~~or~~of Lift Stations

5.2 Force Main

5.3 Inverted Syphons

5.4 Relining of Existing Sewers

5.5 Internal Sealing of Existing Sewers

5.6 Treatment Plants

5.7 Outfall Sewers

5.8 Energy Dissipaters

5.9 Regulating Devices

5.10 Flow Measurement Devices

6. DESIGN PLANS AND PROFILES

Plans will be required for all new or extended sanitary sewers and shall include both a vicinity map and a general layout map of the area showing the location of existing facilities and of the proposed improvements. Plans should be accurate, legible and properly detailed. Dimensions should be either from right-of-way centerline or property lines.

The City of Laurel utilizes the NAD_1983_StatePlane_Montana_FIPS_2500 coordinate system and the Lambert Conformal Conic Projection for all mapping purposes.

6.1 Engineering Drawings (Plans)

Plans for sewer lines should contain at least the following information:

6.1.1 Adjacent streets, property lines, utility easements, and references thereto.

6.1.2 Location of sewer lines and appurtenances. Each manhole shall be numbered and stationed to facilitate checking the plans with the profiles.

6.1.3 Location of water courses, wells, stream and railroad crossings, water mains, gas mains, culverts and underground power, CATV, or other utilities wherever possible.

6.1.4 Limits of hard surface paving with dimension references.

6.1.5 Adequate details, specifications, and other information for Contractor to be able to install the proposed improvements.

6.1.6 Suitable title plate with ~~name and address of owner,~~ scale, north point, date, drawing number, and name, address and telephone of engineer, and the Registered Professional Engineer's (RPE) signature.

6.1.7 Profiles

6.2 Profiles for the individual sewer lines should contain at least the following information:

6.2.1 Location of manholes and other appurtenances with each manhole numbered and stationed.

6.2.2 Profile of existing and proposed ground surface and sewer invert.

6.2.3 Size, material, pipe class, slope, and length of sewer~~, and pipe bedding class~~ between consecutive manholes.

6.2.4 Depth of bury and surface restoration.

6.2.5 Elevation of original ground and finished grade shall be shown graphically, and sewer inverts specified at each manhole.

6.2.6 Depth and location of major utilities and pipelines that cross the plan view of the sewer line. Utility service lines shall be shown if requested by the PWD.

6.2.7 Suitable title plate with the ~~name and address of owner,~~ scale, date, drawing number, and the ~~name,~~ Registered Professional Engineer's (RPE~~ number and expiration date of the registration~~) signature.

6.2.8 Limits of street improvements will be shown including a typical section of the subject street.

~~5.1 Sewer Appurtenances~~

~~Appropriate City Standards shall be included in all plans for construction of sanitary sewer lines.~~

~~5.2 Separate Drawings~~

6.2.9 Separate plans shall be submitted for public sewers installed in combination with private sewers or site plumbing. "Site plumbing" drawings are not acceptable. Public sanitary sewer plans may be combined with other public improvement plans, provided that the plans must be legible and properly detailed.

6.2.10 Appropriate labeling of the services as "Public" or "Private" will be done on both the plan view and profile view.

7. SPECIFICATIONS

7.1 Engineering consultants are encouraged to develop specifications and special provisions for each project. Specifications and special provisions shall incorporate the latest edition of the MPWSS. Special specifications pertaining to materials and workmanship, if developed, shall be submitted to the City for review and approval, together with check prints of the project.

7.2 In general, the sewer specifications should cover pipe material, excavation, laying of sewer pipe, jointing, backfilling, testing, etc. Strict supervision will be required by the City during construction to assure compliance with the specifications. Developer shall provide full time engineering inspection services during Construction activities. The City reserves the right to review or audit the inspection services being provided.

8. ADDITIONAL ITEMS OF CONCERN

8.1 Testing

8.1.1 Sanitary sewers will be required to pass tests specified in MPWSS, Section ~~02722~~ 02730, Sanitary Sewer ~~Mains~~ Collection Systems.

8.1.2 The internal (T.V.) inspection shall be performed prior to issuance of the final acceptance. ~~The developer will perform a T.V. of completed projects A minimum of~~

~~five (5) working days notice is required to schedule the inspection.~~ T.V. inspection will not be performed until the ~~City's~~City's inspector has completed a~~:~~ final inspection and is satisfied that all construction is complete. The T.V. inspection ~~tapes~~ video shall be become the property of the City.

8.1.3 Results of all testing shall be reported to the City on a bi-weekly basis.

~~5.2.1 Manhole Exfiltration Test. The City may require a leakage test for manholes as provided in latest version the MPWSS.~~

~~**5.2.2** Mandrell Test. May be required on PVC pipe as provided in the latest version of the **MPWSS.**~~

~~Light Test. The contractor perform a light test between manholes check alignment and grade~~

9. GENERAL DESIGN CONSIDERATIONS

9.1 Sanitary sewers should be designed to remove the domestic sewage from houses, business buildings and other public and private establishments, but not the street, roof, or subsurface drainage. Each main building on a parcel or residence shall be served by a separate sewer lateral.

9.2 Storm water, including street, roof, or footing drainage, shall be removed by a system of storm sewers or by some other method separate from the sanitary sewer system.

~~5.3 All materials and installation of sanitary sewers shall be in conformance with the latest edition of theMPWSS, except as noted herein and on the standard and special detail drawings.~~

~~5.4 All gravity-flow sewers, up to 10 inches, shall be designed to allow for peak flowsat ½ the capacity; additionally, sewers 12 inches and larger shall be designed to allow for peak flows at ¾ of the capacity of the pipe.~~

9.3 In general, sewer systems should be designed to care for future flows which may reasonably be expected within a period of ~~15 to~~ 20 years, and for ultimate development of the specific drainage basin concerned.

10. CAPACITY

Public sanitary sewers and appurtenances 10 inches and smaller shall be designed to accommodate peak hourly flows when flowing one half full. Public sanitary sewers and appurtenances 12 inches and larger shall be designed to accommodate peak hourly flows, when flowing three quarters full.

11. Design flows shall be determined by consideration of the following factors:

11.1 Drainage Basin Area to Be Served

11.2 Population Within the Area to Be Served

11.3 Land Use Within the Area to Be Served

11.4 Per Capita Sewage Flow

11.5 Commercial, Industrial, or Institutional Users to Be Served

11.6 Infiltration Allowance

11.7 Peaking Factors

In the absence of flow data or other reliable information, the ~~design factors from Table 3 may be assumed. Appropriate~~Designer shall use peaking ~~ratios should be applied to determine flows, where~~factors in conformance with factors outlined in DEQ Circular-2 or others specified by the City.

~~Table 3~~
~~Design Factors~~

	~~Average Flow~~	~~Peaking Factor~~
~~Residential~~	~~100 gpcd~~	~~1.7to4.0~~
~~Commercial~~	~~1,200 gpcd~~	~~2.0 to 4.0~~
~~Industrial~~	~~1,200 gpcd~~	~~2.0 to 4.0~~
~~Infiltration and Storm Water Inflow~~	~~30-50 gpcd~~	~~1,000 gpcd~~

~~It is recommended that design~~Design calculations shall include estimates of average and maximum ~~and minimum~~ daily flows. The submission of design calculations will ~~not ordinarily~~ be required ~~but~~; engineers should be prepared to substantiate pipe sizes, layout, population estimates, land uses or other design assumptions ~~as may be requested~~.

12. SIZE

Main line sewers shall be a minimum of 8-inch inside diameter, except that the ~~lateral~~ sewer service within private property which will not be extended may be of 4-inch inside diameter for residential services and 6-inch for commercial properties.

13. PIPE MATERIALS

13.1 Gravity Sewers

The following pipe materials and fittings are approved~~:~~

MATERIAL	SPECIFICATIONS
Concrete Pipe, Reinforced ~~Ductile Iron Pipe; Class 52~~	ASTM C 76, Class ~~111~~ III, IV, or V

Ductile Iron Pipe: Class 2	ANSI A21.51 or AWWA C151
Polyvinyl chloride (PVC); 4" to 15"	ASTM ~~D~~C 3034, SDR 35; or ASTM F 789
PVC Sewer Pipe; 18" and larger	ASTM F 679: ASTM F 794, Series 46

13.2 Force Mains

The following materials are approved for force mains:

MATERIAL	SPECIFICATIONS
Ductile Iron Pipe; Class 52	ANSI A21.51 or AWWA C151
Polyvinyl chloride (PVC)	AWWAC900

13.3 Other Uses

Pipe materials for special uses such as for liner pipe, temporary construction, stream crossing, bridge crossings, etc., will be considered special design cases and are not covered further in these standards.

14. EXCAVATION, PIPE BEDDING AND BACKFILL

14.1 Details - Standard ~~plans~~ details are the latest edition of the MPWSS.

14.2 Installation

Installation of pipe shall conform to the following:

14.2.1 MPWSS, latest edition.

~~13.1.1 Water settling of backfill material is prohibited. 14 GRADE~~

~~Sewers shall be laid with uniform slope between manholes. All sanitary sewer shall be laid on a grade which will produce a mean velocity, when flowing full or half full, of at least 2 feet per second (fps), based upon Manning's "n", the coefficient of roughness, valued at not less than 0.013, depending upon the type of pipe used. The minimum grades for various sizes of pipe with an "n" value of 0.013 are listed below:~~

14.2.2 Contractor Quality Control and Owner Quality Assurance

Table 6.1 below outlines the minimum frequency of quality assurance testing. This testing may be reduced at the discretion of the City. This testing does not replace an appropriate Contractor quality control testing program as described earlier in this section. In the case of a conflict between QC and QA testing, the QA testing shall govern.

Table 6.1 - Laurel Materials Testing Requirements

EARTHWORKS		
Test Specification/Material	Test Method	Minimum Required Frequency
Trench Backfill	Moisture-Density (MPWSS 02221)	1 Sub/soil type encountered 1 Submittal/borrow source
Trench Compaction	In-Place Density (MPWSS 02221/1.4) 97% Minimum	1 test/lift/200 LF
Trench Compaction (laterals outside the road template, structures, valves, hydrants and manholes)	In-Place Density (MPWSS 02221/1.4) 97% Minimum	1 test/for each 2 ft of vertical depth/2 ft from edge of structure, valve, hydrant, or manhole
Pipe Bedding	Type I Bedding gradation & Plasticity Index / Type II Bedding Gradation (MPWSS 02221)	1 Submittal
Subgrade and Embankment	Moisture-Density (MPWSS 02230)	1 Submittal per soil type encountered / 1 Submittal per borrow source
Compaction of subgrade under curbs, gutters, and sidewalks	In-Place Density (MPWSS 02230/1.3) 95% Minimum	1 test/lift/200 LF (C &G) or 1 test/lift/1000 SF (flatwork)
Compaction of subgrade and embankment for roadways	In-Place Density (MPWSS 02230/1.3) 95% Minimum	1 test/lift/4000 SF
Sub Base Course	Gradation - Moisture Density – Fractured Faces (Crushed) - LA Abrasion, LL, PL, and PI (MPWSS 02234)	1 Submittal
Compaction of Sub Base Course for roadways	In-Place Density (MPWSS 02234/1.3)95% Minimum	1 test/lift/4000 SF
Crushed Base Course	Gradation - Moisture Density – Fractured Faces (Crushed) - LA Abrasion, LL, PL, and PI (MPWSS 02235)	1 Submittal
Compaction of crushed base course under curbs, gutters, and sidewalks	In-Place Density (MPWSS 02235/1.3) 95% Minimum	1 test/lift/200 LF (C &G) or 1 test/lift/1000 SF (flatwork)
Compaction of crushed base course for roadways	In-Place Density (MPWSS 02235/1.3) 95% Minimum	1 test/lift/4000 SF

~~In general, slopes greater than~~

14.3 Water settling of backfill material is prohibited.

15. GRADE

15.1 The Designer shall use minimum grades in conformance with those ~~shown above are desirable and are particularly recommended on~~ outlined in DEQ Circular-2 or others specified by the City ~~upper ends of lateral sewers.~~

15.2 Slopes slightly less than those ~~shown above~~ described may be considered if substantial justification can be demonstrated. There must be enough live sewer interceptions to ensure that the average depth of sewage flow will be 0.3 of the pipe inside diameter.

15.3 Maximum pipe slope shall be governed by terrain and available fall between manholes. Maximum velocity in the pipes shall not exceed 8 fps, unless specifically approved by the City.

16. MINIMUM DEPTH

16.1 All sewers shall be laid at a depth sufficient to drain and be protected against damage from traffic. Sewers laid in areas subject to wheel loads shall have a minimum cover of 6 feet measured from top of pipe to finished grade or be otherwise protected from damage by traffic; except that minimum cover may be reduced to 4 feet with specific approval. Encasement will be required for depths less than 4 feet.

16.2 Under normal conditions, main line sewers in residential areas should be laid at an average depth of 8 to 9 feet. Services to adjacent properties from such sewers should normally be laid so that the depth of the service lateral at property line is at least 5 feet. Insulation shall be provided for sewers that ~~cannot be placed at a depth sufficient to prevent freezing~~ are less than 5-ft deep.

17. LOCATION

17.1 Relation to Water Lines and Wells

No sanitary sewer mains should be less than 10 feet from any well, spring, or other source of domestic water supply. All sanitary sewers or parts thereof which are located within 50 feet from any such source of domestic water supply shall be constructed of cement lined, ductile or PVC with watertight joints. Sanitary sewers and domestic water lines shall not be laid in the same trench. Parallel water and sewer lines wherever possible should be located at least 10 feet apart horizontally.

When physical conditions render this spacing impossible or impractical, then ductile iron water pipe with watertight joints or concrete encasement is required for the sewer line. Wherever it is necessary for sewer and water lines to cross each other, the crossing should be at an angle of approximately 90 degrees and the sewer shall either be located 18 inches or more below the water line or be cement lined, constructed of ductile or PVC pipe with watertight joints for a distance of 10 feet on both sides of the water line.

17.2 Sewers in Streets or Easements

Under normal conditions, sewers should be located in street right-of-way ~~5~~6 feet north or east of the street right-of-way centerline. Sewers shall be located in centerline of alleys and easements, if possible. When it is necessary to locate sewers in easements, such easement shall be at least 20 feet in width. Sewers 24 inches in diameter or larger, or over 12 feet in depth, may require wider easements.

18. ALIGNMENT

18.1 Sewer lines shall be laid on straight alignment and uniform grade between consecutive manholes.

18.2 Horizontal and vertical curves in sewers are not recommended. However, in cases where justification can be shown, limited use of such designs will be considered.

Where curved alignments are utilized, the City may require the following:

18.2.1 Slope greater than minimum slope for the size of pipe.

18.2.2 Manhole spacing of less than 250 feet.

18.2.3 City may require that the developer or contractor shall provide a licensed professional land surveyor or engineer to continuously monitor installation of the curved sewer during construction.

18.2.4 Television inspection of curved sewers is required prior to final acceptance.

19. CHANGE IN PIPE SIZE

19.1 When a smaller sewer joins a large one, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient. An approximate method for securing these results is to place the 0.8 depth point of both sewers at the same elevation.

19.2. Sewer extensions should be designed for projected flows even when the diameter of the receiving sewer is less than the diameter of the proposed extension. Special consideration should be given to minimizing turbulence when designing a flow channel within a manhole where there is a change in pipe size. ~~The appropriate reviewing agency may require a schedule for construction of future downstream sewer relief.~~ The appropriate reviewing agency may require a schedule for construction of future downstream sewer relief.

20. MANHOLES AND CLEANOUTS

20.1 Details - Standard Drawings are found in the MPWSS, latest edition

20.2 Manhole Construction

20.2.1 Construction shall be watertight. If ground water or surface drainage can be expected to flood the top of the manhole, watertight frame and covers shall be used. A 100-year-recurrence-interval storm shall be used in determining flooding elevations.

20.2.2 Manholes located in easements outside of public right-of-way shall have locking frame and covers.

20.2.3 For rigid pipe, there shall be flexible connections provided at the inlets and outlets of each manhole. For all pipes, the flexible joint shall be within 1-1/2 pipe diameters, not to exceed 12 inches, of the exterior wall of the manhole. A flexible connection "boot"/or insert may be utilized in lieu of a flexible joint.

20.2.4 Generally, a ~~0.2~~ 0.1 foot minimum drop from inlet to outlet is required for bends between 120 and 240 degrees. A ~~0.4~~ 0.2 foot minimum drop for all bends outside those angles. Maximum drop in flow line elevation ~~is required through manholes~~ or all inverts shall be 0.4 feet. However, where grade considerations are considered critical, the design engineer may request a waiver from the City if sufficient justification exists.

20.3 Manhole Location

20.3.1 Manholes shall be located as follows:

A. At the end of each public sanitary sewer.

B. Every change in grade or alignment of sewer.

C. Every point of change in size of sewer or pipe material.

D. Each intersection or junction of sewer.

E. Upper end of all lateral sewers.

F. At the beginning and end of all 24-inch diameter and smaller sewers on curved alignment.

G. At intervals of ~~350~~ 400 feet or less as approved by the City.

H. At each and every street intersection unless approved by City.

Cleanouts shall not be substituted for manholes nor installed at the end of public sanitary sewers unless approved by the City.

20.4 Cleanout Locations

A. A cleanout shall be installed 5-ft outside of the building at the connection point.

B. A cleanout shall be installed on a service line whenever the total degree of bends is equal to or more than 45° on any single run of sewer pipe.

C. Cleanouts will not be approved as substitutes for manholes.

20.5 Manhole Covers

A. Standard Cast iron cover as outlined in MPWSS, used in public right-of-way.

B. Locking, may be required.

~~Watertight frame and cover assemblies~~

C. Inflow Protector Covers are required for all installations within the 100-year flood or where ~~periodic flooding may be possible~~ directed by the City Public Works Department.

20.6 Drop Manholes

Drop manholes shall be avoided whenever possible during the design and construction of wastewater extensions. They shall only be used when it is proven impractical to steepen the incoming sewer.

A. Outside drop assemblies shall be provided for pipes 12 inches in diameter and smaller when entering a manhole at a distance of more than 24 inches above the invert of the manhole. Larger pipe should be introduced into the manhole at the manhole invert.[1]

B. Inside drop assemblies will be considered only in special cases involving connections to existing manholes. Special approval for all drop assemblies is required from the City.

20.7 Cleanouts

Cleanouts will not ~~normally~~ be approved as substitutes for manholes~~, except at the upper end of lateral sewers 100 feet or less in length. Temporary clean out assemblies may be installed in mainlines less than 150 feet in length, provided that the line will be extended at a later date, subject to the approval of the City. Manhole ring and cover is required over cleanouts~~.

20.8 Diameter

The minimum diameter of manholes shall be 48 inches; larger diameters are preferable for large diameter sewers. A minimum access diameter of ~~22~~ 24 inches shall be provided.

20.9 Flow Channel

The flow channel straight through a manhole should be made to conform as closely as possible in shape and slope to that of the connecting sewers. For pipes greater than 8 inches in diameter, the channel walls should be formed or shaped to the full height of the crown of the outlet sewer in such a manner to not obstruct maintenance, inspection or flow in the sewers. For pipes 8 inches or less in diameter, the channel shall be formed at least to the spring line of the pipe. When curved flow channels are specified in manholes, including branch inlets, or when entrance or exit losses are significant, minimum slopes shall be increased to maintain acceptable velocities.[2]

20.10 Bench

A bench shall be provided on each side of any manhole channel when the pipe diameter(s) are less than the manhole diameter. The bench should be sloped no less than ½ inch per foot (4%). No lateral sewer, service connection, or drop manhole pipe shall discharge onto the surface of the bench.

20.11 Water Tightness

A. Manholes shall be of the pre-cast concrete or poured-in-place concrete type. Manholes shall be waterproofed on the exterior. Pre-cast concrete manhole sections manufactured in accordance with ASTM C 478M-93 are exempt from the exterior waterproofing requirement.

B. Inlet and outlet pipes shall be joined to the manhole with a gasketed flexible watertight connection or any watertight connection arrangement ___that allows differential settlement of the pipe and manhole wall to take place.

~~Watertight manhole~~

C. Inflow protector covers are to be used wherever the manhole tops may be flooded by street runoff or high water. Locked manhole covers may be desirable in isolated easement locations or where vandalism may be a problem.

20.12 Manhole Adjusting Rings

Adjusting rings installed in manholes on public sanitary sewers shall have a total height of not less than 2 inches and not more than 6 inches.

20.13 Manhole Frames and Covers

Frames and covers used on manholes for public sewers shall be made of cast iron or ductile iron, shall have a clear opening no less than 24 inches, shall have a total weight of not less than 410 pounds, and shall have machined surfaces to ensure a tight fit between cover and frame.

20.14 Manhole Steps

All manholes used for public sanitary sewers shall be equipped with steps of the polypropylene-coated steel type meeting applicable OSHA requirements for fixed ladders. The steps shall withstand a single concentrated load of 400 pounds, have a minimum width of 12 inches, and shall have ribbed, skid-resistant treads with drop fronts to prevent side slip. All manhole steps shall be installed with the center of the rung a minimum of 7 inches from the manhole wall.

21. PIPE JOINTS

All pipe joints must be constructed watertight. Rubber rings or other approved joint sealing material shall be used. Joint deflections shall be controlled such that the watertight integrity of the joint is maintained.

22. SERVICE LATERAL (SIDE SEWER OR HOUSE BRANCH) CONNECTIONS

All service laterals with the exception of house branches from a main sewer to serve an individual building shall be of a minimum size of 6 inches in diameter within public right-of-way or within public easements. House branches to serve single family residences and multi-family residences up to a ~~four (4~~ Two (2) plex may be 4-inch diameter in size. Laterals shall be laid at a minimum slope of 2%. Construction of laterals shall conform to the same standards as for main sewer construction.

During the construction or extension of a public wastewater system, a wastewater service line shall be stubbed to the property line of each lot and/or parcel of property included in the extension application. All wastewater lines so installed shall be subject to and fully comply with the provisions set forth in this section.

All wastewater service laterals shall be marked with a permanent indicator of location in the nearest hard surfacing (i.e. “S” stamp in adjacent curb, sidewalk or driveway”

23. HOUSE OR BUILDING SEWERS

As a minimum criterion, construction of the house or building sewers (on site) shall be of the same quality and meet the same requirements as the public sewer with regard to materials, water tightness and location. In addition, these sewers shall conform to the ~~state and local plumbing codes and restrictions.~~ Uniform Plumbing Code, latest edition. No roof, surface, foundation, or other storm water drain lines shall be connected to the public sanitary sewers.

24. SEPARATE CONNECTION REQUIRED

24.1 Each main building or legal lot (except a private garage) shall be separately connected to a public sewer. Except that main buildings or dwellings located on a single parcel may be connected to a private sewer discharging into the public sewer, provided that an approved statement of maintenance responsibility is recorded with the title to the property and permitted through MT Dept. of Environmental Quality. Examples of such private systems are~~:~~ mobile home parks, residential or office condominiums (unit/owner association by-laws to have statement of maintenance responsibility); or apartment complexes.

24.2. A manhole shall be required at the point of connection of a private sewer system to a public system with a clean out placed at the property line. A monitoring or sampling manhole is required for connections from industrial users.

25. STEEP SLOPE PROTECTION

Sewers on slopes of 20 percent or more may require special anchoring.

26. DRAINAGE DITCH OR STREAM CROSSINGS

26.1 Sewers entering or crossing drainage ditches or streams shall be constructed of watertight pipe. The pipe and joints shall be tested in place, shall not exhibit infiltration, and shall be designed, constructed, and protected against anticipated hydraulic and physical, longitudinal, vertical, and horizontal loads, erosion, and impact.

26.2 Sewer crossing of drainage ditches must be protected from freezing through either depth of bury or insulation.

27. AERIAL CROSSINGS

Support shall be provided for all joints in pipes utilized for aerial crossings. The supports shall be designed to prevent frost heave, overturning, and settlement.[4]

28. PROTECTION OF WATER SUPPLIES

When wastewater sewers are proposed in the vicinity of any water supply facilities, requirements of Circular ~~WQB-1~~ DEQ-1 should be used to confirm acceptable isolation distances in addition to the following requirements.

28.1 Cross Connections Prohibited

There shall be no physical connections between a public or private potable water supply system and a sewer, or appurtenance thereto which would permit the passage of any wastewater or polluted water into the potable supply. No water pipe shall pass through or come in contact with any part of a sewer manhole.

28.2 Relation to Water Works Structures

28.2.1 Sewers shall not be located within 50 feet of a public water supply well.

28.2.2 All existing waterworks units, such as basins, wells, or other treatment units, within 100 feet of the proposed sewer shall be shown on the engineering plans.

28.3 Relation to Water Mains

28.3.1 Horizontal Separation.

A. Sewers shall be laid at least 10 feet horizontally from any existing or proposed water main. The distance shall be measured edge to edge.

B. If the proper horizontal separation as described above cannot be obtained, the design engineer shall submit a request for a deviation to the DEQ along with a description of the problem and justifying circumstances. If the deviation is granted, the sewer shall be designed and constructed with the following minimum conditions:

C. Copy of MT DEQ approved deviation request shall be provided to the City.

D. Sewer pipe shall be PVC with nominal 20-foot lengths.

E. The sewer shall pass low pressure air testing in accordance with UniBell Recommended Practice UNI-B-6-90.

F. Sewer services utilizing in-line fittings and extending to at least property lines shall be provided and tested in the area of the encroachment. Saddles are not acceptable.

28.4 Crossings

28.4.1 Sewers crossing water mains shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and outside of the sewer. This shall be the case where the water main is either above or below the sewer. The crossing shall be arranged so that the sewer joints will be equidistant and as far as possible from the water main joints. Where a water main crosses under a sewer, adequate structural support shall be provided for the sewer to maintain line and grade and to prevent damage to the water main.

28.4.2 If the proper vertical separation as described above cannot be obtained, the design engineer shall submit a request for a deviation to the DEQ along with a description of the problem and justifying circumstances. If the deviation is

granted, the sewer shall be designed and constructed with the following minimum conditions:

A. Minimum vertical separation at crossings between water and sewer mains shall be 6 inches.

B. Sewer pipe shall be PVC with normal 20-foot lengths.

C. At crossings, one standard length of new pipe shall be centered at approximately a 90 degree angle with respect to the existing pipe.

D. The sewer shall pass low pressure air testing in accordance with UniBell Recommended Practice UNI-8-6-90.

E. Sewer services utilizing in-line fittings and extending to at least property lines shall be provided and tested within 10 feet of the crossing. Saddles are not acceptable.

F. If the minimum separation is not viable, the water line must be relocated. In these cases, minimum vertical separation at crossings between water and sewer mains shall be 18 inches.

29. SEWER SERVICES AND PLUMBING

29.1 Plumbing

Sewer services and plumbing should conform to relevant local and state plumbing codes.

30. DESIGN STANDARDS FOR ALTERNATIVE SEWER SYSTEMS

These standards shall be used for design of alternate sewer systems. Variances may be allowed where adequate justification is provided by the design engineer. These standards may be modified as the technology evolves.

30.1 Small Diameter Gravity Sewer Design

~~21.1.1 Hydraulic Considerations~~

30.1.1 Design flow shall be based upon water use records where available. If water use records are not available, ~~70~~ 100 gpcd per residential connection shall be used ~~with additional flow allowances for infiltration~~ and an appropriate peaking factor.

30.1.2 Hydraulic calculations shall use the Manning's formula with a roughness coefficient of n = 0.013.

30.1.3 Hydraulic design shall be based upon an approximately ½ ~~to 3/4 full~~ pipe at 20-year peak design flow.

30.1.4 Minimum design velocity of ~~1.0~~ 2.5 fps in controlling sections should be used considering existing peak flow conditions.

30.1.5 All mains shall be ~~4~~ 6-inch diameter pipe or larger.

30.1.6 To minimize potential sources of infiltration, 20-foot minimum pipe lengths and in-line service fittings should be used.

~~21.1.2 Detection wires for locating buried pipe should be considered.~~

30.1.7 Turbulence should be minimized wherever possible.

30.1.8 Performance tests shall be utilized for determining water-tightness, deflection and alignment of installed pipes.

30.1.9 Service lines and main lines shall be designed and constructed to prevent freezing of the wastewater within the lines.

30.2 Manholes/Cleanouts

30.2.1 The limited use of manholes is encouraged to minimize infiltration, reduce odor potential, limit introduction of extraneous materials and reduce cost. Manholes are to be located at major junctions of three or more pipes and limited to strategic locations for cleaning purposes.

30.2.2 Water-tight manhole covers are recommended for odor control and to limit inflow.

30.2.3 Manholes located in groundwater shall be waterproofed and should be of the type which has the base riser section cast with integral floor.

30.2.4 Clean outs should be used in place of manholes at changes in grade, alignment, and at intersections of pipe. Spacing of clean outs shall be dependent upon cleaning capabilities. A maximum of 600 feet for mechanically cleaned and jet-cleaned systems and a maximum of 1000 feet for systems cleaned by pigging.

30.2.5. Clean outs located in traffic areas shall be designed to withstand normal traffic loads without damage.

30.3 Design Standards for Pump Stations for Alternative Collection Systems

The use of wastewater pumping stations to provide wastewater services for said areas, or portions thereof shall be avoided whenever it can be feasibly accomplished.

In addition to other requirements, the following standards shall apply to pump stations which pump septic tank effluent.

30.3.1 Pumps other than those capable of passing spheres of at least 3 inches in diameter are not acceptable. Screens should be considered where this type of pump is used.

30.3.2 The inlet pipe shall be extended below the low water elevation in the wet well in order to reduce turbulence and odors.

30.3.3 The lift station wet well cover shall be water-tight for odor control.

30.3.4 A vent shall be provided with odor control. The vent can be connected to a buried gravel bed or to a charcoal filter.

30.3.5 Materials in the wet well shall be protected from corrosion. Stainless steel, plastic, or bronze materials are recommended.

30.3.6 The force main sizing shall be based upon hydraulic requirements using a minimum design velocity of ~~1~~ 2.0 ft/sec based on a Manning's roughness coefficient of n = 0.013. The minimum pipe diameter for force mains shall be 1.5 inches.

30.3.7 The force main shall be designed and constructed to prevent freezing.

30.4 Septic Tank/Effluent Pumps

30.4.1 Typically, one septic tank and one effluent pump per household will be provided. Multiple units may be considered where serving multiple family dwellings or trailer courts. Duplex pumps, each capable of handling maximum flow, may be required in these situations.

30.4.2 Pumping units will be activated by appropriate level control switches. High- and low-level alarms will be required with audio-visual alarms recommended. Low level pump deactivation controls shall be provided. A control panel with appropriate circuit protection and electrical safety devices shall be used. The alarm circuit should be separately wired from the pump circuit. All applicable electrical codes must be satisfied. The power cables to the pump shall be designed to facilitate maintenance of the pumping unit. Wiring shall be exterior to the residence for maintenance purposes.

30.4.3 Screens limiting solids carryover into the pump shall be, provided. Pipe fittings used should be commonly available. Appropriate isolation, check, and air release valves must be used with ease of maintenance in mind. All components shall be protected from freezing.

30.4.4 All septic tanks shall be vented.

30.5 Septic Tanks

Septic tanks are not allowed within the City limits.

31. LIFT STATIONS

~~21.2 The City has City-owned and operated sanitary sewer lift stations.~~

31.1 Lift stations will be designed by a ~~RPE~~ Registered Professional Engineer.

31.2 All new sewage lift stations shall be equipped with a backup, redundant level control system.

31.3 The City requires emergency power on any new lift station. All new ~~pumping~~ Lift stations shall be equipped with an emergency power receptacle and an Automatic transfer switch.

31.4 All new ~~pumping~~ Lift stations shall be equipped with an alarm system detecting unauthorized entry, power interruption, high water, and high pump temperature conditions. The alarm signal shall be directed to optional remote locations by telephone dialer system.

31.5 All new pumping station shall be equipped with an electro-magnetic flow meter with 4-20 ma output signal, flow totalizer, and chart recorder and/or electronic recorder.

PART 7 - WATER DESIGN TECHNICAL STANDARDS

1. PURPOSE

The purpose of this design criteria is to provide engineers, designers, engineering technicians, and others, in handy reference form, the City's minimum standards for water system design.

These criteria are intended to cover the design of water mains and apply to any water systems, public or private, ~~6~~ 4 inches in diameter or greater. Private on-site water systems serving mobile home parks, condominiums or apartments ~~may~~ shall be designed in accordance with the uniform plumbing code and approved by the appropriate building inspector.

The design criteria set forth below are intended to result in water systems which will:

1.1 Be consistent with the Water Master Plan~~.~~

1.2 Be consistent with Montana Department of Environmental Quality (DEQ).

1.3 Be consistent with the latest edition of the MPWSS.

1.4 Be of adequate size and pressure to meet expected demands, within their design life.

1.5 Have sufficient flows to meet fire flow requirements.

1.6 Be strong enough to resist all external loads which may be imposed.

1.7 Be of materials resistant to both corrosion and erosion.

1.8 Be economical and safe to build and to maintain.

Alternate materials and methods may be considered for approval on the basis of these objectives.

2. REFERENCES

2.1 Circular ~~WQB-~~DEQ 1, Standards for Water Works, Montana Department of Environmental Quality~~, Design Standards for Wastewater Facilities,~~ latest edition.

2.2 Montana Public Works Standards Specifications, latest edition and revisions.

2.3 Uniform Plumbing Code, latest edition and revisions.

3. APPROVAL OF ALTERNATE MATERIALS OR METHODS

~~Approval of~~ Request for any major deviation from these standards will be submitted to the PWD in written form for approval.

~~2 MONTANA WATER QUALITY BUREAU STANDARDS~~
~~WQB-1, published by the DEQ, is hereby incorporated into this document. WQB's criteria will be used as a guideline to determine standards needed for items not specifically covered in this document.~~

4. SPECIAL PROBLEMS

The design of the following are considered special problems and are not covered in detail in these standards: ~~WQB-~~DEQ 1 provides general guidelines for most of these items.

4.1 Air relief valves

4.2 Water loading stations

4.3 Source development

4.4 Chemical application

4.5 Treatment plants

4.6 Pumping stations

4.7 Water storage

5. DESIGN PLANS AND PROFILES

Plans will be required for all new or ~~extended~~ extension of water mains and shall include both a vicinity map and a general layout map of the area showing the location of existing facilities and of the proposed improvements. Plans should be accurate, legible and properly detailed. Dimensions should be either from right-of-way centerline or property lines.

5.1 Engineering Drawings (Plans)

Plans for water mains should contain at least the following information:

5.1.1 Adjacent streets, property lines, utility easements, and references thereto.

5.1.2 Location of water lines and appurtenances.

5.1.3 Location of water courses, wells, stream and railroad crossings, water mains, sewer main, gas mains, culverts and underground power, CATV, or other utilities wherever possible.

5.1.4 Limits of hard surface paving with dimension references.

5.1.5 Adequate details, specifications, and other information for Contractor to be able to install the proposed improvements.

5.1.6 Suitable title plate with ~~name and address of owner,~~ scale, north ~~point~~ arrow, date, drawing number, and name, address and telephone of engineer, and the Registered Professional Engineer's (RPE) signature.

5.2 Profiles

Profiles for the individual water lines should contain at least the following information:

5.2.1 Location of valves, ~~hydrants~~ hydrant tee, and other appurtenances

5.2.2 Profile of existing and proposed ground surface.

5.2.3 Size, pipe ~~class~~ type, length of water line~~, and pipe bedding class~~.

5.2.4 Suitable title plate with the name and address of owner, scale, date, drawing number, and the name, ~~RPE~~ PE number ~~and expiration date of the registration~~.

5.2.5 Limits of street improvements will be shown including a typical section of the subject street.

~~5.1 Water Appurtenances~~

~~Appropriate City Standards shall be included in all plans for construction of water lines.~~

5.2.6 Depth of bury

5.2.7 surface restoration

5.2.8 new and existing services

5.3 Separate Drawings

5.3.1 Separate plans shall be submitted for public water mains installed in combination with private water lines or site plumbing. "Site plumbing" drawings are not acceptable. Public water main plans may be combined with other public improvement plans, provided that the plans must be legible and properly detailed.

5.3.2 Appropriate labeling of the services as "~~Public" or "~~Private" will be done on both the plan view and profile view.

6. SPECIFICATIONS

6.1 Engineering consultants are encouraged to develop specifications and special provisions for each project. Specifications and special provisions shall incorporate the latest edition of the MPWSS. Special specifications pertaining to materials and

workmanship, if developed, a hard copy shall be submitted to the City for review and approval, together with ~~check prints~~ plans of the project.

6.2 In general, the water specifications should cover pipe material, excavation, laying of water main, jointing, backfilling, testing, etc. Strict supervision will be required by the City during construction to assure compliance with the specifications.

7. ADDITIONAL ITEMS OF CONCERN

7.1 Hydrostatic Testing

Hydrostatic and leakage testing shall be performed in accordance with the American Water Works Association C600. MPWSS Section 02713, 'Water Mains" outlines procedure.

7.2 Cleaning Water Mains

Before chlorination, except when hypochlorite tablets are used, the mains shall be flushed thoroughly after the pressure and leakage test are completed. MPWSS Section 02713, 'Water Mains" outlines procedure.

7.3 Disinfecting Water Mains

7.3.1 General. All water mains shall be disinfected ~~subject to the PWD's approval~~ in accordance with AWWA C651, "Disinfecting Water Mains", and MPWSS Section 02713, 'Water Mains", before placing the main in service. The interior of all pipe, fittings, and appurtenances shall be kept free from dirt, heavy, and foreign particles.

7.3.2 Redisinfection. If the initial disinfection fails to produce approved bacteriological or turbidity samples, the main shall be reflushed and resampled. If check samples show bacterial contamination, the main must be re-chlorinated until approved results are obtained.

8. GENERAL DESIGN CONSIDERATIONS

Water mains should be designed to serve houses, ~~business~~ commercial and industrial buildings and ~~other public and private~~ any establishments that needs water service in the building. Each main building on a parcel or residence on each parcel shall be served by a separate water service.

8.1 Domestic Flows

8.1.1 Water mains shall be designed in accordance with "Circular ~~WQB~~-DEQ 1, Standards for Water Works" published by the State of Montana Department of

Environmental Quality. Water mains shall be sized to provide a combined fire flow and peak day flow in accordance with the standards shown below.

8.2 Fire Flows

8.2.1 For design purposes, minimum fire flows shall be 1000 gpm in low and medium density residential areas, 2500 gpm in commercial and high density residential areas, and 3500 gpm in industrial areas. The design shall provide for the system to provide the minimum fire flow at each fire hydrant, assuming one hydrant flowing at any given time and a minimum pressure of 20 psi.

8.2.2 Where special conditions exist, greater or lesser design fire flows may be approved by the Fire Chief (as per Fire Code) for new and existing buildings.

8.3 Pressure

8.3.1 Water systems shall be designed to provide a minimum pressure of 35 psi with no fire flow. With fire flow, a minimum pressure of 20 psi is required in all areas. Water systems shall be designed by consulting the latest water system model of pressure zones. Pumping stations and pressure reducing valves may be required to lower high pressure concerns. Pipes shall be specified to withstand the maximum test pressures but in no case shall pipes be classed less than 150 psi. The designer should contact the PWD for information on the pressure zones and water supply available for the area.

8.3.2 In general, water systems should be designed to ~~care~~ accommodate for future flows which may reasonably be expected within a period of ~~15 to~~ 20 years, and for ultimate development of the specific service area~~concerned~~.

8.3.3 Specific approval of booster pump stations, storage and additional sources, will be required from the City.

9. CAPACITY

9.1 Design flows shall be determined by consideration of the following factors:

9.1.1 Service area to be served

9.1.2 Population within the area to be served

9.1.3 Land use within the area to be served

9.1.4 Per capita water consumption

9.1.5 Commercial, industrial, or institutional users to be served

9.1.6 Fire flow requirements

9.1.7 Peaking factors

9.2 In the absence of flow data or other reliable information, the design factors from Table 7.1 may be assumed. Appropriate peaking ratios should be applied to determine flows, where specified by the City.

Table 7.1
Design Factors

Average Designation	Adverse Flow	Peaking Factor
Residential	100 gpcd min,	*
Commercial	1,200 gpd/acre	*
Industrial	1,200 gpd/acre	*

* Peaking factor means of calculations outline in latest edition of MT Circular DEQ-1

It is recommended that design calculations include estimates of average daily, maximum daily, and ~~minimum daily~~ peak instantaneous flows. The submission of design calculations will not ordinarily be required but engineers should be prepared to substantiate pipe sizes, layout, population estimates, land uses or other design assumptions as may be requested.

10. SIZE

Water mains shall be a minimum of 8 inches inside diameter for those systems incorporating fire protection. Fire hydrant lead lines shall be a minimum of 6-inch inside diameter.

11. PIPE MATERIALS

The following pipe materials and fittings are approved:

	Specifications
Ductile Iron Pipe; Class 52	ANSI A21.51 or AWWA C151
~~Ductile Iron Pipe; Class 52~~	
~~Polyvinyl chloride (PVC) Concrete Cylinder Pipe Cast Iron Pipe~~	
~~**ANSI** A21.51 or **AWWA** C151~~	
~~(polyethylene film wrapped or encased) AWWAC900~~	
~~*Not allowed Not allowed*~~	

~~Gate Valve~~

~~**MJxMJ**~~

~~Tapping Valve Tapping Saddle~~

~~Valve Boxes Corporation Stops~~

~~Service Saddles~~

~~Service Pipe~~

~~Curb Stop~~

~~Mueller Resilient Wedge Gate Valve~~

~~Gate valve type 12-inch and under; Mueller Butterfly or Double Disc valve for larger than 12 inches~~

~~Mueller Resilient Seat Tapping *Valve*~~

~~Powerseal Stainless Steel Model 3490AS Mueller also acceptable~~

~~Tyler 6868 Series "DD" -screw type #6 Base for water Mueller H-15026 ¾-inch & 1-inch~~

~~Mueller H-15008 ¾-inch & 1-inch~~

~~Mueller H-B25008 ¾-inch & 2-inch; CC x 110 Mueller H-15013 1½-inch & 2-inch~~

~~Mueller B-25000 ¾-inch & 1-inch~~

~~Mueller B-25005 ¾-inch & 1-inch; CC x Install Smith Blair Model 371; 4-inch to 12-inch PVC Smith Blair Model 372; 4-inch to 12-inch Romac Model 304;2-inch to 12-inch PVC Romac Model 305; 10-inch to 32-inch~~

~~Mueller Brass H16000 Main to Building-~~

1. ~~Type K Copper~~
2. ~~PE Pipe (IPS) SOR 7-3/4-inch & 1-inch~~
3. ~~PE Tube (CTS) SOR 9-11/12-inch & 2- inch (200 PSI)~~

~~Mueller H-15209 3/4-inch to 2-inch cop x cop orCTS Mueller B-25209 3/4-inch to 2-inch cop x cop Mueller H-15172 3/4-inch to cop x fip~~

~~ueller B-25172 3/4-inch to 2-inch cop x inst Mueller B-25204 3/4-inch to 1-inch inst x inst~~

~~Mueller B-20283 3/4-inch to 2-inch inst x inst or C11~~

Table 7.2 **Material**	**Specifications**
Ductile Iron Pipe; Class 52	ANSI/AWWA C151/A21.51-17 (polyethylene film wrapped or encased)
Polyvinyl chloride (PVC)	AWWA C900 for pipe 4” to 12”, Pressure Class 150 AWWA C905 for pipe 14” to 48”, DR 18 Pipe
Concrete Cylinder Pipe	Not allowed
Cast Iron Pipe	Not allowed

Valves	10” and under shall be resilient seated gate valves w/ iron body, bronze mounted non-rising stem, set for 200 psi working pressure. 12” and over shall be butterfly valves class 150B, tight closing, for underground service.
MJxMJ	All mechanical joint bolts, nuts, and washers shall be Type 304 stainless steel.
Tapping Valve Tapping Saddle	Stainless Steel Resilient Seat Tapping *Valve with 150 psi working pressure or approved equal.*
Valve Boxes	Cast iron, 5-1/4” diameter, screw type adjustable, and have the word “Water” stamped thereon.
Corporation Stops	¾-inch to 2-inch – Ground Key Valve with AWWA taper threaded inlets and Compression Connection for outlet piping. Or approved equal.
Service Saddles	All Stainless Steel service saddle with 304 SS nuts and bolts a Buna-N nitrile gasket and a minimum working pressure of 150 psi. Or approved equal.
Service Pipe	Main to Building 1. Type K Copper 2. PE Pipe (CTS) SDR 7-¾-inch & 1-inch 3. PE Tube (CTS) SDR 7-1-1/2-inch & 2-inch (200 PSI)
Curb Stop	¾-inch to 2-inch cop x cop or CTS, For PE pipe use compression fittings with stainless steel inserts.
Curb Boxes	6’ extension boxes with stationary one-piece stainless steel rod.
Joint Restraint	Megalug 2000 or thrust blocks
Fire-Hydrant	AWWA C502 w/ two 2-1/2” hose nozzles and one 4-1/2” pumper nozzle with National Standard Thread.
Manhole F/c	D&L Foundry or approved equal
Meters	All meters-Neptune, Remote Read
Backflow Preventers	All new construction ¾-inch and 1-inch use dual check valve Dual Check Valve ¾-inch McDonald 11-3NA-43 1-inch McDonald model 18-4-10-XD 1½-inch Febco 805Y-BV-S #45410;

	Or approved equal. EPA 570/9-89-007 Larger check valves to be approved by Public Works Dept.

Alternate materials not listed must be approved by the Public ~~Utilities~~Works Director.

~~6 EXCAVATION, PIPE BEDDING AND BACKFILL~~

~~6.1 Details~~

~~Standard plans are the MPWSS, latest edition.~~

~~6.2 Installation~~

~~Installation of pipe shall conform to the following:~~

~~6.2.1 **MPWSS,** latest edition.~~

~~6.2.2 Water settling of backfill material is prohibited.~~

12. MINIMUM DEPTH

All water lines shall be laid at a depth sufficient to prevent freezing and be protected against damage from traffic. Water mains shall have a minimum cover of 6 feet measured from top of pipe to finished grade or be otherwise protected from damage by traffic or freezing.

13. DEAD ENDS

13.1 In order to provide increased reliability of service and reduce head loss, dead ends shall be minimized by making appropriate tie-ins whenever practical.

13.2 Where dead end mains occur, they shall be provided with a fire hydrant for flushing purposes. Flushing devices should be sized to provide flows which will give a velocity of at least 2½ feet per ~~section~~ second in the water main being flushed. No flushing device shall be directly connected to any sewer.

14. VALVES

14.1 Valves

Valves should be located at not more than 500-foot intervals in· commercial districts and at not more than 1 block or 800-foot intervals in other districts.

14.2 Line Valves in Distribution Pipe

Four valves shall be installed at a "cross" intersection. Three valves shall be installed at a "Tee" intersection.

~~16.1 Blowoff Valves~~

~~A fire hydrant must be located within 20 feet of the end of any dead-end water main including temporary dead-end mains in phased developments.~~

14.3 Air Relief ~~Valves~~

~~An air~~ Air relief ~~valve~~ will be required at the high point ~~of each~~ in any water main. Pipe grade design shall minimize the use of air relief valves wherever possible. Air relief can be provided by means of a flushing hydrant, fire hydrant, or designated air release valve.

15. HYDRANTS

15.1 Spacing

Fire hydrant spacing shall not exceed 500 feet measured along the curb line in areas zoned R-1 or R-2 and shall not exceed 450 feet in other areas. The Fire Chief may require additional hydrants in accordance with Uniform Fire Code. All hydrants will have secondary valves.

~~16.2 Color Code~~

~~Hydrants shall be color coded to AWWA standards.~~

16. LOCATION

16.1 Relation to Sewer Lines and Wells

Sanitary sewers and domestic water lines shall not be laid in the same trench. Parallel water and sewer lines wherever possible should be located at least 10 feet apart horizontally from outside edge to outside edge of the pipe. When physical conditions render this spacing impossible or impractical, then ~~ductile iron~~ water pipe with watertight joints is required for the sewer line. Wherever it is necessary for sewer and water lines to cross each other, the crossing should be at an angle of approximately 90 degrees and the sewer shall either be located 18 inches or more below the water line or be ~~cement lined~~ flow filled, constructed of ductile or PVC pipe with watertight joints for a distance of 10 feet on both sides of the water line.

16.2 Water Mains in Streets or Easements

Under normal conditions, water mains should be located in street right-of-way ~~5~~ 6 feet south or west of the street right-of-way centerline. Water mains shall be located in centerline of alleys and easements. When it is necessary to locate waterlines in easements, such easement shall be at least 20 feet in width.

~~17 ALIGNMENT~~

~~Water lines should be laid on straight alignment and uniform grade between blocks. However, in cases where justification can be shown, changes will be considered.~~

17. PIPE JOINTS

All pipe joints must be constructed watertight. Rubber rings or other approved joint sealing material shall be used. Joint deflections shall be controlled such that the watertight integrity of the joint is maintained.

18. SERVICE LINE CONNECTIONS

All service laterals from a water main to serve an individual building shall be of a minimum size of ¾-inch in diameter within public right-of-way or within public easements. Construction of service lines shall conform to the same standards as for water main construction.

All curb boxes shall be marked with a permanent indicator of location in the nearest hard surfacing (i.e. "W" stamp in adjacent curb, sidewalk, or driveway)

19. SEPARATE CONNECTION REQUIRED

19.1 Each main building or legal lot (except a private garage) shall be separately connected to a public water main. Except that main buildings or dwellings located on a single parcel may be connected to a private line, provided that an approved statement of maintenance and billing responsibility is recorded with the title to the property.

19.2 A valve shall be required at the point of connection of a private water system to a public system.

20. DRAINAGE DITCH OR STREAM CROSSINGS

Water lines entering or crossing drainage ditches or streams shall be constructed with care. The pipe and joints shall be tested in place, and shall be designed, constructed, and protected against anticipated hydraulic and physical, longitudinal, vertical, and horizontal loads, erosion, and impact.[5]

All ditch crossings shall require approval of the ditch company.

21. AERIAL CROSSINGS

Support shall be provided for all joints in pipes utilized for aerial crossings. The supports shall be designed to prevent frost heave, overturning, and settlement. The crossings shall also provide protection from freezing.

~~24 PROTECTION OF WATER SUPPLIES~~
~~When wastewater sewers are proposed in the vicinity of any water supply facilities, requirements of Circular WQB-1 (DEQ) should be used to confirm acceptable isolation distances in addition to the following requirements.~~

~~24.1 Cross Connections Prohibited~~
~~There shall be no physical connections between a public or private potable water supply system and a sewer, or appurtenance thereto which would permit the passage of any wastewater or polluted water~~

into the potable supply. No water pipe shall pass through or come in contact with any part of a sewer manhole.

24.2 Relation to Water Works Structures

24.2.1 Sewers shall not be located within 50 feet of a public water supply well.

24.2.2 All existing waterworks units, such as basins, wells, or other treatment units, within 100 feet of the proposed sewer shall be shown on the engineering plans.

24.3 Relation to Water Mains

24.3.1 Horizontal Separation. Sewers shall be laid at least 10 feet horizontally from any existing or proposed water main. The distance shall be measured edge to edge.

24.3.2 Crossings. Sewers crossing water mains shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and outside of the sewer. This shall be the case where the water main is either above or below the sewer. The crossing shall be arranged so that thesewer joints will be equidistant and as far as possible from the water main joints.

24.3.3 Where a water main crosses under a sewer, adequate structural support shall be provided for the sewer to maintain line and grade and to prevent damage to the water main.

PART 8 – STORM SEWER DESIGN

1. INTRODUCTION

1.1 Applicability

These design standards shall apply to all development, redevelopment, and construction activities on public and private property within the City of Laurel.

1.2 Policy Requirements

Drainage plans shall be prepared by a Professional Engineer licensed in the State of Montana and shall be submitted to the City PWD for review and approval.

2. PROJECT CLASSIFICATIONS

2.1 All Developments

2.1.1 Impact to water quality and quantity because of development shall be mitigated through design and construction of on-site or regional stormwater management facilities provided in accordance with these standards.

2.1.2 Stormwater discharge to private irrigation ditches, drains and laterals is acceptable provided approval has been granted by such facility owner/operator and discharge is controlled to ensure the ditch, drain or lateral facility is not adversely impacted beyond existing conditions. An agreement shall be signed between the facility owner/operator and developer with the City named as a third party. Agreement must state at a minimum the following:

- Development's discharge requirements,
- Conditions of use,
- Maintenance responsibilities

2.1.3 Provisions stating that the City shall have the first right to accept the automatic transfer of all interests and easements of the ditch/drain facility should the ditch/drain facility operator abandon their facility adjacent to the development. +

2.2 Residential Lot Developments

These requirements apply to residential lot development, including single family homes, duplexes, townhomes, and condo developments constructing two or less living units on a single lot and for "minor" construction projects in which improvements create more than 1,000 SF of impervious surface.

2.2.1 Site grading requirements shall follow specific requirements established in/on the subdivision plat, SIA or any covenants within the subdivision.

2.2.2 Runoff generated from a residential site (or new improvements) shall not drain from that site to a neighboring property.

2.2.3 Stormwater features shall be preserved per the initial design and maintained by the property owner.

2.2.4 The elevation of residential dwellings must be established in recognition of the storm runoff flows allowed in the gutter flowline of adjacent streets during major storms.

2.2.5 Submit a Site Stormwater Plan (SSP)in accordance with section 3.1.1 detailing lot grading and drainage plans.

2.3 Commercial Property Developments

2.3.1 These requirements apply to all commercial, industrial, and residential projects constructing three or more living units on a single lot. They shall apply to commercial expansion projects in which the improvements create more than 2,500 SF of impervious surface.

2.3.2 Stormwater Management facilities shall be design and constructed in accordance with section 2.4.

2.3.3 Runoff from the 10 and 100-year storm events shall not exceed 50-percent of the runoff rate of natural (pre-developed) conditions, prior to subdividing or developing the land. Alternatively, in special cases, subject to City approval, development may discharge at a higher rate than specified above if engineer provides adequate justification that discharge will not create nuisance, flooding or property damage downstream of the development. Pre-developed rates used to justify maximum allowable discharge rate, shall be subject to approval by City reviewer and shall be based on minimal value anticipated from range of values within common accepted engineering practice for the existing hydrological conditions.

2.3.4 If a new connection to the City's storm drain system is installed the development's stormwater system which connects to the City storm drain system shall be brought into compliance with the requirements of this section.

2.3.5 Due to the potential for increased stormwater pollutant runoff, some sites may require additional regulatory and design requirements.

2.3.5.1 Facilities requiring additional pollutant removal are:

A. Fueling station – require oil and metals treatment,

B. Facility storing/transporting more than 1,500 gallons of petroleum products – require oil treatment,

C. Hydraulic equipment storage – require oil and metals treatment,

D. Property zoned heavy industrial – require oil and metals treatment,

E. Vehicle maintenance/repair – require oil and metals treatment,

F. Nurseries – require nutrient treatment,

G. Lawn care/fertilizer facility – require nutrient treatment,

H. agricultural or animal care facility, or other similar facilities – require nutrient treatment,

I. Facility specific as determined necessary by the City

2.3.5.2 Pollutant removal applies to stormwater runoff of the above facilities and shall treat the below areas:

A. Oil Treatment

- required for all high use and high traffic areas that may contain oils and grease,
- Provide for no ongoing or recurring visible sheet and reduce Total Petroleum Hydrocarbons (TPH) to less than 10 mg/l

B. Metals Treatment

- Removal is achieved by basic removal of total suspended solids (TSS),
- Removal should be from 20 to 85% depending on design, metal state, and influent concentration,

C. Nutrient Treatment

- Nitrogen and phosphorus should achieve 50% reduction of total phosphorus and 35% reduction of total nitrogen

2.3.6 Above ground storage in parking lots may not pond to a depth greater than 12 inches during the major storm.

2.3.7 Where infiltration is used for storm water discharge a geotechnical and hydrogeologic evaluation shall be performed that analyzes the capacity of ground to accept discharge.

2.3.8 A comprehensive Drainage Plan (CDP) in accordance with Section 3.1.2 shall be submitted.

2.3.9 The Owner shall call for City inspection of drainage features prior to backfilling and a TV report shall be submitted for storm drain connections within the public right-of-way.

2.3.10 All facilities shall be owned, operated, and maintained by the property owner.

2.4 Subdivisions

Subdivisions shall comply with section 2.3 above as well as the following:

2.4.1 The requirements of this section apply to subdivisions within City Limits as well as tracts of land under review for annexation.

2.4.2 Stormwater management facilities shall be provided and designed to avoid impact to downstream drainage infrastructure and properties in accordance with this section. Points of discharge from the development shall be at locations where runoff flows from the site in the pre-developed drainage condition and shall mimic the type of flow that exists in the pre-developed condition to prevent erosion, flooding or other damage to downstream infrastructure or downstream properties. Where multiple points of discharge exist for one development, each point of discharge shall comply with these provisions individually. Exceptions may be made for downstream facilities that are designed to handle increase flow rates and volumes. In those cases, these standards will be assessed at the downstream end of those facilities.

2.4.3 Runoff entering the Subdivision from upstream properties shall be evaluated and either included in the composite rate and volume of runoff from the subdivision, or diverted through or around the subdivision, back into natural pre-developed drainage courses as the off-site run-off existed prior to development.

2.4.4 The elevation of residential dwellings, buildings, or other permanent facilities must be established in recognition of the depth of flow in the gutter flowline of adjacent streets during the Major Storm. Established minimum building elevations shall be documented in the SIA, plat or other applicable recorded document.

2.4.5 A copy of the HOA agreement, O&M Manuals, and BMP inspection checklist shall be submitted and include provisions for maintenance and operation of all privately owned stormwater management facilities.

2.4.6 Curb cuts for drive approaches installed during initial subdivision construction shall be constructed to accommodate gutter flow to the full curb depth throughout the subdivision.

2.4.7 If off-site discharge onto neighboring properties is required where it has not historically occurred, a drainage easement must be obtained through the downstream neighboring properties to the point at which the runoff is collected in a public drainage facility.

2.4.8 Stormwater facilities within a subdivision, excluding conveyance facilities within public Right of Ways (ROW), shall be owned, operated and maintained by the subdivision HOA. Stormwater facilities outside of the ROW shall be located within a lot owned by the HOA and shall include a platted easement and associated access to the ROW. Easement shall detail property owner/HOA use and maintenance of easement area. Landscape plans shall be submitted with the development plans.

2.5 Maintenance Activities

The activities listed below are considered to be “maintenance” and are therefore not governed by the requirements of this manual. Exclusion from these stormwater management requirements does not relieve the development of other required permits and submittals. Contact the City Public Works Office to determine what (if any) permits or submittals are required.

2.5.1 Replacement of existing infiltration facilities; i.e., boulder pits or French drains.

2.5.2 Resurfacing of an existing parking lot, including reconstruction of base gravel if grades of the parking lot have not altered drainage patterns.

2.5.3 City of Laurel maintenance or rehabilitation projects.

2.5.4 Private utility improvement projects disturbing less than one-acre of land surface.

2.5.5 If a new connection is made to the City’s storm drain system, the development shall meet the requirements of 2.4.

3. PLAN SUBMITTAL REQUIREMENTS

3.1 Site Stormwater Plan (SSP) Stormwater Drainage Plans are divided into two categories based upon the development type; Site Stormwater Plan (SSP) and Comprehensives

Drainage Plan (CDP). The applicability and requirements for each are described as follows:

3.1.1 Site Stormwater Plan (SSP)

A. The SSP applies to all developments listed in Section 2.2 and shall be reviewed and accepted prior to issuance of a building permit. The following shall be addressed in an SSP submittal:

- Inform the City as to the drainage plan, the nature of the construction, project schedule, downstream conveyances, and project contact information. Plan shall include all finished floor elevations, drainage flow paths, top back of curb elevations, downspout, window well locations and similar critical elevations.
- Identify the drainage pattern of adjacent lots to ensure a common drainage approach within the development area is being met.
- Show all easements within lot and show/identify all site-specific criteria and requirements listed within the subdivision SIA, if applicable.

B. If after review of the SSP, the City determines that more detail or information is required, the City may require a Comprehensive Drainage Plan.

3.1.2 Comprehensive Drainage Plan (CDP)

A. The CDP applies to all developments listed in Sections 2.3 and 2.4 and shall be reviewed and accepted prior to issuance of a building, right-of-way permit, preliminary plat approval or final plat approval, as applicable. Table 8.1 shall be used to identify required information to be submitted for various development activities. Additional information to guide these submittals is provided in the referenced appendices.

B. Preliminary Drainage Report

The Preliminary Drainage Report is to be provided at the time of preliminary plat application and is to identify and describe site drainage impacts and illustrate preliminary solutions to the drainage system and any problems which may occur on-site and off-site as a result of the development. The report shall be based on the outline in Appendix A.

C. Final Drainage Report

- The Final Drainage Report is to provide in depth details and calculations to address the drainage issues and present sizing and locations for all

proposed improvements. The report shall be based on the outline provided in Appendix B.

- In addition to details and calculations, the Final Drainage Report shall include a narrative describing in detail how the site and site features will function for the water quality storm and the Minor and Major storm events.

- If infiltration to underlying soils will be used to manage any portion of the site runoff, refer to procedures outlined in Appendix C and the geotechnical/hydrogeological requirements of this manual.

Table 8.1 – Comprehensive Drainage Plan (CDP) Submittals

	Required Submittal						
Development Activity	Preliminary Drainage Report	Final Drainage Report	Geotechnical/ Hydrogeological Report (If infiltration is used)	O&M	HOA	SIA	Reference
Commercial		X	X	X			Appendix B, C, & D
Preliminary Plat	X		X			X	Appendix A & C
Subdivision Construction Permit		X	X	X	X		Appendix B, C, D, & E

3.1.3 Geotechnical/ Hydrogeological Report

A. The Geotechnical/Hydrogeological Report is to provide information such that reviewer has a clear understanding of underlying soils and groundwater characteristics and how those will interact with an be impacted by the proposed development. The report shall be based upon the outline provided in Appendix C.

B. In addition to the report, a letter from the geotechnical or hydrogeological professional shall be submitted stating the impacts that the stormwater runoff will have to groundwater levels, structures, and facilities both within

and outside the limits of developments. If impacts are identified, the report shall provide mitigation solutions for the development.

3.1.4 Operation and Maintenance (O&M) Plan

The O&M plan is to identify the party responsible for operations and maintenance of the stormwater facility, detail maintenance schedules/activities and to ensure adherence with approved design operating conditions.

3.1.5 Homeowners' Association (HOA) Agreement

For subdivision development, an HOA agreement shall be submitted and approved to ensure perpetual legal validity and financial stability of the party responsible for ownership and maintenance of the stormwater facility and the template form found in Appendix E.

4. RAINFALL

4.1 Application

4.1.1 This chapter provides design storm frequency and precipitation data to be used in the design of stormwater management facilities within the City of Laurel. The information provided for the Water Quality Storm is intended for use in the design of permanent water quality treatment facilities.

4.2 Design Storm Frequency

4.2.1 The design storm frequency varies depending on the development type as well as the street classification as shown in Tables 8.2 and 8.3.

Table 8.2 – Design Storm Frequency by Street Classification

Public Street Classification[2]	Design Storm Frequency (Recurrence Interval, Year)	
	Minor	Major
Local Streets	2	100
Collector / Commercial Subdivision Street	5	100
Industrial / Central Business Streets	10	100
Arterial Streets	10	100

Storm drain conveyance systems shall be designed and constructed where needed to assure that flow depths and spread in street do not exceed allowances for the various storm scenarios specified in Table 8.2.

4.3 Design storm depth and intensity

4.3.1 Rainfall depths and intensities are provided in Table 8.3 and 8.4 for the City of Laurel, including durations from 5 minutes up to 24 hours and recurrence intervals from 2 years up to 100 years. This information was derived using precipitation data available from the National Climatic Data Center (NCDC) for Billings Logan International Airport (NCDC Cooperative Station Number 240807 (NCDC, 2014) for the period of record from July 1948 through September 2013.

Table 8.3 – Precipitation Depth – Duration
(Depth In Inches)

Duration	2-year	5-year	10-year	25-year	50-year	100-year
5-min	0.27	0.42	0.51	0.65	0.75	0.85
10-min	0.39	0.58	0.70	0.87	1.00	1.13
15-min	0.47	0.68	0.83	1.03	1.18	1.33
20-min	0.50	0.75	0.91	1.13	1.30	1.46
25-min	0.54	0.80	0.98	1.21	1.39	1.56
30-min	0.56	0.84	1.02	1.28	1.47	1.66
35-min	0.59	0.89	1.08	1.34	1.53	1.72
40-min	0.61	0.92	1.12	1.39	1.59	1.78
45-min	0.63	0.95	1.16	1.43	1.64	1.84
50-min	0.65	0.97	1.19	1.47	1.68	1.89
55-min	0.67	1.00	1.22	1.50	1.72	1.93
1-hr	0.68	1.03	1.26	1.55	1.76	1.97
2-hr	0.76	1.11	1.34	1.63	1.85	2.07
3-hr	0.85	1.18	1.40	1.68	1.88	2.09
6-hr	1.05	1.38	1.60	1.88	2.08	2.28
12-hr	1.29	1.67	1.92	2.23	2.46	2.70
24-hr	1.57	2.05	2.37	2.78	3.08	3.38

Based on DOWL Precipitation Analysis (2015)

Table 8.4 – Precipitation Intensity - Duration
(Intensity In Inches per Hour)

Duration	2-year	5-year	10-year	25-year	50-year	100-year
5-min	3.26	5.02	6.18	7.75	8.96	10.16
10-min	2.33	3.45	4.19	5.20	5.98	6.75
15-min	1.87	2.74	3.31	4.11	4.72	5.32
20-min	1.50	2.24	2.73	3.39	3.89	4.38
25-min	1.29	1.93	2.35	2.91	3.33	3.76
30-min	1.12	1.68	2.05	2.55	2.94	3.33
35-min	1.01	1.52	1.85	2.29	2.62	2.95
40-min	0.92	1.38	1.68	2.08	2.38	2.68
45-min	0.84	1.26	1.54	1.91	2.18	2.45

50-min	0.78	1.17	1.43	1.76	2.02	2.27
55-min	0.73	1.09	1.33	1.64	1.88	2.11
1-hr	0.68	1.03	1.26	1.55	1.76	1.97
2-hr	0.38	0.55	0.67	0.82	0.93	1.03
3-hr	0.28	0.39	0.47	0.56	0.63	0.70
6-hr	0.18	0.23	0.27	0.31	0.35	0.38
12-hr	0.11	0.14	0.16	0.19	0.21	0.22
24-hr	0.07	0.09	0.10	0.12	0.13	0.14

Based on DOWL Precipitation Analysis (2015)

4.3.2 The rainfall depth for a 24-hour storm in Table 8.3 shall be used together with the SCS (NRCS) Type II rainfall distribution to develop the 24-hour storm hyetograph for runoff hydrograph analyses. The rainfall intensities listed in Table 8.4 for the corresponding durations (times of concentration) shall be used in the Rational Method to determine peak runoff rates.

4.4 Water Quality Storm

4.4.1 The water quality design storm shall be used to size runoff treatment and water quality BMPs. Runoff treatment BMPs should be sized based on either the water quality volume or flow rate in order to achieve the required treatment efficiencies.

4.4.2 The water quality runoff volume and/or flow rate for post-development conditions shall be based on the 0.5-inch rainfall event. This storm was selected by the Montana DEQ and issued in the General Permit and has been adopted by the City of Laurel as the water quality design storm.

5. RUNOFF

5.1 Application

This chapter discusses criteria for drainage basin delineation and for selection of acceptable stormwater runoff calculation methods to be used for drainage design within the City of Laurel.

5.2 Drainage Basin Area

5.2.1 The total area, including upstream offsite areas, contributing to the point of interest shall be included in the delineation of drainage basins. Runoff from upstream undeveloped land, not part of the proposed project shall be included in the design calculations. Runoff from upstream developed property must be determined based on the existing conditions or approved drainage plans. A detailed contoured map with the best information available shall be used to identify off-site areas. Contributing drainage areas should take into

consideration potential for overflow of existing ditches or other facilities upstream of the project.

5.3 Selection of Runoff Calculation Methods

Table 8.5 – Acceptable Runoff Calculation Methods

Runoff Calculation Method	Applications	Limitations/Notes
Rational Method	-Used for determining peak runoff rates for sizing conveyance systems -Should not be used when routing of runoff hydrographs is required	-Should only be used for developments and basins of 5 acres or less -Should only be used for basins with homogeneous land uses
Modified Rational Method	-A simplified method used to approximate storage requirements for small drainages	-Should only be used for developments and basins of 5 acres or less
NRCS (SCS) Method	-Used for determining peak runoff rates and runoff hydrographs for large drainage basins -Used for determining storage requirements for detention or retention facilities	-Should be used for developments and basins larger than 5 acres

5.4 NRCS (SCS) Hydrograph Method

5.4.1 The SCS Hydrograph Method shall be employed using the procedures detailed in Section 3.2.4 of the HEC-22 Manual (http://www.fhwa.dot.gov/engineering/hydraulics/pubs/10009/10009.pdf).

5.4.2 Use site-specific soils information for the project site when available, or the Natural Resources Conservation Service (NRCS) Soil Survey of Yellowstone County to identify the soils and corresponding hydrologic soil groups for each drainage basin

5.4.3 Time of Concentration

The time of concentration (TC) shall be calculated using the procedures detailed in TR-55 Method (https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044171.pdf). Sheet flow lengths shall be limited to no more than 100' When TC is used to estimate pre-developed flow rates to justify maximum allowable discharge rate, upper end of potential TC range shall be assumed.

5.4.4 Curve Numbers

Curve numbers (CNs) to be used shall be as set forth in Table 8.6. Depending on basin area, multiple CNs with associated flow properties may be required. A conservative approach shall be used when determining CN values. When CNs are used to estimate pre-developed flow rates to justify maximum allowable discharge rates, lower end of potential CN range for given conditions shall be assumed.

Table 8.6 – Runoff Curve Numbers for Urban Areas (Average Watershed Condition, Ia = 0.2 SR)

Land Use Description	Curve Numbers for Hydrologic Soil Group			
	A	B	C	D
Fully Developed Urban Areas (Vegetation Established)				
Lawns, open spaces, parks, golf courses, cemeteries, etc.				
Good condition; grass cover on 75% or more of the area	39	61	74	80
Fair condition; grass cover on 50 to 75% of the area	49	69	79	84
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Streets and roads				
Paved with curbs and storm sewers	98	98	98	98
Gravel	76	85	89	91
Dirt	72	82	87	89
Paved with open ditches	83	89	92	93
Average % impervious*				
Commercial and business areas 85	89	92	94	95
Industrial districts 72	81	88	91	93
Residential Lots: Average % impervious*				
65	77	85	90	92
38	61	75	83	87
30	57	72	81	86

25	54	70	80	85
*Interpolate as necessary				
Developing Urban Areas (No Vegetation Established)				
Newly graded area	77	86	91	94
Native Ground Cover				
Herbaceous – mixture of grass, weeds and low growing brush, with brush the minor element (30%-70% ground cover)		71	81	89
Herbaceous – mixture of grass, weeds and low growing brush, with brush the minor element (>70% ground cover)		62	74	85
Sagebrush with grass understory		35	47	55
Pasture, grassland or range – continuous forage for grazing	39	61	74	80
Meadow – continuous grass, protected from grazing, mowed for hay	30	58	71	78
Cultivated Agricultural Lands				
Row crops	67	78	85	89
Close-seeded or broadcast legumes or rotation meadow	58	72	81	85
Small grain crops	63	75	83	87

5.5 Rational Method

5.5.1 The Rational formula is given as follows:

$Q = CfCIA$

Where: Q = Flow in cfs,
Cf = correction factor for infrequent storms,
C = a dimensionless runoff coefficient,
I = rainfall intensity in inches per hour, and
A = drainage area in acres

5.5.2 The Rational Method shall be applied using the procedures detailed in Section 3.2.2 of the HEC-22 Manual (http://www.fhwa.dot.gov/engineering/hydraulics/pubs/10009/10009.pdf).

5.5.3 Frequency Correction Factors. Table 8.7 lists the correction factor to be used for infrequent storm events.

Table 8.7 – Frequency Correction Factors for Rational Method

Recurrence Interval (years)	Adjustment Factor C_f
2 and 10-year	1.00
25-Year	1.10
50-Year	1.20
100-Year	1.25
NOTE: C^*C_f should not exceed 1.00	

5.5.4 Runoff Coefficients

Runoff Coefficients to be used shall be as set forth in Table 8.8. A conservative approach shall be used when determining coefficient values. When “C” is used to estimate pre-developed flow rates, lower end of potential “C” rage for given conditions shall be assumed.

Table 8.8 – Runoff Coefficients ("C") for the Rational Method

Type of Drainage Area	Runoff Coefficient, C*
Residential:	
Neighborhood areas	0.70
Single-family areas	0.50
Multi-units, detached	0.60
Multi-units, attached	0.75
Apartment dwelling areas	0.70
Industrial:	
Light areas	0.80
Heavy areas	0.90
Parks, cemeteries	0.10 – 0.25
Playgrounds	0.20 – 0.40
Railroad yard areas	0.20 – 0.40
Unimproved areas (forest)	0.10 – 0.30
Lawns:	
Sandy soil, flat, 2%	0.10
Sandy soil, average, 2-7%	0.15
Sandy soil, steep, 7%	0.20
Heavy soil, flat, 2%	0.17
Heavy soil, average 2-7%	0.22
Heavy soil, steep, 7%	0.35
Streets, parking lots and other paved areas:	
Asphaltic and concrete	0.95
Brick	0.85
Drives, walks and roofs	0.95
Gravel Areas	0.70-.85

*Higher values are usually appropriate for steeply sloped areas and longer return periods as infiltration and other losses have a proportionally smaller effect on runoff in these cases

5.6 Modified Rational Method

5.6.1 The Modified Rational Method approximates the volume of runoff for various storm durations, with peak flows based on the time of concentration for each respective duration. The difference between the volume of runoff into the

facility and the outflow from the facility, computed for the various storm durations is used to establish the maximum required detention storage.

5.6.2 This simplified approach is valid for basins with contributing areas less than 5 acres.

5.7 Computer Aided Design Software

5.7.1 Use of computer aided design software is allowed. However, designer shall provide a detailed, written explanation, within the body of the CDP, detailing selection of input parameters, description for how program calculates results, and a detailed explanation of those results. Appurtenant results pages shall be provided in an appendix of the CDP.

6. HYDRAULIC ANALYSIS AND DESIGN

6.1 Application

This chapter provides criteria to be used in the design of both public and private storm drainage infrastructure including inlets, manholes, storm drain, open channels, culverts, and bridges to safely convey storm runoff for projects within the City of Laurel.

6.2 Gutter Flow

The City allows the use of streets for drainage within the limitations specified in Tables 8.9 and 8.10 Contact the PWD for determination of a street's classification.

Table 8.9 – Allowable Use Of Streets For Minor Storm Runoff

Street Classification	Maximum Street Encroachment
Local	No curb overtopping. Flow may spread to crown of street.[1]
Collectors	No curb overtopping. Flow spread must leave at least one, 11' lane free of water, five feet either side of the street crown. [1]
Arterials	No curb overtopping. Flow spread must leave at least two, 11' lanes free of water, ten feet each side of the street crown or median. [1]
Arterials (more than 6 lanes)	No curb overtopping. Flow spread must leave at least four, 11' lanes free of water, twenty feet each side of the street crown or median. [1]

[1]Where no curbing exists, encroachment shall not extend beyond property lines, except at drainage easements.

6.2.1 Hydraulics

Gutter flow encroachment and hydraulics shall be evaluated using the methods presented in Section 4.3 of the HEC-22 Manual (http://www.fhwa.dot.gov/engineering/hydraulics/pubs/10009/10009.pdf).

6.2.2 Minimum Gutter Slope

Gutters shall be constructed at slopes no flatter than 0.3 percent for retrofit conditions and 0.5 percent for new construction. For new gutter sections in vertical curves, the k-value shall be less than or equal to 167 to provide for adequate drainage. If the k-value exceeds 167, special consideration shall be given to promote drainage.

6.2.3 Inlet Spacing and Location General

The interception capacity of inlets and required spacing shall be determined in accordance with the procedures described in Sections 4.3 and 4.4 of the HEC-22 Manual.

6.2.3.1 Recommended Locations for inlets

A. Away from ADA ramps

B. Prior to pedestrian crossings

C. At low points in the gutter grade

D. Where significant flows from off the right-of-way are expected

E. On horizontal curves where a change from normal crown to super-elevation may cause water to sheet-flow across the road

F. Where lay-down curb (e.g., at approaches) may allow the flow to escape and cause flooding

G. Where necessary to maintain gutter flow widths and depths within the allowable limits set forth in Tables 8.9 and 8.10

H. Mid-block inlets within subdivisions, shall be located along property lines to minimize impacts to future driveways and other development features

I. Where a curbed roadway crosses a bridge, the gutter flow should be intercepted and not permitted to flow onto the bridge.

6.2.3.2 Inlets Are Not for Flood Prevention

Inlets shall not be considered as the sole defense for flood protection. Grading design shall not allow water to back up and flood any parts of a building during a major storm event in the event that an inlet is blocked.

6.2.3.3 Inlet Types

Allowed storm inlet types include grated and combination (grated with curb opening or grated with curb opening plus slotted drain) inlets. The City of Laurel standard inlets include Type II inlets in sag locations and Type III inlets for on-grade installations for streets without curb and gutter, these inlets may not be appropriate, and another inlet may be selected with City approval.

- Inlets in low point along road profile – calculated inlet capacity at low points shall assume 50 percent plugging by debris.
- Inlets along straight graded sections of road profile– calculated inlet capacity in straight grade areas shall assume 25 percent plugging by debris.
- Inlets installed within the right-of-way, or are adjacent to trails, sidewalks, and bike lanes must have grates that are designated for pedestrian and bicycle traffic. Approval by the City is required for inlets within the right-of-way that are not designated for pedestrian and bicycle.

6.3 Storm Drain

6.3.1 Hydraulics

Use the methods set forth in Chapter 7 of the HEC-22 Manual for the hydraulic design of storm drains, except as modified herein (http://www.fhwa.dot.gov/engineering/hydraulics/pubs/10009/10009.pdf).

6.3.2 Diameter, Slope, and Velocity Limits

A. Minimum slopes for storm drainpipes shall be as required to maintain a full-flow velocity of at least 2.5 feet per second during the Minor Storm Event.

B. Minimum diameter for storm drain lines and laterals, which will be part of the public storm drainage system, shall be 12 inches. Minimum diameter for private connections into the public storm drainage system shall be 6 inches. Pipe sizes shall not decrease in the downstream direction and transitions from smaller pipes to larger pipes shall occur by matching the inside top (crown) of the pipes where practicable. Where it is not possible

to match crowns, the 67-percent diameter points of the pipes shall be matched at a minimum, where practicable; or, upon approval from the City Public Works Office, inverts may be matched if the HGL does not exceed the street elevation during a minor storm event.

6.3.3 Maintenance Access

A. All stormwater pipe and facilities shall be accessible for operation and maintenance.

B. When vehicle access is necessary, for facilities constructed outside of the street section, access roads shall be provided in access easements. The minimum clear driving lane width of access roads is 12 feet. Access roads shall have a maximum grade of 9% and shall be constructed with gravel, pavement, concrete or an appropriate all-season surface.

C. Gates and/or bollards are required when necessary to restrict access to stormwater facilities. Cables and/or chains stretched across access roads are not acceptable.

6.3.4 Manning "n" Values

The Manning's "n" value used for the design for storm drains shall be as shown in Table 8.10.

Table 8.10 – Manning's Coefficients (n) for Storm Drain Conduits

Pipe Material	Roughness or Corrugation	Manning's n
Concrete Pipe	Smooth	0.013
Concrete Boxes	Smooth	0.015
Spiral Rib Metal Pipe	Smooth	0.013
Corrugated Metal Pipe, Pipe-Arch and Box	2-2/3 by 1/2 in Annular	0.027
	2-2/3 by 1/2 in Helical	0.023
	2-6 by 1 in Helical	0.025
	5 by 1 in	0.026
	3 by 1 in	0.028
	6 by 2 in Structural Plate	0.035
	9 by 2-1/2 in Structural Plate	0.037
Poly Based Thermoplastic	Smooth	0.015
	Corrugated	0.025
PVC Based Thermoplastic	Smooth	0.011

*Published values may differ; however, values presented in this table assume long term use of pipe which leads to increased roughness. Manufacturer recommendations shall be used if values are higher than presented above.

6.4 Materials

6.4.1 Access Manholes

A. Access manholes are required when joining pipes of different types, sizes, at horizontal or vertical bends in the alignment, at lateral connections, and at the upstream terminus of storm drain mains.

B. Required Size

The required minimum manhole size shall be 48-inches and larger when required by pipe sizes and geometry to satisfy applicable ASTM specifications.

C. Required Spacing

The maximum manhole spacing along storm drains is as set forth in Table 8.11.

Table 8.11 – Maximum Allowable Manhole Spacing

Storm Drain Diameter	Maximum Spacing
12” to 36”	400’
42” to 60”	500’
66” and Larger	600’

6.4.2 Maximum Manhole Depth

Manhole depths shall not exceed 20 feet without special safety provisions such as intermediate platforms and minimum diameter risers of 48 inches.

6.4.3 Drop Manholes

The difference between the highest trunk line pipe invert entering a manhole and the invert leaving shall not exceed 24 inches. Manholes with drops exceeding 24 inches shall be designed as drop manholes. Drop manholes with drop heights exceeding six feet shall be designed with high strength (6,000psi) concrete.

6.5 Clearance from Other Utilities

The following utility clearances shall be maintained where possible. All clearance are based on the outside edge of the storm drain to the outside edge of the other utilities.

6.5.1 Horizontal clearances from storm main:

- Cable TV, Gas, Power 5 feet

- Sewer 6 feet
- Telephone, Fiber Optics 5 feet
- Water 10 feet

6.5.2 Vertical clearances from storm main:

- Cable TV, Gas, Power 1 feet
- Sewer 1 feet
- Telephone, Fiber Optics 1 feet
- Water 1.5 feet
- Misc. Private Utilities 1 feet

6.5.3 Water main crossings shall be designed to prevent freezing due to minimal clearance from storm drains.

6.5.4 Avoid crossing other utilities at highly acute angles. The angle measure between utilities shall be between 45 and 90 degrees where possible.

6.6 Private Drainage System Connections

Private drainage system connections to the public storm drain system shall comply with the following criteria. Such connections shall be entirely owned and maintained to the main by development in which the connection was installed and/or serves.

6.6.1 All private stormwater connections shall include backflow prevention to prevent stormwater from the City's storm drain system from surcharging onto private property unless such backflow is not possible due to grades. Backflow preventer must be installed on-site and not within the public right-of-way.

A. Minimum pipe diameter discharging to the City's storm drain system shall be 6 inches. The maximum pipe diameter allowed will depend on an evaluation of the capacity of the City's storm drain system and approval from the City Public Works Office.

B. Directly connected pumped connections to the City's storm drain system are not allowed. Developments may install a pump to mitigate stormwater runoff per the requirements of this manual; however, stormwater runoff shall be pumped to a manhole or other feature prior to making a gravity connection to the City's system.

C. Directly connected pumped connections to the connections shall only be made at a structure.

6.7 Outfalls

6.7.1 General

- Use the methods set forth in Chapter 7.1.5 of the HEC-22 Manual, as modified herein.
- Invert elevations of outfalls shall be no lower than the bank-full water surface elevation (2-yr flood) in open channels or streams, where practical.
- Outfalls downstream of detention facilities shall be designed to prevent backwater into those facilities.
- Outfalls within ditches/drains shall be constructed with fire-proof material.

6.7.2 Erosion Protection

Erosion protection is required at the outlet to prevent erosion of the outfall channel bed and bank.

6.7.3 Energy Dissipation/Rip-Rap

A. Where flow velocities exceed 10 feet-per-second at the outfall, during the design storm, energy dissipation, in addition to erosion protection may be required. Design energy dissipation measures in accordance with FHWA HEC-14, "Hydraulic Design of Energy Dissipaters for Culverts and Channels" (https://www.fhwa.dot.gov/engineering/hydraulics/pubs/06086/hec14.pdf).

B. Rip-Rap size and classification shall be based upon flow rates to be mitigated. Rip-Rap sizing shall follow MDT's guidelines within their Standard Specifications, Division 700: http://www.mdt.mt.gov/other/webdata/external/const/specifications/2014/division_700.pdf

6.7.4 Maintenance Access

All stormwater pipe and facilities shall be accessible for operation and maintenance.

When vehicle access is necessary, for facilities constructed outside of the street section, access roads shall be provided in dedicated access easements. The minimum clear driving lane width of access roads is 12 feet. Access roads shall have a maximum grade of nine percent and shall be constructed with gravel, pavement, concrete or an appropriate all- season surface.

Gates and/or bollards are required when necessary to restrict access to stormwater facilities. Cables and/or chains stretched across access roads are not acceptable.

6.8 Open Channel Conveyances

6.8.1 General

A. New or altered channels shall be lined with grass, rocks or other erosion resistant materials adequate to prevent erosion during maximum design flow scenario. Concrete or asphalt shall not be used unless approved by the City Public Works Director.

B. Design open channels in accordance with the methods provided in Chapter 5 of HEC-22 except as modified herein.

6.9.2 Clearance

Channels shall be located no closer than ten feet from any structure foundation as measured horizontally from the edge of the swale at the top of freeboard elevation.

6.8.3 Erosion Control

A. Channel segments shall be designed according to the permissible tractive force (shear stress) methodology set forth in Section 5.3 of HEC-22 and Hydraulic Engineering Circular 15 (http://www.fhwa.dot.gov/engineering/hydraulics/pubs/10009/10009.pdf, http://www.fhwa.dot.gov/engineering/hydraulics/pubs/05114/05114.pdf, respectively)

B. Both the bare soil condition immediately following construction and the anticipated vegetated conditions of the channel shall be evaluated. If the channel is determined to be unstable during the maximum design storm event for either of these conditions, the appropriate long-term, temporary, and transitional linings shall be installed.

C. Erosion control structures, such as check drops or check dams, may be required to control flow velocities.

6.8.4 Freeboard Requirements

A minimum freeboard of one-foot from the water surface during Major Storm event to the top of bank shall be provided for open channel conveyances.

6.8.5 Friction Factors (n)

Use Manning's roughness factors (n) set forth in Table 5-1 of HEC-22. The design shall consider the channel roughness both immediately after construction and when vegetation is fully established. Roughness factors, which are representative of unmaintained channel conditions, shall be used for the analysis of water surface profiles. Roughness factors, which are representative of well-maintained channel conditions, shall be used to determine maximum velocity.

6.8.6 Side Slopes

Side slopes shall be no steeper than 4H:1V for maintained grass-lined channels, 3H:1V for unmaintained native grass-lined channels and 2H:1V for riprap-lined channels.

6.8.7 Maintenance Access

Provide maintenance access for inspection, mowing operations, and debris removal by conventional equipment along the length of the conveyance channel. The type of equipment needing access is dependent on the size of the channel. Large channels will need access for dump trucks and loaders. For small channels, foot or pick-up truck access may suffice. Channels may need to be offset within the easement to facility maintenance.

6.8.8 Operation & Maintenance of Private Open Channels

A. Open channels require periodic maintenance. The degree of maintenance is dependent on the location, the specific type of facility, and the liner material (grass, rock, etc.).

B. Maintenance of open channels is required to insure the conveyance capacity of the facility is maintained and that channel erosion does not occur. The condition of open channels should be checked on a periodic basis, especially after large storms or extended periods of high flow or immediately following periods of high intensity winds (erosion may occur during high flows, from scour caused by localized debris blockage or from debris blown into the channel). Debris should be removed to prevent channel plugging, channel scour and loss of channel conveyance. Erosion shall be repaired or stabilized.

C. Vegetated channels shall be maintained to ensure that vegetation does not limit the conveyance capacity of the facility. If conveyance restrictions are apparent, the vegetation should be trimmed to restore capacity.

D. Emergent vegetation (spirogyra, elodea, watercress, etc.) in conveyance channels may also become a problem if it is allowed to constrict the conveyance capacity of the facility. Vegetation above the ordinary high water mark shall also be monitored primarily for its ability to retain bank stability without reducing channel capacity at maximum design flows.

6.9 Culverts

Culverts shall be designed using the methods set forth in the Federal Highway Administration (FHWA) Hydraulic Design Series No. 5 (HDS-5), "Hydraulic Design of Highway Culverts", Publication No. FHWA-NHI-01-020 except as modified herein (http://www.fhwa.dot.gov/engineering/hydraulics/pubs/12026/hif12026.pdf)

6.9.1 Street Overtopping

Culverts shall be sized such that the depth of street overtopping is limited as set forth in Table 8.12.

Table 8.12 – Allowable Street Overtopping Depths at Culvert Crossings

Street Classification	Minor Storm	Major Storm
Local and Collector	None	Six inches at the street crown. Residential dwellings and public, commercial, and industrial buildings shall not be inundated at the ground line unless flood-proofed.
Arterial	None	No overtopping allowed. Provide 1-ft of clearance between the crown of the culvert and the water surface elevation where practicable, for drainage basins greater than one square miles.

6.9.2 Headwater Depth

A. The headwater (HW) depth shall be limited according to the following ratios to diameter (D):

- For culverts with a cross sectional area less than or equal to 30 square feet: HW/D ≤1.5
- Culverts must also be sized without creating significant flow constriction, such that existing channels upstream are not overtopped during the design flow event.

6.9.3 Allowable Velocities

A. Culverts shall be designed to maintain a minimum velocity of2.5 feet-per-second during the Minor Storm to prevent sediment accumulation and shall be designed with a minimum slope of 0.5 percent, where practicable.

B. Culverts shall be sized to limit velocities in order to minimize erosion potential during the Major Storm Events. For exit velocities in excess of 10 feet-per-second during the Major Storm, energy dissipation, in addition to erosion protection may be required. Design energy dissipation measures in accordance with FHWA HEC-14, "Hydraulic Design of Energy Dissipaters for Culverts and Channels" (https://www.fhwa.dot.gov/engineering/hydraulics/pubs/06086/hec14.pdf)

6.10.4 Materials

A. Culverts shall be constructed of concrete, corrugated polyethylene pipe, or polyvinyl chloride corrugated sewer pipe with a smooth interior. Efforts should be made to eliminate corrugated steel pipe.

B. Culvert wall strengths and coatings shall be suitable for the soil conditions design depths, and trench details. Culvert strength shall be designed assuming HS-20 live load capacity unless unique conditions of the crossing warrant a higher load capacity (i.e., Hs-25 or E-80).

C. When an abrasive bed load is anticipated or when velocities exceed 10 feet per second, protective measures shall be implemented to limit pipe damage. Corrosion, abrasion and other appropriate observations of field culvert materials and be considered in determining appropriate culvert materials and joint types. Corrosion resistance shall be evaluated based on minimum resistivity, pH, sulfate content and chlorine content of the soil and groundwater.

6.10.5 End Treatments

Culverts shall be designed with appropriate end treatments at their inlets and outlets such as flared end sections, headwalls, or wingwalls to provide smooth transitions to/from the drainage channel or ditch and to conform to embankment slopes. In addition to the pipes, end treatments installed within ditches/drains shall be fire-proof. Erosion protection or energy dissipaters shall be provided as necessary to limit erosion due to turbulent flow and high velocities. Depending on the culvert location, a safety grate or trash rack may need to be installed.

6.10.6 Maintenance Access

Provide maintenance access to the upstream and downstream ends of culverts for inspection and debris removal.

7. EROSION AND SEDIMENT CONTROL

7.1 Regulatory Requirements And Permit Coverage

Developer shall comply with all applicable state and federal requirements associated with stormwater pollution preventions, including coverage under the States National Pollution Discharge Elimination System Permit to Discharge Stormwater Association with Construction Activities (NPDES Permit), when required.

7.2 Construction

Regardless of requirement for coverage under the NPDES Permit, construction activity shall implement BMPs and good housekeeping practices to minimize impacts including, but not limited to, erosion and sediment transport into public right-of-way or onto adjoining property. Homebuilders/contractors are responsible for managing BMPs on individual lots within a subdivision and/or master plan area and are required to follow the requirements in the Notice of Intent (NOI) and Stormwater Pollution Prevention Plan (SWPPP), when applicable.

7.3 Best Management Practices (Bmp)

Temporary erosion and sediment control BMPs may be selected, designed, and installed using the methodology discussed in the most current edition of the Montana Department of Transportation Erosion and Sediment Control Best Management Practices Manual, available on MDT's website (https://www.mdt.mt.gov/publications/docs/manuals/env/bmp-manual-jan15.PDF). In addition, the Montana Department of Environmental Quality developed the Storm Water Management During Construction Field Guide for Best Management Practices reference document which may help in developing a BMP plan. Contact their office for a copy of this document.

Appendix A Preliminary Drainage Report

The purpose of the preliminary drainage report is to describe and illustrate the preliminary solutions to the drainage problems which may occur on-site and off-site as a result of the development or any phase of the development. The drainage report shall be submitted during the subdivision process with the application for Preliminary Plat.

Preliminary drainage reports shall provide an appropriate level of detail to address drainage issues and present the overall plan for the property. The report shall be based on the following outline and include appropriate background information, supporting data, calculations and plan drawing(s).

TITLE PAGE

1. Type of Report (Concept)
2. Project Name
3. Prepared for/by
4. Date
5. P.E. Seal and Signature

INTRODUCTION

1. Location
   a. City, County, State Highway and local streets within and adjacent to the site, or the area to be served by the drainage improvements.
   b. Names of surrounding developments, properties or landmarks.

2. Description of Property
   a. Area in acres
   b. Ground cover (type of ground cover and vegetation)
   c. Existing land uses and known and foreseeable future land uses
   d. Topographic features, steepness of slopes
   e. Major drainage ways and receiving channels
   f. Existing drainage facilities
   g. Flood Hazard Zones
   h. Geologic Features (if applicable)
   i. Previous drainage studies for the property (if any)

3. Proposed Project Description
   a. Land uses
   b. Changes to existing facilities
   c. Changes to floodplains
   d. Proposed system improvements

4. Drainage Criteria
   a. Minor and Major Storm Analysis
   b. Geotechnical/Hydrogeological Analysis

c. Hydrologic Methods
    i. Rainfall
    ii. Design Storms
    iii. Runoff methods and computer models
d. Hydraulic Methods
    i. Design standards
    ii. Hydraulic models
    iii. Detention Pond sizing
e. State or Federal Regulations (if applicable).

HISTORIC DRAINAGE SYSTEM

1. Major Basin Description
    a. Reference to major drainage way planning studies such as flood hazard delineation report, major drainage way planning reports, and flood insurance rate maps.
    b. Major basin drainage characteristics and structures, existing and planned land uses within the basin.
    c. Summary of off-site and on-site basin characteristics and runoff rates.

PROPOSED DRAINAGE SYSTEM

1. Design Concepts
    a. Discussion of concept and typical drainage patterns.
    b. Discussion of compliance with off-site runoff considerations.
    c. Discussion of proposed drainage patterns and improvements including streets, storm sewer, culverts, open channels and detention storage.
    d. Discussion of the content of tables, charts, figures, plates, or drawings presented in the report.
    e. Discussion of geotechnical and hydrogeological impacts of development.

SUMMARY

1. Relation to off-site drainage features.
2. Summary of proposed improvements.
    a. Storm sewer
    b. Culverts
    c. Open channels
    d. Detention Storage
    e. On-site and off-site impact and mitigation measures
3. Floodplain impacts.
4. State or Federal regulations.
5. Compliance with applicable regulations and standards.

REFERENCES

Reference all criteria, master plans, and technical information used in support of concepts and calculations.

APPENDICES Background Data

1. Floodplain maps
2. Applicable reports or report excerpts.
3. Key correspondence with adjacent property owners or utilities.

PRELIMINARY REPORT DRAWING CONTENTS

All drawings shall be submitted as back-up materials with the Preliminary Plat. A map shall be provided in sufficient detail to identify drainage flows entering and leaving the development and general drainage patterns. The map shall identify any major facilities from the property (i.e., development, existing detention facilities, culverts, storm sewers) along the flow path to the nearest major drainage way.

Floodplain Information: The location of the subject property shall be included with the report. All major drainage ways shall have the floodplain defined and shown on the report drawings.

Drainage Plan shall show the following:

1. Existing topographic contours at two (2) feet maximum intervals. The contours shall extend a minimum of one-hundred (100) feet beyond the property lines.
2. All existing drainage facilities.
3. Approximate flooding limits based on available information.
4. Conceptual major drainage facilities including detention basins, storm sewers, swales, riprap, and outlet structures in the detail consistent with the proposed development plan.
5. Major drainage boundaries and sub-basin boundaries.
6. Any off-site features influencing development.
7. Proposed flow directions and, if available, proposed contours.

Appendix B Final Drainage Report

The purpose of the Final Drainage Report is to present the final design details for the drainage facilities discussed in the Preliminary Drainage Plan. Any changes to the preliminary concept must be presented and fully explained.

Drainage plan shall provide an appropriate level of detail to address the drainage issues and present sizing and locations for all proposed improvements. The report shall be based on the following outline and include appropriate background information and supporting data and calculations and plan drawing(s).

TITLE PAGE

1. Type of Report (Final)
2. Project Name
3. Prepared for/by
4. Date
5. P.E. Seal and Signature

INTRODUCTION

1. Location
    a. City, County, State Highway and local streets within and adjacent to the site, or the area to be served by the drainage improvements.
    b. Names of surrounding developments, properties or landmarks.

2. Description of Property
    a. Area in acres
    b. Ground cover (type of ground cover and vegetation)
    c. Existing land uses and known and foreseeable future land uses
    d. Topographic features, steepness of slopes
    e. Major drainage ways and receiving channels
    f. Major drainage ways and receiving channels
    g. Existing drainage facilities
    h. Flood Hazard Zones
    i. Geologic Features (if applicable)

3. Previous drainage studies for the property (if any)
    a. Proposed Project Description
    b. Land uses
    c. Changes to existing facilities
    d. Changes to floodplains
    e. Proposed system improvements
    f. Right-of-way conveyance or acquisition required

4. Drainage Criteria
    a. Application Standards or exceptions
    b. Minor and Major Storm Frequencies

c. Hydrologic Methods
    i. Rainfall
    ii. Design Storms
    iii. Runoff methods and computer models
    iv. Geotechnical/Hydrogeological Analysis (Attach Reports)
d. Hydraulic Methods
    i. Design standards
    ii. Hydraulic models
    iii. Detention Pond sizing
e. State or Federal Regulations (if applicable)

HISTORIC DRAINAGE SYSTEM

1. Major Basin Description
    a. Reference to major drainage way planning studies such as flood hazard delineation report, major drainage way planning reports, and flood insurance rate maps.
    b. Major basin drainage characteristics and structures, existing and planned land uses within the basin.
    c. Summary of off-site and on-site basin characteristics and runoff rates.

2. Sub-Basin Description
    a. Discussions of historic drainage patterns of the property.
    b. Discussion of off-site drainage flows and flow patterns and impact on development under existing and fully developed basin conditions.
    c. Summary of off-site and on-site basin characteristics and runoff rates.

PROPOSED DRAINAGE SYSTEM

1. Design Concepts
    a. Discussion of minor and major drainage patterns, impacts, flows and volumes.
    b. Discussion of compliance with off-site runoff considerations.
    c. Discussion of proposed drainage patterns and improvements including streets, storm sewer, culverts, open channels and detention storage.
    d. Discussion of the tables, charts, figures, drawings, etc. presented in the report.

2. Design Details
    a. Discussion of problems encountered and solutions at specific design points.
    b. Discussion of detention storage and outlet design.
    c. Discussion of maintenance and access aspects of the design.
    d. Discussion of impacts of concentrating the flow on the downstream properties.

e. Summary of basin characteristics and runoff rates.
f. Discussion of geotechnical and hydrogeological impacts of development.
g. Discuss flooding hazards and describe minimum building elevations.

SUMMARY

1. Relation to off-site drainage features.

2. Summary of proposed improvements.
   a. Storm sewer
   b. Culverts
   c. Open channels
   d. Detention Storage
   e. Geotechnical/Hydrologic impacts
   f. On-site and off-site impacts and mitigation measures

3. Floodplain impacts.

4. State or Federal regulations.

5. Compliance with applicable regulations and standards.

REFERENCES

Reference all criteria, master plans, and technical information used in support of concepts and calculations.

APPENDICES

1. Background Data
   a. Floodplain maps.
   b. Applicable reports or report excerpts.
   c. Key correspondence with adjacent property owners or utilities.

2. Hydrologic Computations
   a. Land uses regarding adjacent properties.
   b. Soil types, coverage and loss coefficients
   c. Proposed land uses for project by basin.
   d. Time of concentration and runoff coefficients for each basin.
   e. Basin parameters used for modeling including basin area, length, slope, distance to centroid and routing elements.
   f. Initial and major storm runoff at specific design points for off-site and on-site flows.
   g. Off-site, historic and fully developed runoff computations at specific design points.
   h. Hydrographs at critical design points.

i. Schematic diagram of hydrology model showing basins and routing elements and combination elements.

3. Hydraulic Computations
   a. Culvert Capacities and inlet and outlet protection.
   b. Storm sewer capacity, including energy grade line (EGL) and hydraulic grade line (HGL) elevations.
   c. Gutter capacity as compared to allowable.
   d. Storm inlet capacity including roughness coefficients, trickle channels, freeboard, hydraulic grade line, and slope protection.
   e. Check and/or channel drop placement.
   f. Detention area volume capacity and outlet capacity calculations; depths of detention basins, outlet configuration.
   g. Downstream/outfall capacity to the Major Drainage way system.

4. Miscellaneous Information
   a. Other documents relating to drainage conditions on the property.
   b. Agreements with property owners or other agencies.
   c. Permits, etc.

Appendix C Geotechnical/Hydrogeological Report

1. The evaluation shall include at a minimum:

    a. A review of available geologic, hydrogeological, and topographic conditions to identify any site conditions that could impact the use of the storm drainage systems or the construction of sub-level structures. This review shall include all available previous geotechnical engineering reports for the development. Citations to possibly useful references are provided at the end of this appendix.

    b. Where access to adjacent properties is unavailable, the project owner shall rely upon the best known information for the area, supplemented with available information, including any existing engineering reports or studies for sites in the vicinity.

    c. A surface and subsurface reconnaissance of the site and an inspection of adjacent properties to assess potential impacts from the proposed stormwater system and to verify that the conditions are consistent with the mapped information.

    d. The level of data for the hydrogeological assessment required will be dependent on the amount of stormwater to be managed, the type of infiltration system proposed, and the surface and subsurface soil conditions at the site. The assessment will be conducted by a professional with experience collecting and analyzing hydrogeological data.

    e. An assessment of hydrogeological conditions that indicate the potential for infiltrated stormwater to impact on- or off-site, facilities or structures. The assessment will also demonstrate that impacts to groundwater elevation or flow, resulting from the proposed infiltration system will be confined to the property. A groundwater mounding calculation shall be provided to identify the impacts of infiltrated stormwater runoff. An example calculation method and spreadsheet is made available from the United States Geological Survey (USGS); however, other approved, similar calculation methods may be accepted. This information can be found at the following link: https://pubs.usgs.gov/sir/2010/5102/

    f. The Geotechnical/Hydrogeological report will contain the signed project certification cover sheet found in Appendix G.

2. The Report Narrative shall include:

    a. A brief project description including size, number of lots proposed, project location (section, township and range), and background information relevant for drainage design;

b. A discussion of the study investigations including methods and results of field assessments, testing and analyses performed;

c. A description of the soil units and subsurface geologic conditions on the site and in the vicinity of the site;

d. A description of the site including surface, soil, and groundwater conditions, etc.

3. Test Method Documentation shall include:

a. A map with the location of all subsurface field explorations, sampling locations and any in- place field tests;

b. A description of the field test and any difficulties encountered during excavation and testing;

c. A description of the equipment used to perform the field explorations or tests. When applicable, describe the type of fabric lining and gravel backfill used;

d. Logs of subsurface borings shall identify the depth to groundwater, the presence of any limiting layers and the target soil layer; include test pit or excavation dimensions. Borings intended to characterize hydrogeologic conditions for infiltrations systems should extend a minimum of 10-feet below the base of the proposed infiltration system, or a minimum of 25-feet below the ground surface, whichever is deeper;

e. Report test data documenting any infiltration testing, calculations, results problems encountered; and,

f. A description of the condition of any existing facilities being tested, noting any silt build-up, water level, connections to other structures (including distance to inverts of any interconnecting pipes), measured depths and dimensions, etc.

4. Results of field and laboratory testing conducted, including the grain size analysis represented both graphically and in tabular format;

5. A summary of field testing conducted and the measured and proposed design infiltration rates for infiltration systems. Approved test methods for infiltration testing are found in Appendix H;

6. Results of the sub-level structure feasibility study and a summary of the property boundary and down-gradient analysis as applicable; and,

7. A geologic cross-section of the stormwater disposal area drawn to scale, with the proposed stormwater disposal facilities superimposed on the cross-section. All relevant geologic units shall be clearly identified including the target disposal layer and limiting layers.

8. Conclusions and recommendations.

    a. The Site Plan shall include:

    b. Project boundaries (including all existing and proposed property lines);

    c. Labeled topographic contours, extending beyond the project and drainage basin. Projects in an urban area shall use a maximum contour spacing of 1 foot;

    d. Location of the soil and geologic units identified;

    e. Location of significant structures, properties or geologic features on site and in the project vicinity;

    f. Location of existing natural or constructed drainage features on site and in the project vicinity; and,

    g. Location of proposed site infrastructure including roadways and drainage features such as ponds, drywells, etc.

SUGGESTED SOURCES:

• Montana Ground Water Information Center Database: http://mbmggwic.mtech.edu/

• Lopez, D.A., and Sims, M., 2003, Areas of potential swelling-clay hazard in the Billings area, Yellowstone County, Montana: Montana Bureau of Mines and Geology Geologic Map 61D, 1 sheet, scale 1:48,000.

• Lopez, D.A., 2002, Geologic map of the Billings area, Yellowstone County, Montana: Montana Bureau of Mines and Geology Geologic Map 61A, 1 sheet, scale 1:48,000.

• Lopez, D.A., 2000, Geologic map of the Billings 30' x 60' quadrangle, Montana: Montana Bureau of Mines and Geology Geologic Map 59, 1 sheet, scale 1:100,000.

• Olson, J.L., and Reiten, J.C., 2002, Hydrogeology of the west Billings area: Impacts of land-use changes on water resources: Montana Bureau of Mines and Geology Report of Investigation 10, 32 p., 2 sheets.

• Olson, J.L., and Reiten, J.C., 2001, Basic hydrogeologic data for the West-Billings area

(1999-2000), Yellowstone County, Montana: Montana Bureau of Mines and Geology Open-File Report 436, 110 p. United States Geological Survey (USGS). Scientific Investigations Report 2010-5102. Simulation of Groundwater Mounding Beneath Hypothetical Stormwater Infiltration Basins. Glen B. Carleton. http://pubs.usgs.gov/sir/2010/5102.

Appendix D Operations and Maintenance Requirements

OPERATION AND MAINTENANCE

An Operations and Maintenance Manual is required for Subdivision and Commercial Property development. The O&M Manual summarizes the tasks required for perpetual maintenance to ensure the proper operation of stormwater facilities. The O&M manual shall include at a minimum:

- Contact information for the party responsible for O&M.
- Description of the maintenance tasks to be performed and their frequency.
- An inspection checklist to be used for annual maintenance. Template forms found in Appendix G.
- List of the expected design life and replacement schedule of each component.
- Site plan showing the overall layout of the development.
- Copy of recorded HOA Agreement and SIA, if applicable.
- Other information as necessary.

The O&M Manual shall first be submitted to the City's Environmental Affairs Division for review and comment. After acceptance by the Environmental Affairs Division, the O&M Manual shall be recorded at the Yellowstone Clerk and Recorders Office in a format acceptable to them.

Appendix E HOA Agreement Requirements

HOMEOWNERS' ASSOCIATIONS REQUIREMENTS

For stormwater systems within subdivisions, a homeowner's association (HOA) shall be formed to maintain and operate the facilities.

A draft copy of the SIA and/or CC&Rs for the HOA in charge of operating and maintaining the facilities associated with the stormwater system shall be submitted at the time of Preliminary Plat submittal. Final copies are required at the time of initial Private Contract Submittal. The SIA/CC&Rs shall summarize the maintenance and fiscal responsibilities of the HOA. In addition, the SIA/CC&R's shall state that any proposed changes to the stormwater system/facilities shall first be approved by the City Engineer's Office. The O&M manual shall also be submitted at this time. A financial plan is required in order to provide the entity responsible for maintenance with guidance in regard to financial planning for maintenance and replacement costs. The financial plan shall include the following items:

• A list of all stormwater-related facilities and their expected date of replacement and associated replacement costs.

• Sinking fund calculations that take into consideration probable inflation over the life of the infrastructure and estimates the funds that need to be set aside annually.

• A mechanism for initiating and sustaining the sinking fund account demonstrating that perpetual maintenance of all facilities associated with the stormwater system will be sustained.

Homeowners' associations are to be non-profit organizations. A standard business license is not acceptable for this purpose. The HOA shall remain in good standing with the requirements of the State of Montana. Developer shall sign HOA Agreement stating ownership and responsibilities prior to approval of development.